TRANSCRIPT MANAGEMENT SYSTEM

Kunal Pandya
B.E., Saurashtra University, 2005

PROJECT

Submitted in partial satisfaction of
the requirements for the degree of

MASTER OF SCIENCE
in
COMPUTER SCIENCE
at

CALIFORNIA STATE UNIVERSITY, SACRAMENTO
SPRING
2010
TRANSCRIPT MANAGEMENT SYSTEM

A Project

by

Kunal Pandya

Approved by:

__________________________________, Committee Chair
William J Mitchell, PhD

__________________________________, Second Reader
Robert Buckley, MS

___________________________
Date
Student:  Kunal Pandya

I certify that this student has met the requirements for format contained in the University format manual, and that this project is suitable for shelving in the Library and credit is to be awarded for the Project.

__________________________, Graduate Coordinator   ________________
Cui Zhang, PhD                          Date

Department of Computer Science
Abstract

of

TRANSCRIPT MANAGEMENT SYSTEM

by

Kunal Pandya

Student transcripts are a critical component of admission, transfer credit processing, and graduation processing. The majority of transcripts come into the University in paper form through multiple points of entry and are processed in multiple areas depending on the reason the transcript is requested (admissions evaluation, additional credit, prerequisite requirements, special programs or graduation processing). Currently, until a transcript is data entered and processed in Common Management System (CMS), there is no reliable way to track incoming transcripts. This creates many problems for students and staff. Students may be required to send in multiple transcripts if their initial submissions cannot be located. Staff spends a considerable amount of time trying to locate transcripts. Lost or misplaced transcripts can delay admission decisions, prevent a student from registering into a course with pre-requisites and ultimately delay graduation which can lead to unwanted consequences.

The purpose of my Master’s Project is to design, develop and implement an efficient transcript tracking system for transcripts submitted at California State University, Sacramento. The system will accommodate multiple points of entry and allow staff to efficiently track the acceptance and routing of a transcript. The system will interact with
the existing CMS and provide a real time status of the processing of the transcript turned in and additional reports needed for audit processes.

The project aims to provide many benefits including proper routing and tracking of turned in transcripts, improved processing efficiency of the system, and increased satisfaction for both the staff and students for the processing of transcripts.

_______________________, Committee Chair
William J Mitchell, PhD

_______________________
Date
ACKNOWLEDGEMENT

This space provides me a great honor to thank all the people without whom this project would never reach its proper end. I would take this opportunity to convey my heartfelt thank you to all.

First of all, I would like to thanks Dr. William Mitchell. He has been a very helpful and supportive guide throughout the project and helped me whenever I have hit the roadblock. He took extreme pain in reviewing the report and helped with his valuable suggestions all the time.

I would like to also thank Dr. Robert Buckley for his extended support. He provided me with his valuable suggestions when they were greatly needed.

Next I would like to thanks Mr. Edward Mills (Associate Vice President, Student Affairs) who was the visionary behind the project. It was because of Mr. Mills I was able to get all the requirements I needed for the project and finish in stipulated timeline. I would extend my special thanks to Mr. Tejeshwar Chowdhary for his help throughout the project.

I would also like to extend my thanks to Dr. Cui Zhang for her valuable inputs over the report writing.
Last but not the least; I am thankful to all my friends and colleagues who directly or indirectly helped me in my project completion. Without their continuous support, the journey to the completion would have been extremely painful.
TABLE OF CONTENTS

Acknowledgement ............................................................................................................. vi
List of Figures .................................................................................................................. xiv
List of Tables .................................................................................................................... xv

Chapter

1. INTRODUCTION AND MOTIVATION ...................................................................... 1
   1.1 Student Affairs ..................................................................................................... 1
   1.2 Motivation ............................................................................................................ 3

2. CURRENT TRANSCRIPT PROCESSING FLOW ....................................................... 7
   2.1 Input ..................................................................................................................... 9
   2.2 Classification ...................................................................................................... 10
   2.3 Transcript Flow .................................................................................................. 11
   2.4 Output ................................................................................................................. 12

3. PROPOSED TRANSCRIPT PROCESSING FLOW ................................................... 14
   3.1 Transcript Acknowledgement ............................................................................ 16
      3.1.1 Record of Receipt ....................................................................................... 17
      3.1.2 Document Imaging .................................................................................... 17
      3.1.3 Control and Notification .......................................................................... 17
   3.2 Transcript Routing .............................................................................................. 18
      3.2.1 Routing Mechanism ................................................................................... 19
      3.2.2 Control ........................................................................................................ 20
   3.3 Transcript Processing ......................................................................................... 21
4.8.3 Software Interface....................................................................................... 39
4.8.4 Communication Interface............................................................................ 39
4.9 Non Functional Requirements............................................................................ 39
4.9.1 Performance Requirements......................................................................... 39
4.9.2 Security Requirements................................................................................ 40
5. HIGH LEVEL DESIGN FOR TMS ............................................................................. 41
5.1 Introduction ........................................................................................................ 41
5.1.1 Definition and Acronyms............................................................................ 41
5.2 User Interface Design for TMS Staff ................................................................. 42
5.2.1 Login Design............................................................................................... 42
5.2.2 Brief Overview............................................................................................ 43
5.2.3 Field Matrix ................................................................................................ 43
5.2.4 Process Flow ............................................................................................... 44
5.3 Transcript Reception .......................................................................................... 46
5.3.1 Transcript Receipt....................................................................................... 46
5.3.2 Brief Overview............................................................................................ 46
5.3.3 Field Matrix ................................................................................................ 47
5.3.4 Process Flow ............................................................................................... 49
5.4 Transcript Acknowledgement ............................................................................ 50
5.4.1 Acknowledging Transcript.......................................................................... 50
5.4.2 Brief Overview............................................................................................ 51
5.4.3 Field Matrix ................................................................................................ 52
5.4.4 Process Flow ............................................................................................... 53
5.5 Transcript Routing........................................................................................................ 56
  5.5.1 Transcript Routing System .................................................................................. 56
  5.5.2 Brief Overview.................................................................................................... 57
  5.5.3 Field Matrix ....................................................................................................... 57
  5.5.4 Process Flow ..................................................................................................... 58

5.6 Transcript Processing ............................................................................................... 62
  5.6.1 Transcript Processing System .......................................................................... 62
  5.6.2 Brief Overview.................................................................................................. 62
  5.6.3 Field Matrix ..................................................................................................... 63
  5.6.4 Process Flow ..................................................................................................... 64

5.7 TMS Reporting ...................................................................................................... 67

5.8 TAS – Optix Report ............................................................................................... 67
  5.8.1 Brief Overview.................................................................................................. 68
  5.8.2 Field Matrix ..................................................................................................... 69
  5.8.3 Processing Logic ............................................................................................... 70

5.9 TRS Report ........................................................................................................... 72
  5.9.1 Brief Overview.................................................................................................. 72
  5.9.2 Field Matrix ..................................................................................................... 73
  5.9.3 Processing Logic ............................................................................................... 74

5.10 TPS Report ........................................................................................................... 76
  5.10.1 Brief Overview................................................................................................ 77
  5.10.2 Field Matrix ................................................................................................... 78
  5.10.3 Processing Logic ............................................................................................. 79
6. SQL SERVER SERVICE BROKER ................................................................. 82
   6.1 Importance of Messaging Technology ......................................................... 82
      6.1.1 Asynchronous Message Processing ...................................................... 82
      6.1.2 Deferred Message Processing ............................................................ 83
      6.1.3 Fault Tolerance ................................................................................. 83
      6.1.4 Distributed System ........................................................................... 83
   6.2 Different Messaging Techniques with Windows Technology ...................... 84
      6.2.1 Microsoft Message Queuing ( MSMQ) ................................................. 84
      6.2.2 Queued Components .......................................................................... 84
      6.2.3 BizTalk Server ................................................................................... 84
      6.2.4 XML Web Services ............................................................................. 84
      6.2.5 Windows Communication Foundation (WCF) ................................... 85
   6.3 SQL Server Service Broker Basics ............................................................. 85
      6.3.1 Conversations ..................................................................................... 86
      6.3.2 Anatomy of Service ........................................................................... 86
      6.3.3 Security .............................................................................................. 89
      6.3.4 Message Processing ............................................................................ 91
      6.3.5 SQL Statements for Service Broker .................................................. 93
      6.3.6 Performance ...................................................................................... 95
      6.3.7 Benefits ............................................................................................. 96
   7. CONCLUSION AND FUTURE WORK ..................................................... 97
      7.1 Key Challenges ..................................................................................... 97
      7.2 Conclusion and Expected Outcome ....................................................... 98
7.3 Future Work ........................................................................................................ 100

Appendix - SQL Server Service Broker Code for TMS ................................................. 101

Bibliography ................................................................................................................... 107
LIST OF FIGURES

1. Figure 1 Current Transcript Processing Flow ......................................................... 8
2. Figure 2 Proposed Transcript Processing Flow ....................................................... 15
3. Figure 3 Transcript Acknowledgement ................................................................. 16
4. Figure 4 Transcript Routing ............................................................................... 19
5. Figure 5 Transcript Processing ........................................................................... 21
6. Figure 6 High Level Processing Flow .................................................................... 29
7. Figure 7 User Login ............................................................................................. 44
8. Figure 8 TAS Flowchart ....................................................................................... 53
9. Figure 9 TRS Flowchart ....................................................................................... 59
10. Figure 10 TPS Flowchart ................................................................................... 64
11. Figure 11 TAS-Optix Report ................................................................................ 70
12. Figure 12 TRS Report Flowchart ......................................................................... 74
13. Figure 13 TPS Report Flowchart ......................................................................... 79
14. Figure 14 Message Processing for Service Broker ............................................... 91
LIST OF TABLES

1. Table 1 List of Departments under Student Affairs ................................................. 2
2. Table 2 Input Sources for the Transcripts ............................................................... 4
3. Table 3 Dependencies .............................................................................................. 5
4. Table 4 Acronyms ..................................................................................................... 42
5. Table 5 Field Matrix for the Login Screen ............................................................. 43
6. Table 6 Field Matrix for TAS Base ......................................................................... 48
7. Table 7 Field Matrix for TAS .................................................................................. 52
8. Table 8 Field Matrix for TRS .................................................................................. 58
9. Table 9 Field Matrix for TPS .................................................................................. 63
10. Table 10 Field Matrix for TAS-Optix Report ........................................................ 69
11. Table 11 Field Matrix for TRS Report ................................................................... 73
12. Table 12 Field Matrix for TPS Report ................................................................... 78
Chapter 1

INTRODUCTION AND MOTIVATION

Referring to software as a novel by famous author Rudy Rucker would be too artistic for a normal man. A more acceptable meaning would be a code written to accomplish a specific task on computer. A specific meaning can be cited as “The programs, routines, and symbolic languages that control the functioning of the hardware and direct its operation” [1]. Since its invention, the software, has aimed to ease our day to day tasks like managing daily expenses to highly complex scenarios like controlling the projectile of space shuttle. But the basic motivation behind each of the software developed remains the same – ease workload of human beings. This Master’s Project aims at developing a software application for the department of Student Affairs to help them ease the current overly-complicated scenario of managing student transcripts.

