HUMAN RESOURCES RECRUITMENT MANAGEMENT PLUG-IN FOR ENTERPRISE RESOURCE PLANNING SYSTEMS

By

ALEX RIABOV

A Senior Project submitted
in partial fulfillment
of the requirements for the degree of
Bachelor of Science in Industrial Engineering

California Polytechnic State University
San Luis Obispo

Graded by: Reza Pouraghabagher Date of Submission: May 27, 2011
Checked by: ____________________ Approved by: ____________________
Abstract
Enterprise Resource Planning (or ERP in short) systems today are a backbone of most large United States and International corporations. Around 1990s these companies transitioned from using different software packages for each business unit to using the modules of Enterprise Resource Planning system for the business unit’s specific needs. Some functionality was lost. Human Resource function of recruitment was one example of large functionality left out of Enterprise Resource Planning systems such as SAP or PeopleSoft. As a result, these large companies turned to 3rd party Applicant Tracking Systems to manage recruitment and subsequently created redundancies in workflow, increased spending, and missed on opportunity to utilize the full Enterprise Resource Planning functionality for their Human Resource department.

This senior project proposes a plug-in to extend the functionality of Enterprise Resource Planning applications to include the recruitment of new employees. Proof of concept for such plug-in is developed in this senior project and reviewed in this report. As a result of analyzing the changes between current process and the new process with the plug-in instead of Applicant Tracking System, the use of the plug-in saved an average large company of 10,000+ employees an estimated $160,000 yearly. Additionally, the plug-in showcased the potential for improvement in the speed of Human Resource department, increased visibility of Human Resource department spending, and potential to make the Human Resource staff more satisfied with their job.
# Table of Contents

Abstract ............................................................................................................................... 2

List of Tables ....................................................................................................................... 5

List of Figures ...................................................................................................................... 6

Introduction ......................................................................................................................... 7

Background .......................................................................................................................... 7

- Understanding ERP ............................................................................................................ 9
- Understanding Recruitment Process ................................................................................. 13
- Understanding Redundancy .............................................................................................. 15

Literature Review ................................................................................................................ 17

- Historical and Current States of Enterprise Resource Planning System ....................... 17
- Ergonomics and Usefulness of Enterprise Resource System ............................................ 18
- Impact of Enterprise Resource Planning on Firms Performance ....................................... 19
- Support Tools and Extensions for Enterprise Resource Planning System ...................... 20
- Human Resource Management and Enterprise Resource Planning In Various Size Firms ... 20
- Implementation of Enterprise Resource Planning System ............................................... 21
- Best Practices for Small Software Development .............................................................. 21

Design .................................................................................................................................. 23

- Determine Functionality ................................................................................................... 23
- Select Technology ............................................................................................................. 25
- Create Database Schema ................................................................................................. 26
- Create Wireframe .............................................................................................................. 28

Solution Walkthrough ........................................................................................................ 30

- Dashboard Walkthrough ................................................................................................ 30
- Positions Section Walkthrough: ...................................................................................... 31
- Applicant Section Walkthrough: ...................................................................................... 32
- Reimbursements Section Walkthrough: ......................................................................... 33
- Cost Centers Section Walkthrough: ............................................................................... 34

Methodology ....................................................................................................................... 35

- Process Analysis .............................................................................................................. 35
- Economic Justification ...................................................................................................... 36

Results .................................................................................................................................. 39

Conclusion ........................................................................................................................... 40

Bibliography: ...................................................................................................................... 41
Appendix A – Plug-In Showcase ................................................................. 43
Appendix B – Economic Justifications ......................................................... 46
List of Tables
Table 1 – Employee Conversion Savings........................................................................................................34
Table 2 – Assumption for New Hires Savings....................................................................................................46
Table 3 – Reimbursement Savings...................................................................................................................35
Table 4 – Assumptions for Reimbursements Savings.........................................................................................47
List of Figures

Figure 1 – Enterprise Configuration Without Enterprise Resource Planning System .........................10
Figure 2 – Enterprise Configuration With Enterprise Resource Planning System ............................11
Figure 3 – Enterprise Resource Planning System Architecture ......................................................12
Figure 4 – General Steps In Recruitment Process ........................................................................13
Figure 5 – Recruitment Process at Cisco Systems, Inc. .................................................................14
Figure 6 – Enterprise Resource Planning & Applicant Tracking System Recruitment Conversion
Flowchart .............................................................................................................................16
Figure 7 – Graphical Representation of Plug-In Functionality .......................................................24
Figure 8 – Technological Framework for the Plug-In .................................................................26
Figure 9 – SQL Schema for the Plug-In .......................................................................................28
Figure 10 – Wireframe of Layout for the Plug-In ........................................................................29
Figure 11 – Dashboard Screenshot .............................................................................................30
Figure 12 – Positions List Screenshot .........................................................................................31
Figure 13 – Details Page for a Position Screenshot .....................................................................43
Figure 14 – Create Page for a Position Screenshot ......................................................................43
Figure 15 – Applicant Page Screenshot ........................................................................................32
Figure 16 – Applicant Details Page Screenshot ...........................................................................44
Figure 17 – Reimbursement Page Screenshot .............................................................................33
Figure 18 – Reimbursement Details Screenshot ...........................................................................44
Figure 19 – Cost Center Page Screenshot ....................................................................................34
Figure 20 – Cost Center Details Page Screenshot .........................................................................45
Figure 21 – Enterprise Resource Planning & Plug-In for Recruitment Conversion Flowchart .......35
Introduction
This project is required in partial completion of degree requirements for a Bachelor of Science in Industrial Engineering at California Polytechnic State University, San Luis Obispo. The need to improve the way Human Resources recruit new employees in a large company was experienced firsthand while