1.1 Student Affairs

The Department of Student Affairs at Sacramento State operates with a mission to “empower students to reach their unique potential as learners, as contributing members of their community and as responsible leaders” [2]. As it is clear from the mission statement, it is a department that places the students first and strives to support their all round development. Twenty three departments fall under direct regulation of the Student Affairs. Table 1 lists all the departments that fall under Student Affairs.
<table>
<thead>
<tr>
<th><strong>Departments under Student Affairs</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The Office of Vice President</td>
</tr>
<tr>
<td>Academic Advising</td>
</tr>
<tr>
<td>Admissions and Outreach</td>
</tr>
<tr>
<td>Associated Students, Inc.,</td>
</tr>
<tr>
<td>Career Center</td>
</tr>
<tr>
<td>Financial Aid</td>
</tr>
<tr>
<td>Global Education</td>
</tr>
<tr>
<td>Health Center</td>
</tr>
<tr>
<td>Housing and Residential Life</td>
</tr>
<tr>
<td>Multi-Cultural Center</td>
</tr>
<tr>
<td>New Student Orientation</td>
</tr>
<tr>
<td>Off-Campus Housing</td>
</tr>
<tr>
<td>PRIDE Center</td>
</tr>
<tr>
<td>Psychological counseling Services</td>
</tr>
<tr>
<td>Student-Athlete Resource Center</td>
</tr>
<tr>
<td>Student Conduct</td>
</tr>
<tr>
<td>Student Organizations and Leadership</td>
</tr>
<tr>
<td>Student Services Center</td>
</tr>
<tr>
<td>Testing Center</td>
</tr>
<tr>
<td>University’s Registrar Office</td>
</tr>
<tr>
<td>University Union</td>
</tr>
<tr>
<td>Veterans Service Center</td>
</tr>
<tr>
<td>Women’s Resources Center</td>
</tr>
</tbody>
</table>

Table 1 List of Departments under Student Affairs [3]
One of the many departments is “Outreach, Admissions and Records” (OAR) which plays crucial role in the admission, evaluating student credits, and graduation process. This department handles roughly about 12,000 transcripts each year from various students ranging from juniors to seniors and international students.

1.2 Motivation

A student transcript plays a crucial role in the process of admissions, evaluating credits, and the graduation process. As per Associate Vice President of Student Affairs, Edward Mills, the question that is asked most by the students is “Do you have my transcripts?” To illustrate how difficult it is to answer this question let us look into the details. There are fifteen entry points for transcripts to enter in the system which includes various offices and staff. Table 2 gives a list of the flow of the inputs of transcripts.
The “transcript exchange system (CCC Tran) is unique in its ability to request transcripts and fulfill transcript requests automatically, extracting student data from a community college’s student information system and delivering the data into the requesting college’s system, without human interaction.” [5]. CCC Trans is an existing state-wide Transcript format used by most Community Colleges and the CSU System. More and more systems are considering use of the CCC-Tran format which makes it an inevitable component in any Transcript management system.

Since the application covers multiple entry points (input sources) there are more chances of transcripts getting lost or misplaced. As a result, the students need to resend the
transcripts to process their admissions or graduation. Table 3 illustrates sources of dependencies which affects processing of transcripts.

<table>
<thead>
<tr>
<th>Transcript processing Dependencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other departments</td>
</tr>
<tr>
<td>Advisors/Admissions Counselor</td>
</tr>
<tr>
<td>Grad Studies</td>
</tr>
<tr>
<td>AAC/Other Depts.</td>
</tr>
<tr>
<td>Electronic Availability</td>
</tr>
<tr>
<td>Routing System</td>
</tr>
<tr>
<td>Identification that transcripts are in the system</td>
</tr>
<tr>
<td>Compliance</td>
</tr>
<tr>
<td>Feedback Loops</td>
</tr>
<tr>
<td>System Capability</td>
</tr>
<tr>
<td>Human Error</td>
</tr>
<tr>
<td>Expertise</td>
</tr>
<tr>
<td>Students</td>
</tr>
<tr>
<td>Outreach Admissions and Records Responsibility</td>
</tr>
<tr>
<td>Other staff</td>
</tr>
</tbody>
</table>

Table 3 Dependencies

Considering these dependencies and complications it is very difficult to effectively track the flow of transcripts. Most of the time the administrators in the admissions office do not have an answer to most frequently asked question.

The project aims to streamline the effective processing of every transcript that enters the system via any of the entry points. This will help administrators to track each transcript that enters the system and its corresponding processing at various stages.
Apart from the inherent complications in the system, there is a financial aspect that is related to the transcripts. According to sources in the Admissions and Records office, an average student needs to turn in at least three transcripts during their academic career. Each transcript costs, on average, $8. Since the transcripts are not tracked properly, an average student sends at least three sets of transcripts. So according to the simple calculation this amounts to $72 per student instead of one time of $24.

On the other hand, as mentioned in [4], 12,000 transcripts are processed on an average by the OAR department during each year. Seven staff members process this large number of transcripts annually. According to the estimate in [4], 30% of the efforts required for processing a transcript are duplicated, as most of the student turns in multiple copies of the transcripts. Considering an estimated salary of $3250 [6] per month for a regular Sacramento State employee, the amount spent in excess because of the duplicate processing of the transcripts is close to $82000. This is a large sum of money that is being spent unnecessarily every year.

Successful development and deployment of the project will save roughly this much amount of money every year. The staff can be allocated towards other productive work rather than duplicate work. Additionally, the project will help in faster processing of the graduation or admission request. It is rightly said nothing can make up for the lost time.
CURRENT TRANSCRIPT PROCESSING FLOW

As discussed in the previous chapter, regulating the flow of transcripts has financial and time elements. This chapter discusses the present processing flow and the system that is used for managing the flow of transcripts.

Figure 1 describes the state of processing transcripts today in the system.
Figure 1 Current Transcript Processing Flow
2.1 Input

Recall that transcripts enter the Sacramento State from thirteen different entry points. The transcripts that are turned in are in various forms such as CCC Tran, email PDF file or hard copy. Transcript entry points includes handing in transcripts to the Admission Counselors, Front counter staff, other office staff, transcripts mailed by student to various school departments, Office of Graduate Studies, transcripts handed in to the faculty and transcripts turned in by various forms such as External Institutions Mails.

The Outreach and Admissions Department relies on Optix for imaging the transcripts that are turned in. Optix is workflow tool developed by Mindwrap®. Optix is family of products which provides essential functionality ranging from day to day scanning to creating workflow and even developing modules that interact with Optix directly using Optix Application Path Interfaces [7]. Optix also provides facility of text searching within scanned documents, routing and indexing fax documents, and even providing functionality to interact with complex mainframe reports [7]. At this point, the Optix is not linked with Content Management System (CMS) used extensively by Sacramento State. This project provides a missing link between the Optix and CMS which would ease collaboration and generate reports for finding any ambiguities in the transcript management.
Since the Optix scanning system is not implemented at each and every transcript entry point; all the transcripts are eventually converted into hardcopy. The hardcopy of a transcript is then, physically routed to a department for further processing.

2.2 Classification

Once the transcript is turned into a hardcopy, it is sorted out into various categories depending on the type of processing needed. The sorted transcripts can go to any of the following classifications:

- Grad evaluation
- Wall-Imaging area
- Staff’s Desk
- Imaging Buckets (official and unofficial)
- Applicants
- Evaluation
- Additional Credit
- No I.D bin (transcript with un-identified purposes)
- Hershey filing cabinet
- Intermediate File
Another Office such as Financial Aid, Academic Advising etc.

2.3 Transcript Flow

A desired flow from either of this sorting is that the transcripts should be scanned in the Optix and entered in the Common Management System (CMS). CMS is a facility that supports “human resources, financials and student services administration functions with a common suite of Oracle Enterprise applications in a shared data center, with a supported data warehouse infrastructure” [8]. If a transcript needs further processing the image scanned in Optix should be used as a reference instead of the hardcopy. Ideally every transcript should be scanned in Optix and then entered into CMS within 72 hours of its receipt. Later on when the transcript is needed by any of the administrative staff they can refer to the scanned transcript in Optix.

In the real case, the administrative staff tries to follow the ideal scenario as much as possible, but due to the dependencies and complexity in the system this is not true all the time. After the transcripts are imaged in Optix and entered in CMS they are shredded for the privacy reason. Occasionally there are cases when the transcripts are sent back for imaging in Optix or someone’s desk for further processing or are filed in forever for document imaging for international records.

After the transcripts are processed certain throughput is anticipated. One of the most important is the transcript entry in CMS and scanned copy in Optix. There are a couple of possible outcomes after the transcript is processed. Some of them are: the administrative
staff might request further documentation from the student for further processing, updating external credit, evaluating for admissions and graduation, clearing any holds, updating information in CMS, pre-screening it for the admissions or attaching Employee Id and/or SSN with the transcripts.

2.4 Output

The output of this long complicated transcript processing is one or more of the following:

- Imaged Transcripts in Optix
- Posted external credit
- Reports
- Decisions for Admissions or Graduations
- Visible CMS Record
- Communication with the student for further documentation for processing

Depending on how the transcripts are processed in the system, the result varies. A correctly processed transcript will yield accurate advising, degree progress and official transcript reports leading to a satisfied student. On the other hand, if there was something amiss during the entire process it might lead to error in the either of the above mentioned reports leading to a frustrated, confused and discontented student.
The missing transcript scenario reflects a highly unprofessional attitude from the administrative aspect of the university. In the worst case a transcript might be lost which in turn opens a whole new can of worms which forces everyone involved to repeat the same process for a re-submitted transcript.

One of the main reasons that make this system overly complex is, the underlying dependencies referred to Table 3 and large number of the transcripts that needs to be handled.
Chapter 3

PROPOSED TRANSCRIPT PROCESSING FLOW

In Chapter 2, we looked at existing transcript processing flow implementation at Sacramento State University. As mentioned in the Chapter 2, each submitted transcript goes to one of the many classification criteria and the overall process has multiple output(s).

One of the limitations of the present system is that, in the entire process, there is no tracking process, which would report and tally the number of transcripts that were routed to various classifications and the output at each stage. Transcript tracking must not “lose” document status and must be current and correct. This is presently done using Excel sheets prepared manually by staff looking at the data from CMS and integrating various reports generated independently of each other.

The proposed flow includes generating reports at various stages throughout the process. This will help to track each and every transcript at sub-atomic level along with the owner of the process. Following Figure 2 depicts the proposed transcript flow.
Figure 2 Proposed Transcript Processing Flow

Transcript Processing (Desired State)

Reconcile

Record of Receipt (available to all)
- to staff
- Attributes list

DOCUMENT IMAGING
- CMS and Opts
- Scanned (24 hr cycle time)
- Screening parameters

CONTROL
1. Reconcile Report
2. Error Report
3. Verification (identification)

RECEIVED?

Yes

NOTIFICATION OF RECEIPT
- Dependency
  - ≤24 hrs → Contact
  - ≤72 hrs → Contact
  - >72 hrs → Kiet

No

Reconcile

ROUTING IDENTIFIED?

Yes

CONTROL
1. Error Report
   - Didn’t type
   - Other

Delivered?

No

NOTABLE TO IDENTIFY
- Notification

Yes

RECONCILE

DELIVERY MECHANISM
- CMS and Opts
- Scanned (24 hr cycle time)
- Screening parameters

PROCESS POINT
- Worklist

CONTROL
1. Error Report
2. Production report

DELIVERED?

No

Feedback

Reconcile
The proposed transcript flow specified in Figure 2 can be divided into three sub-functions:

1. Transcript Acknowledgement

2. Transcript Routing

3. Transcript Processing

3.1 Transcript Acknowledgement

As shown in Figure 3 the transcript acknowledgement consists of three stages of Record of Receipt, Document Imaging, and Reconciliation and Notification.
3.1.1 Record of Receipt

This is the first step in the Transcript Acknowledgement. This system will be visible to all student and staff members. A student can check the status whether the transcript was received by the university using a screen that reflects the status of the submitted transcript. The staff member can also do the same by entering the appropriate credentials.

3.1.2 Document Imaging

After the system acknowledges that a transcript is entered into the system, the next step is to image the transcript and enter it into CMS and Optix. CMS captures particular data in the database table for later retrieval while Optix stores an imaged transcript for later retrieval, thus avoiding creation of hard copies. All the transcripts in the system must be imaged and assigned a unique ID prior to subsequent processing.

3.1.3 Control and Notification

This step of Transcript Acknowledgement deals with generation of reconciliation and error reports. The reconciliation report will generate a summary of number of transcripts that were entered into the system and how many of those were actually imaged by Optix. The error report will identify and pin-point which transcripts were not entered into the Optix. This report will also help to identify requests for further action (for example, if further documentation is required from student).
After the received transcripts are scanned and imaged into the Optix, a notification will be sent to student acknowledging the receipt of a transcript in the system. The turnaround time for notifying the concerned members (student and/or staff) after the arrival of transcript will be 24 hours. This includes receiving of transcript, scanning, and sending a notification. If there is a delay of 48 hours in imaging a transcript after it is entered into the system, a separate email should be sent to an application administrator concerning this delay. After 72 hours an alert should be generated to notify that there is a critical error in reconciling the input transcript and imaging it and that it demands special attention.

There are two main advantages of the proposed Transcript Acknowledgement Flow.

1. It will make sure that each transcript received into the system is scanned and imaged into the Optix.

2. It will also identify all the transcript documents that are not entered into the imaging mechanism. After identifying the problem, an administrator can send a notification to the concerned student and/or staff members to take further manual action(s).

3.2 Transcript Routing

Routing is the second part in proposed transcript flow. This process flow considers only imaged transcripts in the Optix system. It essentially isolates all the transcript documents
that have problem while scanning and are not entered. It essentially involves a Routing Mechanism and Control. Figure 4 details the Transcript Routing mechanism.

This step is localized to the department of Outreach, Admissions, and Records.

3.2.1 Routing Mechanism

After a transcript is entered and successfully imaged in the system, the transcripts are routed to appropriate departments and/or persons. This step involves examining a transcript in imaged form. The concerned staff will then update the corresponding report in CMS and change received attributes. This step deals with:

1. Identifying the “Why” factor associated with the transcript.
“Why” factor deals with why the transcript is present in the system. There are many reasons why a transcript is sent to the department. For example, request of transcript by the admissions department for the purpose of admissions processing.

This step explores all the possible scenarios and identifies the actual purpose for which a transcript is in the system. More than one reason could be associated with a single transcript record.

2. Identifying multiple copies of the transcripts records and consolidating all of them into one record.

There are, at times, multiple (different) transcripts turned in by the student for the same purpose for example admissions. This processing step also identifies scenarios in which there are multiple transcripts with same purpose and eliminates the duplicate at this step.

3.2.2 Control

The next step in the acknowledgment is generating an error report if there were any discrepancies in the routing process. A typical example would be two set of unmatched transcript from the same student; another example is a request for additional document which was not turned in by the student. Yet another example would be a failure to identify why a transcript is in the system. It is possible to have multiple errors associated to a single transcript.
3.3 Transcript Processing

This last part of the proposed transcript flow is mainly concerned with the processing of the transcripts in the system. As mentioned in the Transcript Routing, each transcript in the system needs to have a specific purpose. After the transcripts are delivered by the Routing to specific departments, each department may undertake steps to process the transcript. As show in Figure 5 the Transcript Processing is divided into three main parts: Delivery Mechanism, Process Points, and Control and Notification.

![Transcript Processing Diagram](image)

**Figure 5 Transcript Processing**

3.3.1 Delivery Mechanism

Transcripts that are routed to the Transcript Processing are all identified to have a specific purpose. The main task of this process is to accomplish the specific task for which the transcript is in the system. The transcripts are delivered in the form of scanned image from Optix or CMS. This part of the system should be refreshed with a refresh rate of 24
hours. This means a whole new lot of transcripts will be routed to the transcript processing after 24 hours.

3.3.2 Process Points

The software acknowledges the entry of the transcript by entering it into the database and sending an acknowledgement to the student. After the transcripts are delivered in the Transcript Processing mechanism by the software, the next step is to assign the process to a staff member for further processing. Each transcript will be identified by its purpose and should be routed to concerned personnel in the department. The identified personnel will be responsible from there on to update the records, make decision, and process the transcript for any other relevant reason.

3.3.3 Control and Notification

As mentioned previously, the control is meant for consolidating and generating the reports. The reports generated in Control will be tracking the processing of the transcripts. This report will provide an insight to what are the most time consuming operations, what operations are most frequent, as well as staff allocation for a typical operation. Analysis of these reports will help in increasing throughput, sharing the workload equally among staff members and reduced processing time for a particular operation.

Once the processing of the transcript is complete, an email notification will be sent to the administrators and/or concerned student and staff members. The type notification can
include; whether the credits were granted for the subjects taken at another university, whether the student is cleared for the admission eligibility, a staff can now see the transcript on CMS, etc.
Chapter 4

SOFTWARE REQUIREMENT SPECIFICATION

In Chapter 3, we took a look at the proposed transcript processing flow in detail. Chapter 4 describes the requirements specification for the Transcript Management System as approved by client (Division of Student Affairs).

4.1 Purpose

Transcript Management System (TMS) is an initiative undertaken by the Department of Student Affairs, to streamline the existing Transcript process flow. This project will help to:

- Increase student satisfaction by providing them a real time status of their transcript processing.
- Save money (for both students and the University) by eliminating the need to order and process duplicate transcripts.
- Maximize staff productivity by eliminating duplicate processing of transcripts.

The current transcript flow does not provide reports of transcript flow at critical stages. Thus, when an administrator needs to reconcile the transcripts to determine if specific processing activities have been completed, they must rely on manually prepared Excel documents (prone to human error). The Division of Student Affairs relies on a system called Optix for the imaging solution for transcripts. All transcripts received should be
scanned and uploaded in Optix. Since there are multiple entry points, and since Optix is not implemented at each and every entry point, there is always discrepancy in the number of transcripts received vs. those that are imaged in Optix.

A new Transcript Management System will help eliminate the inconsistent transcript process flows and provide one flow for all transcripts. This project will overhaul current transcript processing and provide control reports to help managers carefully track transcript processing flow and provide information for student inquiries regarding transcripts they have provided.

4.2 Intended Audience and Reading Suggestions

This document should be reviewed by the primary stake holder of the Transcript Management System project.

Primary Transcript Management System Stakeholders:

- Edward Mills, Associate Vice president for Student Affairs
- Tejeshwar Chowdhary, Boyana Barbula, Enrollment Operations Support
- Martha Reyes, Document Imaging Coordinator
- Dennis Geyer, University Registrar
- Key Staff in Outreach, Admissions, and Registrar’s Office
• Appropriate IRT Management and Staff

The SRS is also intended for review by any developer who is going to work on the TMS project.

4.3 Project Scope

The Sacramento State Transcript Management System (TMS) provides full transcript processing support for all incoming, undergraduate transcripts received in identified departments throughout the university. As of date, the Department of Graduate Studies does not come under direct regulations of Student Affairs Department. Hence, the graduate transcripts do not fall under the current scope of the project. The initial system focuses on transcripts received within Student Affairs Departments.

The TMS project consists of following major components:

1. Transcript acknowledgement system (TAS)

2. Transcript Routing system (TRS)

3. Transcript Processing system (TPS)

Transcripts received outside Students Affairs will be integrated in future enhancements to the TMS. Outgoing transcripts are currently managed by RoboRegistrar® which is a product from Credentials Solutions. Due to complexity and the scope of the project, this
project does not entertain outgoing transcripts. More information about RoboRegistrar product is available at [9].

4.4 Overall Description

4.4.1 Product Perspective

The TMS will be used for managing the process flow of transcript through various CSUS departments. This flow will be managed by providing a unique ID to each transcript entering the system. After assignment of unique ID, the system will track the classification, processing and final outcome of each entered transcript.

The proposed TMS will completely replace the existing transcript processing flow after its successful implementation.

4.4.2 Product Features

All the three components of TMS are described below.

4.4.2.1 Transcript Acknowledgement System (TAS)

This part of the TMS will focus on all the functionalities related to acknowledging a transcript entering into the System. This will enable a student and/or staff to make sure that the transcript was turned in and processing is started on the transcript.
4.4.2.2 Transcript Routing System (TRS)

Each transcript is received for a specific purpose (example for external credit evaluation, admission decisions, or to remove a hold). The Transcript routing system will help in routing the transcript (scanned image of the transcript) to proper staff and department. The reports generated within this module will help consolidation of each entered transcript with its purpose in the system.

4.4.2.3 Transcript Processing System (TPS)

This component constitutes the heart of the TMS. Each routed transcript needs to be processed by the staff member(s) and/or department(s). Transcript processing system will assign each transcript to appropriate staff members. A report generated at the end of the stage will help the administrative staff analyze what transcript processing requires immediate attention, how a certain type of processing can be improved and various actions that will improve the throughput for processing transcripts.
4.5 High Level Processing Flow

Figure 6 describes the high level processing flow of Transcript Management System.

Figure 6 High Level Processing Flow
The design of the TMS will be done under specific constraint. The reasons for these constraints fall under a wide variety of categories ranging from the availability of the hardware to software licensing availability to developer skill sets.

4.5.1 Operating Systems

The TMS application will be a web based application available only via secure server on the CSUS system. The system should be accessible on all the standard HTML browsers but will primarily be optimized for Internet Explorer ver. 6.0 and above.

4.5.2 Languages

The development of the TMS will primarily utilize the Microsoft .NET framework under the C# language. A considerable usage of Workflow foundation and SQL Server Service broker is anticipated at this point during the development of the system.

4.5.3 Database platform

The database to be used will be Microsoft SQL Server 2005.

4.5.4 Other 3rd party Libraries

The Telerik web-control is anticipated at this point to enhance the usability experience of the system. “Telerik is a leading vendor of ASP.NET, AJAX, ASP.NET MVC, Silverlight, WinForms and WPF Controls and components, as well as .NET Reporting, .NET ORM, .NET CMS, Code Analysis, Mocking, Automated Testing and Team productivity tools.
Telerik product helps thousands of companies to be more productive and deliver reliable applications under budget and on time [10].

4.6 Assumptions and Dependencies

Following are the dependencies that are identified at this point:

- An interface to the CMS and Optix is needed to make this product work. As of now there is no interface that is defined for CMS. Student Affairs relies on Information Resources and Technology (IRT) for building and providing this interface. However, for testing purposes, a hard coded web-service can be used to simulate the behavior of the Interface.

- A transcript in the format of CCC-Tran or PDF will not be considered into the project at this point. Support for these formats will be implemented at a later stage in TMS.

4.7 Functional Requirements

This section describes how the different component of the TMS will behave functionally.

4.7.1 General Requirements

- The TMS will be accessible on the CSUS intranet via a secure server that will be authorized with a valid User Id and password. However, a module for the student access shall be available over the internet after proper authentication by Saclink login mechanism.
• Not all the components will be accessible to all the staff members. The decision of granting the access to the particular modules will be restricted to the system administrators only.

• No feature in TMS shall force change in the database at either CMS or Optix level.

• All the errors must be logged into the database automatically and the user should be directed to a common error page. Technical details need not be included in the standard users.

• Any change in the existing mechanism should be seamless and in case of the downtime the main page should depict the same.

• TMS shall never interact with CMS/Optix directly. An appropriate interface should be requested in case of any specific need of data or functionality from the either systems.

• All the reports that are generated can be exported to Excel. Functionality should be kept open to export the selected reports in PDF files in subsequent development stages. Each report should contain a title along with the date and time and the requestor name.

• At each major step (i.e. in TAS, TRS and TPS) the status of the transcript should be set to “Acknowledging/Acknowledged”, “Routing/Routed” and
“Processing/Processed” state respectively. At any time when the process hits a road block the status should be set to “Error/On Hold” and email should be sent to the administrator for their attention.

4.7.2 Database Requirements

The TMS is being designed for the use at only California State University, Sacramento; however, the database design should be scalable so that in future a modified system can be deployed at other CSU campuses using Optix technologies.

4.7.3 TMS Requirements

4.7.3.1 TAS Requirements

- The staff members accepting transcript will enter detail for each transcript on a form containing the following fields:
  - Name
  - Email Address (Optional)
  - Mode of Entry
  - Turned in Date
  - Purpose (Optional)
  - Email notification? – Yes/No
After the successful entry of these fields into the system a unique ID will be assigned to each transcript and the ID will be used for identification henceforth in the system. An acknowledgement email (if provided) will be sent to the student along with the unique ID assigned to the transcript.

- Separate notifications should be generated to staff members when the transcript is scanned into Optix and entered into CMS and the student should be sent an email (if they opted for this notification and provided a valid e-mail address).

- Student and staff can check the acknowledgement of the transcript by entering the last name on a separate form and the result area will show the steps performed on the turned in transcript.

- The system should generate following reports at every 24 hours cycle. This can be a SQL trigger or a scheduled task in Windows Operating System. These reports should be accessible only to the administrative staff selected previously.
  
  o Reconciliation Report – This report should tally the number of transcripts entered into the system and the transcripts that are imaged and the transcript data uploaded in CMS.

  o Error Report – This report should point out any transcripts that are in the system and not in CMS and/or Optix. The error report should highlight any data that is older than 24 hours but not older than 48 hours in
“Yellow” color. Any data that is greater than 48 hours but not older than 72 hours in “Orange” color. Any data that is older than 72 hours should be displayed in “Red” color and an email notification should be sent to the administrative staff notifying of any discrepancies. The status of the transcript will be automatically set to “Acknowledging - On Hold” at this stage.

4.7.3.2 TRS Requirement

- The staff person can look upon a transcript record by entering the unique ID associated with the transcript. They can select a transcript record by clicking against it and it should open a screen with Name, Entry Date, Purpose and Mode of entry in not editable form. This form will also contain a field called Transcript Purpose which can be filled by the staff identifying its purpose.

- After identifying and entering the purpose the staff will change the status of the Transcript to “Routed” and then they should be given a list of options to which the transcript can be forwarded. An email notification will be sent to the administrative staff of the selected department stating that the transcript has been forwarded to them for their further actions.

- For this module, following reports need to be generated every 24 hours which will indicate the following:
- The first report will identify the number of transcript entered into the TRS from TAS and will show a list of all the transcripts (includes transcripts with unidentified purpose). The transcripts whose purpose could not be identified needs to be show in “Red” color.

- The second report needs to identify all the transcripts whose purpose could not be identified or those that have duplicate entries in the system. As soon as the data in TRS is older than 48 hours a notification will be sent to the administrator who can then decide course of action. The status of the transcript will be automatically set to “Routing - On Hold” at this stage.

4.7.3.3 TPS Requirements

- The input of the TPS is the data from the TRS after the purpose of the transcript is identified. The transcript can be looked for by entering the unique ID specified to the transcript or by entering the Student Name and submission date. The transcript should open upon the screen with the all the available details of the transcripts including from where it is routed, the router (the person who routed the transcript from TRS) information. The person can also access the information about the entire acknowledgement and the routing that has happened on the transcript. The report should show all the process steps along with the date time and the person name that acted on it.
• Staff members can select a transcript from the list of transcripts and will be shown all the details of the actions performed on the transcript till that time. At this time the status of the transcript processing should be set to “Processing” automatically. Staff can select from a list of processing details and add the details to the processing step and will reflect onto the transcript processing status.

• When the processing of the transcript hits a road block because of the insufficient documents or details, the processing state of the transcript will change to “On Hold” by the system and the staff member can select from a list of corrective actions that are taken.

• The following reports needs to be generated at the TPS level at every 24 hours cycle:
  
  o A list of report that includes all transcript requests that cannot be processed. Further selecting on the details of each individual should list of the problem with each transcript and corrective actions that is suggested by the staff. A staff member can change the state of the processing if they have the sufficient documents/data requested and they are able to finish the transcript processing.

  o A report that indicates the average time taken by each type of processing request. The time will start from the date of entry from TRS to TPS and
end time will be set to the when the processing state of the transcript is set
to “Done”.

- A list of all processing request that each of selected staff members
  undertakes during a specified date range. The report should be broken
  among the type of processing request and should be supplemented by
  average time for a particular kind of request.

- A list which indicates all the transcripts processing of which cannot be
  completed because of insufficient document or information. At this stage
  the processing status will be set to “Processing- On Hold”.

4.8 External Interface Requirements

4.8.1 User Interface Requirements

- The designed website should conform to the CA disability act – Section 508 and
  should pass the thorough check on the same. More information about Section 508
  can be found on [11].

- The User Interface should be simple and easy to use.

4.8.2 Hardware Interface

None identified at this point
4.8.3 Software Interface

- An external interface is required to CMS and Optix due to the sensitivity of the data including and not restricted to the SSN and demographics of the student.

- A CMS external interface is expected to be developed by Division of Information and Resource Technology and should provide read only access to all the CMS data. In a special case, if an additional data is required a special request needs to be made to the IRT staff for the same. This is a lengthy process and may change the scheduled delivery date of the project.

- The Optix interface may be developed by the office of Outreach, Admissions and Records and at this point no data requirements have been completed. The document needs to be updated at a later stage to add the information.

4.8.4 Communication Interface

None identified at this point.

4.9 Non Functional Requirements

4.9.1 Performance Requirements

None identified at this point in time.
4.9.2 Security Requirements

- All the web forms and reports in the entire product will be accessible only after a person has been successfully authenticated with login credentials.

- Users will be allowed to belong to more than one role. As such, the TMS must accommodate multiple roles per user. For example, a person can also have staff access while being an administrator or managerial level access.
Chapter 5

HIGH LEVEL DESIGN FOR TMS

5.1 Introduction

The High Level Design document is intended to illustrate the user interface design of the Transcript Management System and give the stakeholders an idea of the system behavior in its final form.

Note: Slight variations from the current screens shot are expected to increase usability but the number and content of the fields on the form are expected to be the same in final version of the software. Third party control “Telerik Web Controls” will be used for the enhanced usability experience.

5.1.1 Definition and Acronyms

Table 4 lists down the explanation for the acronyms and terms used in document.
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA</td>
<td>Student Affairs</td>
</tr>
<tr>
<td>CMS</td>
<td>Common Management System</td>
</tr>
<tr>
<td>TMS</td>
<td>Transcript Management System</td>
</tr>
<tr>
<td>TPS</td>
<td>Transcript Processing System</td>
</tr>
<tr>
<td>TAS</td>
<td>Transcript Acknowledgement System</td>
</tr>
<tr>
<td>TRS</td>
<td>Transcript Routing System</td>
</tr>
</tbody>
</table>

Table 4 Acronyms

5.2 User Interface Design for TMS Staff

5.2.1 Login Design

This will be the first screen that will be displayed when the staff accesses the TMS. A valid user ID and password is required to enter the TMS. The user will be directed to different pages upon authentication depending on their roles. In TMS, roles are defined as different classes of staff members that are responsible for a particular function indicated by the role name. Currently, the following Roles are identified in the system

- Manager – Responsible for the efficient utilization of the entire TMS system and its smooth running.
• Administrator - Responsible for maintenance of the entire TMS system technically and functionally.

• Staff – Staff members of the CSUS system that will use TMS

5.2.2 Brief Overview

This screen will enable the users to login to TMS. Upon proper authentication, depending upon the user privileges, the system will route the user to their default screen.

5.2.3 Field Matrix

This screen has the following field displayed as mentioned in Table 5:

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Validation Rule</th>
<th>Data Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Id</td>
<td>User Id as used by the user to authenticate against the TMS database</td>
<td>This is a mandatory field and the username should be &lt;= 8 characters</td>
<td>Yes</td>
</tr>
<tr>
<td>Password</td>
<td>This is a masked textbox, where the entry would be masked using &quot;*&quot; character.</td>
<td>Maximum of 10 characters in the password and no check for the minimum length will be done.</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 5 Field Matrix for the Login Screen
5.2.4 Process Flow

5.2.4.1 Login to TMS

1. As shown in Figure 7, the TMS validates the user ID and password against the TMS database. Since the application is to be hosted on the college internal secure
server, the password and the user ID is sent in plain text. Encrypted passwords are possibility that could be considered for future versions of TMS.

2. In case the authentication fails, the system will show message “Invalid Login/Password” and the user will be given a chance to re-enter the password.

3. No track of successful or unsuccessful login attempt is kept. User can attempt any number of attempts without locking out of the system.

4. On successful login, the user, depending on the role, will be redirected to the respective default pages. This will prevent the user from accessing any information for which they are not authorized.

5.2.4.2 Validations

1. Any user with a valid user ID and password combination for TMS can login into the system.

2. All the passwords and user ID will be stored in SQL Server database in clear text without any encryption.

3. When an unauthorized user tries to login into the system, the TMS will throw an error message.

5.2.4.3 Assumptions

1. Every user will have a unique user ID and password for TMS login.
2. If a new user wants access to the system, he/she needs to get a user ID and password from the administrators. Administrators will give access to the user through a special module called “Manage Staff”.

5.3 Transcript Reception

5.3.1 Transcript Receipt

This screen is accessible to all the staff members who are member of TAS role. This screen is used for entering the details of the transcript that is received. It captures all the necessary information for a transcript to be in the system. Each received transcript is assigned a unique ID. Mode of entry will be configurable and will be changed according to the point at which the application is deployed. If a user opts in for the email notification, automatic email notification will be sent to the user whenever the transcript is imaged and the status is changed to “Routing.” This module of TMS will be deployed at all transcript entry points.

A student may turn in multiple transcripts for the same purpose. The Transcript Routing Process takes care of the problem and essentially joins both the documents to single process.

5.3.2 Brief Overview

This screen will let the TAS staff input all the required fields needed for acknowledging a transcript in the TMS. When the staff clicks on “Submit”, it inserts the data into the TMS
database which is later on used to reconcile the report with the Optix database and track transcripts at various stages.

5.3.3 Field Matrix

TAS Screen will show the fields mentioned in Table 6, displayed by default:
<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Validation Rule</th>
<th>Data Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Get the name of the person who is turning in the transcript.</td>
<td>This is a required field. Maximum length is limited to 50 characters.</td>
<td>Yes</td>
</tr>
<tr>
<td>Mode of Entry</td>
<td>Get the mode of entry. It can be a list which enlists 15 pre-identified entry points of TMS system. Example of Mode of Entry are - Front Counter Staff - Students - EOP, etc.</td>
<td>Non-editable. Single select Dropdown.</td>
<td>Yes</td>
</tr>
<tr>
<td>Purpose</td>
<td>Identifies the purpose of the Transcript.</td>
<td>Optional. Maximum length limited to 1000 characters. Multiple purposes can be separated by comma.</td>
<td>No</td>
</tr>
<tr>
<td>Institution</td>
<td>Identifies the institute what school the transcript is from.</td>
<td>Optional.</td>
<td>No</td>
</tr>
<tr>
<td>Email Notification</td>
<td>Identifies if a person wants to get an email notification or not.</td>
<td>User needs to select from yes or no radio button. Default is No.</td>
<td>Yes</td>
</tr>
<tr>
<td>Email</td>
<td>If the user selects yes in the above, he/she needs to enter a valid email address</td>
<td>Email address should be of the format <a href="mailto:a@b.c">a@b.c</a> which is standard email format in world wide web.</td>
<td>Yes</td>
</tr>
<tr>
<td>Date</td>
<td>System date when the transcript was turned in.</td>
<td>Non-Editable</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 6 Field Matrix for TAS Base
5.3.4 Process Flow

5.3.4.1 Transcript Acknowledgement System – Initial Entry

1. Staff enters the Name, Mode of Entry, Purpose and Email notification fields on the screen.

2. The data is saved into the TMS database which is later used along with Optix interface to generate a reconciliation report.

3. The status of the received transcript is set to “Acknowledging” at this point in the system automatically.

5.3.4.2 Field Validation Rules

1. The name is a required field with a maximum length of fifty characters.

2. Mode of entry is selected from a drop down list. It contains a pre-identified list of fifteen entry points. If any entry point is added later on, a request needs to be made to the system administrator to add it manually into the database.

5.3.4.3 Validations

1. A valid email is required to be entered by the user.

2. If the user opts-in to get notification, an email notification will be sent to the users every time the status of transcript changes.
3. A turned in date will be recorded by the system which will not be editable by the user of the system. This date will be used to generate reconciliation report against the Optix Interface.

4. Clicking on Submit button will insert the all the valid data entered, into the TMS database. Any error while inserting the data into the database will be logged and user will be redirected to an error page. In case there is an error contacting the database, the error will be logged on a local file on the system on a pre-decided path.

5.3.4.4 Assumption

1. Mode of entry data is pre-populated into the database prior to entering data on this form.

2. A staff person is authenticated on the system under TAS Staff role prior to entering any information in the system.

5.4 Transcript Acknowledgement

5.4.1 Acknowledging Transcript

As per Figure 6, acknowledging a transcript is the first step in actual TMS flow. This process takes care of scans the turned in transcript and entering the relevant data into the CMS.
5.4.2 Brief Overview

After logging in to the TMS system, Transcript Acknowledgment staff will be able to see a list of transcript received from various entry points. Each TAS staff member will be able to filter transcripts turned in at their respective locations (fifteen pre-identified). The staff member can either scan the transcript into Optix or can forward it to the concerned department where Optix is implemented. In case, the staff members queue the document for scanning in other department, they can put a comment on the entered transcript. Later on the scanned transcript in Optix will be matched against the turned in transcript every 24 hours. A report will be generated showing the status of transcripts that are not scanned in Optix but received in to TAS.
5.4.3 Field Matrix

The TAS screen will show fields described in Table 7:

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Validation Rule</th>
<th>Data Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sr. No</td>
<td>Indicates the serial number of the turned in transcript</td>
<td>Non-editable</td>
<td>Y</td>
</tr>
<tr>
<td>Name</td>
<td>Name of the Student whose transcript is turned in.</td>
<td>Non-editable</td>
<td>Y</td>
</tr>
<tr>
<td>Mode of Entry</td>
<td>Entry mode from where the transcript is turned in.</td>
<td>Non-editable</td>
<td>Y</td>
</tr>
<tr>
<td>Turned-In Date</td>
<td>Date when the transcript is turned in into the system</td>
<td>Non-editable</td>
<td>Y</td>
</tr>
<tr>
<td>Purpose</td>
<td>Purpose(s) for which the transcript is into the TMS. This can be a comma separated values.</td>
<td>Non-editable</td>
<td>Y</td>
</tr>
<tr>
<td>Scanned in Optix</td>
<td>Is the transcript scanned into Optix? User selects from Yes/No. Default is No</td>
<td>Editable</td>
<td>Y</td>
</tr>
<tr>
<td>Uploaded in CMS</td>
<td>Is the transcript data uploaded in the CMS? User selects from Yes/No. Default is No.</td>
<td>Editable</td>
<td>Y</td>
</tr>
<tr>
<td>Forwarded to Department</td>
<td>This field identifies where the transcript is forwarded for scanning into Optix. This will be a drop down list which includes departments where Optix is deployed. Default is blank.</td>
<td>Editable</td>
<td>Y</td>
</tr>
<tr>
<td>Comments</td>
<td>Identifies any comments and special messages on the transcript. A transcript can have more than one comment.</td>
<td>Editable</td>
<td>Y</td>
</tr>
</tbody>
</table>

Table 7 Field Matrix for TAS
5.4.4 Process Flow

Figure 8 shows the flow chart for the Transcript Acknowledgement System Flowchart.

Figure 8 TAS Flowchart
5.4.4.1 Transcript Acknowledgment System

As shown in Figure 6, transcript acknowledgement system is the first step in Transcript Management System.

1. The TAS staff logs in to the TMS. They are redirected to a screen that shows all currently turned in transcripts at their default location. Default location can be any of the locations that are pre-identified.

2. The staff can select a particular transcript which will display the details of that transcript.

3. There are two options after staff selects to operate on a particular transcript.
   a. The staff can scan a transcript. Staff can also choose to enter the data into CMS. After completing the process, staff will update the status of ‘Scanned’ in Optix to ‘Yes’ and Uploaded in CMS to ‘Yes’. At this point the life cycle of a transcript in TAS ends and the status of the transcript processing are set to “Routing” automatically. An entry is made in the status changed table along with the name of the staff member who completed transcript acknowledgment.
   b. In case the Optix system is not deployed at the place where the TAS is running, the TAS staff member is responsible for forwarding it to the department where Optix is deployed. The staff member will put in a
comment in the selected transcript and can come back at later stage for updating the status of the transcript.

4. If the concerned party (student) has opted for an email notification, an email notification will be sent to them once the status is set to “Routing” from “Acknowledging”.

5. The staff member can go back and select another transcript to process on or can logout of the system.

5.4.4.2 Field Validation Rules

1. Scanned in Optix and Uploaded in CMS fields can have values from Yes/No. Each time a status is changed the value is logged in a different table along with the credentials of the staff member who is logged in.

2. The transcript can be forwarded to Admissions and Outreach Department for scanning into Optix. Later on many of the departments listed in Table 1 will be added for scanning the Transcript.

3. Each comment is limited to 1000 characters and will be displayed in separate grid for the sake of convenience and usability.
5.4.4.3 Validations

1. No data on the screen can be edited. All the editable fields will be shown separately for usability purpose. All the comments will be shown in a separate grid and will not be editable for the tracking purpose. Only an administrator will be given access to delete the comment.

2. The comments field is limited to 1000 characters.

5.4.4.4 Assumptions

1. A staff member is logged in as TAS staff member to access the TAS system.

2. TAS staff member is fully responsible for changing the status of “Upload in CMS” and “Scanned in Optix”. The status change for Optix however will be checked against an automatic report that is generated using the Optix interface.

3. A valid email ID is provided for email notification to be sent.

5.5 Transcript Routing

5.5.1 Transcript Routing System

This forms the second crucial step in the processing of the Transcript as shown in Figure 6. After the transcript is acknowledged by TAS, the second step is to identify its purpose and route it to concerned personnel or department. TRS is meant for tracking the transcript while it is in the phase of the identifying purpose.
5.5.2 Brief Overview

The Transcript Routing System Staff will be the primary user of this module. After logging into the TMS as TRS Staff, they will be able to assign a purpose to the received transcript. In addition to the above, they can also assign the transcript to a particular department or personnel for further processing.

5.5.3 Field Matrix

Table 8 describes the field matrix for the Transcript Routing System.
<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Validation Rule</th>
<th>Data Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sr. No</td>
<td>Indicates the serial number of the acknowledged transcript</td>
<td>Non-editable</td>
<td>Y</td>
</tr>
<tr>
<td>Name</td>
<td>Name of the Student.</td>
<td>Non-editable</td>
<td>Y</td>
</tr>
<tr>
<td>Acknowledged Date</td>
<td>Date when the transcript is acknowledged into the TMS</td>
<td>Non-editable</td>
<td>Y</td>
</tr>
<tr>
<td>Purpose</td>
<td>Purpose(s) for which the transcript is into the TMS. This can be a comma separated values.</td>
<td>Editable</td>
<td>Y</td>
</tr>
<tr>
<td>Scanned in Optix</td>
<td>Indicates whether the softcopy is available in Optix.</td>
<td>Non-editable</td>
<td>Y</td>
</tr>
<tr>
<td>Uploaded in CMS</td>
<td>Indicates if the transcript data is uploaded into the CMS.</td>
<td>Non-editable</td>
<td>Y</td>
</tr>
<tr>
<td>Forward to Department</td>
<td>Indicates the department for which a transcript is meant to serve. The staff can select from pre-listed departments to forward to in electronic form.</td>
<td>Editable</td>
<td>Y</td>
</tr>
<tr>
<td>Comments</td>
<td>Identifies any comments and special messages on the transcript.</td>
<td>Editable</td>
<td>Y</td>
</tr>
</tbody>
</table>

Table 8 Field Matrix for TRS

5.5.4 Process Flow

Figure 9 show the flow chart for the Transcript Routing System.
Figure 9 TRS Flowchart

- Login to TMS
- Access to TRS Modules?
  - Yes: Retrieve the Transcript Records from TMS DB where status is set to "Routing"
  - No: Show message "Access Denied"
- Identify the Purpose of the Transcript and add it in the system
- Is the purpose identified?
  - Yes: Select the department to forward for processing Transcript
  - No: Wait for a pre-defined period
- Send Email notification to the student for identifying the purpose
- System sets the status of transcript to "Routing - On Hold"
- Student Opted For Email Notification?
  - Yes: Send Email Notification
  - No: Proceed to TPS
- System changes the status of the Transcript to "Processing"
5.5.4.1 Transcript Routing System

1. The TRS staff logs in to the TMS. They are redirected to the page where they can see all the transcripts with status set to “Routing”.

2. The staff can select a transcript that will show them all the details of selected transcript.

3. The staff can then assign multiple purposes to the Transcript from a list of pre-identified purposes. If a purpose is not listed in the drop down, the staff will have an option to select “Other” from the list and can enter a custom purpose for the Transcript.

4. The staff can then set the forwarding department for the transcript for final processing. When the staff hits the Submit button the transcript status is set to the “Processing”.

5. In case a purpose is not identified, the staff can select “Purpose – Not identified” option from the dropdown. When the staff hits submit, they will be given an option to send a message to the concerned party stating the purpose of the transcript. At this time the processing status of the transcript will be set to “Routing-On Hold” automatically by the system.

6. After the completion of the process, the staff can select another transcript to work on or can log out of the system.
5.5.4.2 Field Validation Rules

1. The custom purpose length is limited to 500 characters.

2. The transcript can be forwarded to only department that are listed in the dropdown. If there is a specific person for whom the transcript is meant for, the TRS staff needs to mention it explicitly in the comments.

5.5.4.3 Validations

1. No data on the grid can be edited. All the editable fields will be shown separately for usability purpose. All the comments will be shown in a separate grid and will not be editable for the tracking purpose. Only an administrator will be given access to delete the comment.

2. The comments field is limited to 1000 characters.

5.5.4.4 Assumptions

1. All the transcripts are scanned into Optix and corresponding data uploaded in CMS prior to a transcript processing reaching TAS point.

2. It is assumed that a valid email address is provided at the Transcript Entry which will be used to send notification to the concerned parties in event of unidentifiable purpose for the transcript.
5.6 Transcript Processing

5.6.1 Transcript Processing System

This is the third and final step in processing of the transcript. After identifying the purpose of the transcript and routing it to proper department, the next task is to fulfill the identified purpose of the transcript. The Processing Staff members are responsible for finishing the processing of the transcript.

5.6.2 Brief Overview

The Transcript Processing System Staff will be the primary user of this module. After logging into the TMS as TPS Staff, they will be able to see all the purposes listed for a particular transcript. A staff member can select a transcript to start processing it. As soon as the staff member fulfills a particular purpose, s/he is given a Checkbox option to select it and change it to “Done”. This process continues till all the purpose in the list is set to done.
### 5.6.3 Field Matrix

Table 9 describes the field matrix for the Transcript Processing System.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Validation Rule</th>
<th>Data Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sr. No</td>
<td>Indicates the serial number of the routed transcript.</td>
<td>Non-editable</td>
<td>Y</td>
</tr>
<tr>
<td>Name</td>
<td>Name of the Student.</td>
<td>Non-editable</td>
<td>Y</td>
</tr>
<tr>
<td>Routed Date</td>
<td>Date when the transcript is routed into the TMS. This date indicates when the status of the transcript is set to “Processing”</td>
<td>Non-editable</td>
<td>Y</td>
</tr>
<tr>
<td>Purpose</td>
<td>Purpose(s) for which the transcript is in the TMS. This can be a comma separated values.</td>
<td>Non-Editable</td>
<td>Y</td>
</tr>
<tr>
<td>Scanned in Optix</td>
<td>Indicates whether the softcopy is available in Optix.</td>
<td>Non-Editable</td>
<td>Y</td>
</tr>
<tr>
<td>Uploaded in CMS</td>
<td>Indicates if the transcript data is uploaded into the CMS.</td>
<td>Non-Editable</td>
<td>Y</td>
</tr>
<tr>
<td>Routed By</td>
<td>Indicates the name of the person who routed the transcript from TRS.</td>
<td>Non-Editable</td>
<td>Y</td>
</tr>
<tr>
<td>Comments</td>
<td>Identifies any comments and special messages on the transcript.</td>
<td>Non-Editable</td>
<td>Y</td>
</tr>
</tbody>
</table>

Table 9 Field Matrix for TPS
5.6.4 Process Flow

Figure 10 depicts flow chart for the Transcript Processing System.
5.6.4.1 Transcript Routing System

1. The TPS staff logs in to the TMS. They are redirected to the page where they can see all the transcripts whose status is set to “Processing”.

2. The staff member selects a transcript and it is routed to a different page which will display all the information about the transcript. All the purpose will be displayed in an editable grid view which will have the option to set it to done against each of the purpose. It will also have an option to put a particular purpose for attention to a particular TPS staff member.

3. When a staff member sets a purpose to ‘Done,’ no other staff members needs to re-process the transcript for the same purpose.

4. Alternatively, when a staff member set the purpose to “Attention” to a particular staff member in TPS, an email notification is sent to the staff member stating the Name of the student, Unique Id of the Transcript and the purpose which requires its attention.

5. The targeted staff members can then work on the particular task assigned to them and can set it to “Done”.

6. When the last purpose is set to “Done”, the status of the Transcript is set to “Processed”. An email notification is sent to the concerned party stating the processing is complete.
7. The TPS staff member can either then log out of TMS or alternatively can select another transcript to work on.

8. In certain cases when the transcript processing could be not completed due to the lack of other documents that are also required to complete processing for a specific transcript, the staff members can check a flag stating the processing to be put on hold. At this point the processing status of the transcript will be set to “Processing – On hold”. The staff member will be given an option to notify the concerned party via email to send the missing/additional documents.

5.6.4.2 Field Validation Rules

1. Comments on transcript are limited to 1000 characters.

2. A purpose can only be assigned to a single staff for attention. (Needs approval from the stake holders).

3. Optimistic concurrency will be used when two staff members try to access the same transcript data in Transcript Management System.

5.6.4.3 Validations

1. More than one staff member can work on the same transcript at the same time. But only one staff member can work on a purpose at a single time. It is implemented by design that a particular purpose cannot be split between more than one staff members.
2. Only transcripts that are addressed in the TPS are the one whose status is set to “Processing”.

3. There is no explicit way to change the status to “Processing Complete”. It will be done automatically by the system when all the purposes are set to done. The only exception to this is when the staff has to put the processing on hold due to lack of documents.

5.6.4.4 Assumptions

1. A staff member is logged in as TPS staff member to access the TPS.

2. It is assumed that a valid email address is provided at the Transcript Entry which will be used to send notification to the concerned parties in event of missing and/or additional documents are required.

3. All the transcripts are scanned into Optix and corresponding data uploaded in CMS prior to a transcript processing reaching TAS point.

5.7 TMS Reporting

5.8 TAS – Optix Report

This report is aimed at providing a high level view of the discrepancies in scanning a turned in transcript into the Optix.
5.8.1 Brief Overview

This report is aimed at finding the discrepancies in the TMS which will show how many of the transcripts that are turned in versus the number of transcript that got scanned into Optix. This report will be generated at every 24 hours and will compare the data from the TMS database against the data in the Optix database. This report will not report any discrepancies on uploading the data of the turned in transcript in the CMS.
5.8.2 Field Matrix

Table 10 describes the field matrix for the TAS-Optix Report.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Validation Rule</th>
<th>Data Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sr. No</td>
<td>Indicates the serial number of the transcript record</td>
<td>Non-editable</td>
<td>Yes</td>
</tr>
<tr>
<td>Transcript ID No</td>
<td>Unique Id No for the transcript assigned by the system.</td>
<td>Non-editable.</td>
<td>Yes</td>
</tr>
<tr>
<td>Name</td>
<td>Name of the student.</td>
<td>Non-editable</td>
<td>Yes</td>
</tr>
<tr>
<td>Purpose</td>
<td>Identifies the purpose of the Transcript.</td>
<td>Optional. Maximum length limited to 1000 characters. Multiple purposes can be separated by comma.</td>
<td>Yes</td>
</tr>
<tr>
<td>Turned-In Date</td>
<td>The date when the transcript is turned in into the system.</td>
<td>Non-editable.</td>
<td>Yes</td>
</tr>
<tr>
<td>Comments</td>
<td>Any comments on the transcript put in by the TAS staff</td>
<td>Non-editable</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 10 Field Matrix for TAS-Optix Report
5.8.3 Processing Logic

Figure 11 depicts the flow chart for the TAS-Optix Report.

5.8.3.1 Generating Report

1. Retrieve all the data from the TMS database for a single date for a cycle of 24 hours.

2. Retrieve all the data from the Optix interface.
3. Compare the retrieved data of TMS against the data from the Optix Interface. Report the transcripts that are not matched against the data in Optix.

4. Depending upon the maturity of the data sorted each will highlighted in different colors. Any data that is <=24 hours will be highlighted in light bright green color (HEX value #00CC33), the one that is <= 48 hours and >= 24 hours will be highlighted in Orange color (HEX value #FF6600), and any data that is >= 48 hours will be shown in Red color (HEX value #FF0000). All the colors are color blind tested.

5. For every transcript data that is >= 48 hours old an email notification will be sent to the administrator. It is possible to that an administrator will get a daily email notification if the problem is not solved even after notification is sent to them.

5.8.3.2 Field Validation

None

5.8.3.3 Validation

1. The received date of the transcript will serve as the base-line date for calculating the elapsed time period for generating the report.

2. Only the administrators will have access to these reports.

3. A valid email ID is required for the notification to be sent to the administrator.
4. All the report values 24 hours and 48 hours are configurable and the administrators can change it.

5.8.3.4 Assumptions

1. The report is only meant to provide a high level view of transcripts that did not get scanned into the Optix.

2. Any further steps that need to be taken for rectifying the problem needs to be taken by the administrator and is outside the scope of the current application.

5.9 TRS Report

This report is aimed at identifying the transcripts whose purpose could not be identified in TMS.

5.9.1 Brief Overview

This report is aimed at identifying the transcripts whose purpose could not be identified in the system after the transcript has been acknowledged in the TMS. This report will be generated at every 24 hours and will compare the data in TMS database for the transcript whose status is set to “Routing” but whose purpose is not identified.
5.9.2 Field Matrix

Table 11 describes the field matrix for the TRS Report.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Validation Rule</th>
<th>Data Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sr. No</td>
<td>Indicates the serial number of the transcript record</td>
<td>Non-editable</td>
<td>Yes</td>
</tr>
<tr>
<td>Transcript ID No</td>
<td>Unique Id No for the transcript assigned by the system.</td>
<td>Non-editable</td>
<td>Yes</td>
</tr>
<tr>
<td>Name</td>
<td>Name of the student.</td>
<td>Non-editable</td>
<td>Yes</td>
</tr>
<tr>
<td>Purpose</td>
<td>Identifies the purpose of the Transcript.</td>
<td>Optional. Maximum length limited to 1000 characters. Multiple purposes can be separated by comma.</td>
<td>Yes</td>
</tr>
<tr>
<td>Routing Date</td>
<td>The date when the status of the transcript is set to “Routing”.</td>
<td>Non-editable</td>
<td>Yes</td>
</tr>
<tr>
<td>Comments</td>
<td>Any comments on the transcript put in by the TAS staff</td>
<td>Non-editable</td>
<td>Yes</td>
</tr>
<tr>
<td>Notification-Sent to Student</td>
<td>Indicates whether if any notification is sent to the concerned parties.</td>
<td>Non-Editable with value Yes/No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 11 Field Matrix for TRS Report
5.9.3 Processing Logic

Figure 12 depicts the flow chart for the TRS Report

Figure 12 TRS Report Flowchart

NOTE: The date to be used as baseline to color the report rows will be the one when the status of the Transcript was set to “Routing”
5.9.3.1 Generating Report

1. Retrieve all the data from the TMS database whose status is set to “Routing”.

2. Depending upon the maturity of the data retrieved each will highlighted in different colors. Any data that is <=24 hours will be highlighted in light bright green color (HEX value #00CC33), the one that is <= 48 hours and >= 24 hours will be highlighted in Orange color (HEX value #FF6600), and any data that is >= 48 hours will be shown in Red color (HEX value #FF0000). All the colors are color blind tested.

3. For every transcript data that is >= 48 hours old an email notification will be sent to the administrator. It is possible to that an administrator will get a daily email notification if the problem is not solved even after notification is sent to them.

4. The only exception to this rule is if an email notification is already sent to concerned party stating to identify the purpose. In this case the row will be reported in the report in Sky Blue color (HEX value #7ADAE1). No notification will be sent to the administrator in such case.

5.9.3.2 Field Validation

None
5.9.3.3 Validation

1. The date of the transcript when the status is set to “Routing” will be served as the base-line date for calculating the elapsed time period for generating the report.

2. Only the administrators will have access to these reports.

3. A valid email ID is required for the notification to be sent to the administrator.

5.9.3.4 Assumptions

1. The report is only meant to identify the transcripts whose purpose could not be identified in the TMS.

2. Any further steps that need to be taken for rectifying the problem needs to be taken by the administrator and is outside the scope of the current application.

3. All the transcripts reported in the report are the ones that have successfully passed the transcript acknowledgement step.

4. All the report values 24 hours and 48 hours are configurable and the administrators can change it.

5.10 TPS Report

This report is aimed at identifying the transcripts whose processing is not complete after the transcript purpose is successfully identified in the TRS step.
5.10.1 Brief Overview

This report is aimed at identifying the transcripts whose processing cannot be completed after it is successfully routed from the TRS. This report will be generated at every 24 hours and will compare the data in TMS database for the transcript whose status is set to “Processing”.
### 5.10.2 Field Matrix

Table 12 describes the field matrix for the TPS Report.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Validation Rule</th>
<th>Data Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sr. No</td>
<td>Indicates the serial number of the transcript record</td>
<td>Non-editable</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Transcript ID No</td>
<td>Unique Id No for the transcript assigned by the system.</td>
<td>Non-editable</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Name of the student.</td>
<td>Non-editable</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Purpose</td>
<td>Identifies the purpose of the Transcript.</td>
<td>Optional. Maximum length limited to 1000 characters. Multiple purposes can be separated by comma.</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Processing Date</td>
<td>The date when the status of the transcript is set to “Processing”.</td>
<td>Non-editable</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Comments</td>
<td>Any comments on the transcript put in by the TPS staff</td>
<td>Non-editable</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Notification-Sent to Student</td>
<td>Indicates whether if any notification is sent to the concerned parties.</td>
<td>Non-Editable with value Yes/No</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

Table 12 Field Matrix for TPS Report
5.10.3 Processing Logic

Figure 13 depicts the flow chart for the TPS Report.

![TPS Report Flowchart](image)

5.10.3.1 Generating Report

1. Retrieve all the data from the TMS database whose status is set to “Processing”.

*NOTE: The date to be used as baseline to color the report rows will be the one when the status of the Transcript was set to “Processing”*
2. Depending upon the maturity of the data retrieved each will be highlighted in different colors. Any data that is <=24 hours will be highlighted in light bright green color (HEX value #00CC33), the one that is <= 48 hours and >= 24 hours will be highlighted in Orange color (HEX value #FF6600), and any data that is >= 48 hours will be shown in Red color (HEX value #FF0000). All the colors are color blind tested.

3. For every transcript data that is >= 48 hours old an email notification will be sent to the administrator. It is possible to that an administrator will get a daily email notification if the problem is not solved even after notification is sent to them.

4. The only exception to this rule is if an email notification is already sent to concerned party stating to identify the purpose. In this case the row will be reported in the report in Sky Blue color (HEX value #7ADAE1). No notification will be sent to the administrator in such case.

5.10.3.2 Field Validation

   None

5.10.3.3 Validation

1. The date of the transcript when the status is set to “Processing” will be served as the base-line date for calculating the elapsed time period for generating the report.

2. Only the administrators will have access to these reports.
3. A valid email ID is required for the notification to be sent to the administrator.

5.10.3.4 Assumptions

1. The report is only meant to identify the transcripts whose processing could not be completed within the TPS.

2. Any further steps that need to be taken for rectifying the problem needs to be taken by the administrator and is outside the scope of the current application.

3. All the report values 24 hours and 48 hours are configurable and the administrators can change it.

4. All the transcripts reported in the report are the ones that have successfully passed the transcript routing step.
Chapter 6

SQL SERVER SERVICE BROKER

This chapter provides an overview of different messaging techniques that are in used most often in today’s automated workflow contexts. It outlines commonly seen approaches to sending/distributing messages as well as receiving/consuming messages. Applicability of Service Broker facilities to CSUS transcript processing will be apparent.

In addition, this chapter focuses on details of the Service Broker, the latest arrow in the quiver of the Microsoft SQL Server. This chapter also discusses how the Service Broker can be used in conjunction with the designed TMS. The chapter ends with a small discussion on the performance analysis of Service Broker and the benefits derived from it.

6.1 Importance of Messaging Technology

Klaus Aschenbrenner in his book “Pro SQL Server 2005 Service Broker” illustrates four different advantages of using the Messaging Technology [12].

6.1.1 Asynchronous Message Processing

This gives the user flexibility to carry on with a different task while the long running task is being processed in background without the interaction of the user. This leads to highly scalable application.
6.1.2 Deferred Message Processing

In Deferred Message Processing the task can be scheduled to start at a particular time which can range from minutes, hours to days and weeks. This provides excellent opportunity to do a load balancing on highly busy systems with limited number of servers.

6.1.3 Fault Tolerance

Messaging Technology provides fault tolerance by using Reliable Messaging, Load Balancing, and Dynamic Rerouting. The reliable messaging ensures a guaranteed delivery of the message while Load balancing provides a flexibility to efficiently divide the load among the different servers. This feature provides efficient fault tolerance in aspect of any discrepancies that might arise due to any external factors such as network outage, lost packets or data corruption along the route. Dynamic rerouting can be used in circumstances like a server going down for planned or unplanned purposes. [12]

6.1.4 Distributed System

In very large scale systems, finance application for banks and stock exchanges, running on multiple servers on a network the messaging technology helps providing a highly scalable system with high fault tolerance and dynamic rerouting capabilities.
6.2 Different Messaging Techniques with Windows Technology

Over time Microsoft has come up with different Messaging technology to solve different types of problem. Following is a brief compilation of all of them.

6.2.1 Microsoft Message Queuing (MSMQ)

MSMQ was the first Messaging Technology used by the Microsoft. It is not tied to any database and it comes licensed with the Microsoft Windows operating system. There is no additional licensing added to it. [12]

6.2.2 Queued Components

Queued Components are a part of the Component Object Model (COM+) infrastructure [12]. The Queued Components provides functionality like asynchronous processing and queuing of user messages.

6.2.3 BizTalk Server

“BizTalk Server is a business process management (BPM) server that enables companies to automate, orchestrate, and optimize business Processes” [13]. This technology is not widely used primarily due to its high cost of ownership although it provides full featured tool set for design, development and maintenance of the system [12].

6.2.4 XML Web Services

This is a highly popular messaging technique in today’s world which primarily uses the open standard SOAP and Web Services Description Language to communicate among
different machines on networks. The main advantage of using this open standard technique is, it is not confined to Microsoft Technology and works well in interoperability scenarios.

6.2.5 Windows Communication Foundation (WCF)

The newest among the messaging technology is the Windows Communication Foundation (WCF) which was introduced with a unique objective in mind to provide a common programming interface for all the above mentioned Messaging Service namely Web Services, .Net Remoting, Biz Talk Server, and COM+. It is available from .NET framework 3.0 and above.

6.3 SQL Server Service Broker Basics

SQL Server Service Broker is typically divided into 5 different components [14]:

- Conversations
- Anatomy of Service
- Security
- Message Processing
- Performance

The following sections describe each of them in detail.
6.3.1 Conversations

The whole architecture of Service Broker is based around conversations. Basically conversations can be Dialog or Monolog [14].

The Dialog, as the name suggests, is a two way conversation between 2 Service Brokers. The developer and consumer can have the flexibility of specifying and customizing the conversation to include Guaranteed Delivery of the Message, Delivering a message exactly one time, delivery in the order of requests, long-lived ranging from a sec to couple of years and finally a persistent service which states that if the Service Broker is restarted it guaranties the processing of unprocessed requests [14].

The Monolog is service architecture of one way communication between a Publisher Service and 1 or many subscriber Services. Subscriber services are the one that are listening actively for a message from the Initiator Service. As of now, the Monolog is not supported in the SQL Server 2005 but they can be in future versions of SQL Server.

6.3.2 Anatomy of Service

“A Service Broker service is a named endpoint to which messages from other services are sent [15].” Although Service Broker is a built-in object of the SQL Server, it internally consists of following four components:

- Message Types
- Contracts
6.3.2.1 Message Types

“A message type defines the type of data that a message contains, and its name is associated with that message type [16].” The message type can be of any default or in built types. Prior to send, a message can be validated against one of the following three types of validation techniques:

- XML Validated against an XML Schema
- Well-formed XML
- Empty

Since message validation occurs every time a message is sent or received by the service, it provides a lot of overhead. Alternatively, one can specify to do no validation if the service is between trusted sources. In case of validation error the service sends back the original to the originator.

6.3.2.2 Contracts

A contract is an agreement between two Services of the Service Broker on which message types to be used to accomplish a specific task [16]. The contract determines which message type can be received between the services and it is must to have a contract
to establish a service. The contract also determines if only the sender can initiate the conversation, only the target can initiate the conversation or both can. A sender and target can have more than one contract to communicate with different targets and senders respectively. Following Contracts are defined in SQL Server Service Broker [17]:

- **SENT BY INITIATOR** – only initiator sends the message

- **SENT BY TARGET** – only target sends the message

- **SENT BY ANY** – either initiator or target sends the message

### 6.3.2.3 Queues

Queues as the name suggests queues the incoming messages from the service. A queue must be defined for the initiator and target service. A queue in SQL Server is implemented with a concept called *Hidden Tables*. Hidden Tables are implemented in similar fashion as SQL tables internally, except there is no interface to access it by outside world. It is implemented at the database level. So unlike a SQL table one cannot use a select, insert and update on the queue directly. However there is a read-only view that is associated with each of the queues and “SELECT” can be performed on it. The Hidden Tables offers different feature such as transactions, logging, backup, mirroring and clustering similar to the normal SQL Tables which can be applied to SQL Server Service Broker.
6.3.2.4 Service Programs

“A Service Broker service is a name for a specific business task or set of business tasks [18].” It can be a stored procedure for internal activation or separate program for external activation. Service Broker automatically activates a service program when a new message arrives. We can also schedule an event to activate the service program or if we decide we can activate it manually.

6.3.3 Security

One of the most important aspects in today’s communication world is the security especially when it is over the network or between different domains. The Service Broker offers two types of the security – Transport and Dialog security [18].

Transport Security establishes a secure connection between two different instances of SQL Server Service Broker and thus prevents unauthorized services from sending messages to the Service Broker. The Transport Security supports Windows Based authentication and Certificate based authentication. Whereas Windows based authentication can only be used between two instances running on the same network or trusted domain, the certificate based authentication overcomes this limitation and provides a secure way to communicate over distrusted domains.

However, many times, just transport security is not enough when the packets are routed from one network to another as it only provides encryption between two different servers. The Dialog security provides adds a level of security along with the Transport level. The
packets in Service Broker are forwarded by Forwarder along the network. “A Service Broker forwarders is an instance of SQL Server that accepts Service Broker messages and forwards them to the next hop on the route to the target service [19].” The forwarders are needed because of the different network topologies through which the packets might have to travel through different SQL Server services instance that has nothing to do with the payload it carries but needed to pass through to reach their ultimate destination, the target service. The transported packets are decrypted and re-encrypted again before being sent to another Forwarder. As there is no encryption involved in Transport security, dialog security adds a little more security when the packets are hoping on different un-trusted networks.
6.3.4 Message Processing

Figure 14 shows the details of a typical message processing scenario of the Service Broker.

A typical Message Processing cycle is divided into eight steps and uses Request message, Response Message, Transmission Queue, Initiator Queue and Initiator Service, and Target Queue and Target Service. Following steps describes the typical communication between Initiator Service and Target Service [20]:
1. An external application (Windows or Web) will execute a stored procedure “StartDialog” where the “InitiatorService” is defined. It is responsible for opening conversation between two services.

2. The second step puts a message with message type “Request Message” in the local “Initiator Queue” of the “Initiator Service”. This process uses “Transmission Queue” to provide a reliable messaging.

3. When the message arrives on Target Service it is transferred to the Target Queue where it will awaits further processing. During this step a receipt is sent back to the initiator so that the initiator queue can delete the request from transmission queue.

4. An external application or a built in stored procedure starts processing the incoming message.

5. After the processing of the received message is completed a response message is created and sent back to the initiator service.

6. The response message is stored in the transmission queue on the target side.

7. The response message is transported to the transmission queue on the initiator side.
8. The service program processes the response message and notifies the client application about the result of service request.

6.3.5 SQL Statements for Service Broker

This section provides an overview of all the key words that will be used for the configuration and implementing of the Service Broker in the SQL Server. Full working example of the Service Broker for TMS can be found in Appendix – A.

- The following code snippets creates a message type “RecordTranscript” with no Validation and creates a Contract by name “TranscriptContract” which states that “RecordTranscript” is the message type and the message will only sent by Initiator.

```sql
CREATE MESSAGE TYPE [RecordTranscript] VALIDATION = NONE;
CREATE CONTRACT [TranscriptContract] (
    [RecordTranscript] SENT BY INITIATOR
);
```

- The following code snippets will create a queue by name “TranscriptQueue” and a service by name “TranscriptService” that will listen on the “TranscriptQueue”

```sql
CREATE QUEUE [TranscriptQueue];
CREATE SERVICE [TranscriptService] ON QUEUE [TranscriptQueue]([TranscriptContract]);
```

- This following snippet will get the first request from the Queue and stores it in a variable called @HANDLE, message type in @MESSAGETYPE and the payload in @MESSAGE. It is equivalent of “SELECT” statement from the table.
The snippet below alters the “TranscriptQueue” to invoke stored procedure “usp_RecordTranscriptMessage” when there is a message on the queue. It demonstrates internal activation. This also specifies the maximum reader on the queue and the permission level (OWNER).

```
ALTER QUEUE [TranscriptQueue] WITH ACTIVATION
(
    STATUS = ON,
    MAX_QUEUE_READERS = 1,
    PROCEDURE_NAME = usp_RecordTranscriptMessage,
    EXECUTE AS OWNER
);
```

The BEGIN DIALOG CONVERSATION actually begins the process of passing a message to the “TranscriptService” (receiver) from the “RecordTranscriptsService” (sender). This statement returns a conversation handle, which you can then use to send the message. The SEND ON CONVERSATION statement does the work of sending the XML message payload.

```
BEGIN DIALOG CONVERSATION @Handle
FROM SERVICE [RecordTranscriptsService]
TO SERVICE 'TranscriptService'
ON CONTRACT [TranscriptContract]
WITH ENCRYPTION = OFF;
SEND ON CONVERSATION @Handle
MESSAGE TYPE [RecordTranscript](@MessageBody);
```
6.3.6 Performance

Service Broker provides several performance benefits from when implemented in the system [21].

- **Message-processing Logic:** One can implement the messaging-processing logic of service program in different ways.

- **Multiple Queue readers:** Can define how many service programs can process messages concurrently. It helps in controlling message throughput and adjusts it according to requirements.

- **Transaction Management:** Service Broker uses the SQL Server transaction and hence it eliminates the performance loses of distributed transactions as message and message processing logic are stored in the same database.

- **Single log writes:** No transaction co-coordinator is needed to manage the transactions as only one log write is needed when SQL Server transaction is committed.

On the down side the validation does provide a performance overhead, but overall it is a good bet to use the Service Broker for distributed Transactions.
6.3.7 Benefits

There are unique benefits for using the Service broker [22].

- **One Application Path Interface (API):** The service broker includes the messaging support directly in T-SQL instead of a different API.

- **Centralized Administration Tools:** Only SQL Server Management Studio is required to for administrating Service Broker. You can use the same for administering the online transaction processing (OLTP) database.

- **Reliable Messaging:** There is no need for explicitly using the reliable messaging as Service Broker provides it inherently.

- **Scale-out Scenarios:** There is no change in the programming model while developing Service Broker application. The only change needed is while configure the Service Broker application.
Chapter 7

CONCLUSION AND FUTURE WORK

This chapter provides an overview of the learning acquired in developing and documenting this Master’s Project. It also highlights key challenges faced in developing this analysis and design of the proposed Transcript System and advantages it offers over the existing system. The chapter concludes with the future development prospects of the project.

7.1 Key Challenges

In the course of working towards this Master’s Project, one of the main challenges faced was to gather the requirements. The processing of transcript is an overly complicated process touching as many as fifteen departments from where it can be entered and then at least ten departments processing it afterwards. The transcript is processed by many people in many departments to fulfill its purpose in the system. Identifying and documenting the process flow was the biggest challenge encountered in the project.

Another challenge was the cost benefit analysis for the proposed project. Pinpointing the exact monetary aspect related to each individual entity and finally adding up for the department and then at the school level required a lot of detailed analysis; including the person hours spent on processing transcripts, daily wages and the exception handling during the process.
During the course of selecting a technology to implement a proof of concept, exploring various technical approaches to solve the same problem posed a unique challenge in itself. Recommending SQL Server Service broker was a tough decision to make but the benefits like scalability, ease of deployment across multiple sites and load balancing and scheduling outweighs most of the competitors for the selection. Also the decision favored the existing SQL Server database architecture underlying the Optix Database used for as a solution for scanning the transcripts.

7.2 Conclusion and Expected Outcome

The most important conclusion to be drawn from the specification of a new Transcript Management System is the potential cost savings it offers over the existing system. If implemented correctly it will provide cost saving of approximately $70,000. Also, it will ease the tracking of the transcript at any given time and decrease the time to serve the student with their requests. It also aims at benefitting the “Going Green” effort by eliminating the need of paper at various points it will reduce the usage of the paper in quantifiable amount. A successful implementation of this project will help The Division of Student Affairs streamline the process flow of the transcript and reduced the time for taking critical decision which can lead to both time and resource saving to the Department.

An important conclusion from the project is the enormous promises SQL Server Service Broker holds. It is a comparatively new technology to the SQL Server database system. It
is analogous to the Advanced Queuing in Oracle. But the solid architecture underlying the Service Broker and ease of its implementation and its feature like scalability, ease of coding and deployment and load balancing makes it unique and a choice of implementation for the current project.

As demonstrated in the Appendix, one can easily link the SQL Server Service Broker with the desired functionality for the Transcript Management System. There is an inherent queuing mechanism of Service Broker that queues all the incoming transcripts in the order of the Transcript Turned-In Date. After the acknowledgement of the transcript, using the Message-processing Logic each of the transcripts can be routed to single or multiple departments by implementing Multiple Queue readers in the code. For example, a transcript turned in for credit of number of units will be routed to the Admissions and Records can also be routed to the Academic Advising for Graduation Evaluation and to the Financial Aid Department for proposed Financial Aid eligibility.

All the above can be done with just a simple code in Service Broker. The inherent transaction processing of the Service Broker provides a consistent mechanism for implementing workflows in the Transcript Management System. These are a few of the reasons which make SQL Server Service Broker a suitable candidate for workflow process implementation.
7.3 Future Work

As the title of the project suggests, this project aims at analyzing and designing of the Transcript Management Systems. The next step would be to enhance the proof of concept to a full-size implementation of the system interacting with various systems across the campus. This will be a sizeable effort according to the analysis. Major challenges in implementing the project in full fledge will be the security parameters across system, access to the systems, requirements regression and the SQL Server service broker implementation with a front end tied to it.

Another extension to the project, after being tested on CSUS campus, is to generalize it for the other CSU campuses. According to the Associate Vice President, Edward Mills, there are at least eight other campuses across CSU system which are facing a similar problem. There would be benefiting developing a much generalized application architecture which can be deployed at multiple sites with very few changes across the system.
APPENDIX

SQL Server Service Broker Code for TMS

-- 1. Delete if there is an existing database by name SB_TMS
-- 2. Create the Service Broker Database
-- 3. Enable the Service Broker on newly created Database

USE MASTER

IF EXISTS(SELECT * FROM sys.databases where name = 'SB_TMS')
  DROP DATABASE SB_TMS
GO

CREATE DATABASE SB_TMS
GO

ALTER DATABASE SB_TMS
SET ENABLE_BROKER
GO

-----------------------------------------------------------------
-----------------------------------------------------------------
-----------------------------------------------------------------

-- 4. Create the Transcript Table (used for the demo purpose)

USE SB_TMS;
GO

CREATE TABLE Transcripts
(
  -- Indicates a unique Transcript Id
  TranscriptID INT IDENTITY(1,1),
  -- Date when Transcript is turned in
  TransTurnedInDate SMALLDATETIME,
  -- Dept who request Transcript
  DepartmentName VARCHAR(100),
  -- Mode from where Transcript entered system
  ModeOfEntry VARCHAR(100)
);
GO
--- 5. Create the 'Message type' and 'Contract'

---- Message Type ----
-- A message type defines the name of a specific kind of message -- and
the validation that Service Broker performs on that kind
-- of message.

---- Contract ----
-- The contract defines which service can send messages of a
-- given message type. A contract is required to communicate
-- effectively between two different Services on same or
-- different instances of the SQL Server. It also specifies
-- whether whether the message type is sent from the initiator
-- to the target, from the target to the initiator, or in both
-- directions. (MSDN)

CREATE MESSAGE TYPE [RecordTranscript] VALIDATION = NONE;
CREATE CONTRACT [TranscriptContract]
(
    [RecordTranscript] SENT BY INITIATOR
); GO

--- 6. Create the 'Queue'

--- Queue ---
-- A queue holds incoming messages for a service
-- This service will receive messages and activate a procedure to
-- process them.

--- Service ---
-- The definition of a Service Broker service includes the names
-- of the contracts for which the service is a target. Page # 86
-- provides additional details on Service.

CREATE QUEUE [TranscriptQueue];
CREATE SERVICE [TranscriptService] ON QUEUE [TranscriptQueue]([TranscriptContract]);
GO

-- Goto the Stored Procedure dbo.usp_RecordTranscriptMessage [23]
-- in the procedure RECEIVE equivalent to the Select in except
-- used to receive from the Queue
-- Implementation using the XQuery as the XML message type

CREATE PROCEDURE usp_RecordTranscriptMessage
AS
BEGIN
    SET NOCOUNT ON;
    DECLARE @Handle UNIQUEIDENTIFIER;
    DECLARE @MessageType SYSNAME;
    DECLARE @Message XML
    DECLARE @TurnedInDate DATETIME
    DECLARE @DeptName VARCHAR(100)
    DECLARE @ModeofEntry VARCHAR(100);
    RECEIVE TOP (1)
        @Handle = conversation_handle,
        @MessageType = message_type_name,
        @Message = message_body
    FROM [TranscriptQueue];
    IF(@Handle IS NOT NULL AND @Message IS NOT NULL)
    BEGIN
        SELECT @TurnedInDate =
            CAST(CAST(@Message.query('/Params/TurnedInDate/text()') AS NVARCHAR(MAX)) AS DATETIME)
        SELECT @DeptName =
            CAST(@Message.query('/Params/DeptName/text()') AS NVARCHAR(100))
        SELECT @ModeofEntry =
            CAST(@Message.query('/Params/ModeOfEntry/text()') AS NVARCHAR(100))
        INSERT INTO dbo.Transcripts
        (TransTurnedInDate,
         DepartmentName,
         ModeOfEntry)
        VALUES

ALTER QUEUE [TranscriptQueue] WITH ACTIVATION
(
  STATUS = ON,
  MAX_QUEUE_READERS = 1,
  PROCEDURE_NAME = usp_RecordTranscriptMessage,
  EXECUTE AS OWNER
);
GO

-- 7. Create the 'Queue' and 'Service' called
-- [RecordTranscriptsQueue] and [RecordTranscriptsService]
--- Queue ---
-- A queue holds incoming messages for a service
CREATE QUEUE [RecordTranscriptsQueue];
CREATE SERVICE [RecordTranscriptsService] ON QUEUE [RecordTranscriptsQueue];

-- Goto the Stored Procedure dbo.usp_SendTranscriptInfo [23]
-- The BEGIN DIALOG CONVERSATION actually begins the process of
-- passing a message to the TranscriptService from the
-- RecordTranscriptsService. This statement returns a
-- conversation handle, which you can then use to send the
-- message. The SEND ON CONVERSATION statement does the work of
-- sending the XML message created from the SELECT statement from
-- my temp table.
CREATE PROCEDURE usp_SendTranscriptInfo
(
  @TurnedInDate SMALLDATETIME,
  @DeptName VARCHAR(100),
  @ModeofEntry VARCHAR(100)
)
AS

BEGIN

DECLARE @MessageBody XML
CREATE TABLE #ProcParams
(
    TurnedInDate SMALLDATETIME,
    DeptName VARCHAR(100),
    ModeOfEntry VARCHAR(100)
)

INSERT INTO #ProcParams
    (TurnedInDate, DeptName, ModeOfEntry)
VALUES
    (@TurnedInDate, @DeptName, @ModeOfEntry)

SELECT @MessageBody = (SELECT * FROM #ProcParams FOR XML PATH
    ('Params'), TYPE);

DECLARE @Handle UNIQUEIDENTIFIER;
BEGIN DIALOG CONVERSATION @Handle
FROM SERVICE [RecordTranscriptsService]
TO SERVICE 'TranscriptService'
ON CONTRACT [TranscriptContract]
WITH ENCRYPTION = OFF;

SEND ON CONVERSATION @Handle
MESSAGE TYPE [RecordTranscript](@MessageBody);

END

GO

GO

-- 8. Test the queue and service broker app

EXECUTE usp_SendTranscriptInfo '1/9/2009','Student Affairs','Front Counter'
-- 9. Demonstrate the select from the table

```
SELECT * FROM transcripts;
```

-- Results

```
<table>
<thead>
<tr>
<th>TranscriptID</th>
<th>TransTurnedInDate</th>
<th>DepartmentName</th>
<th>ModeOfEntry</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2009-01-09 00:00:00</td>
<td>Student Affairs</td>
<td>Front Counter</td>
</tr>
</tbody>
</table>
```

(1 row(s) affected)
BIBLIOGRAPHY


2. Vision, Mission and Core Values, Source location: Student Affairs Website [Online]
   Available: http://saweb.csus.edu/students/mission.aspx

3. About Student Affairs, Department Description, [Online]
   Available: http://saweb.csus.edu/students/departments.aspx

4. Student Affairs Workload Analysis March – 2008 (Author: Edward Mills) Office of Vice-President, Student Affairs (Internal Report), Contact: Lori Rowe


6. California State University, Long Beach, October 1, 2007 [Online]
Available:

http://daf.csulb.edu/offices/univ_svcs/budget/docs/fy0708/employee_data/salaries_tenure.html


8. The California State University, December 3, 2009 [Online]


9. Credentials Solutions, Copyright © 2010 [Online]


10. Telerik Inc, Copyright © 2002-2010 [Online]

Available: www.telerik.com


Available:

http://www.disabilityaccessinfo.ca.gov/lawsregs.htm#rehabilitation_act_508


17. SQL Server Books Online – Copyright © 2007, [Online]

Available:


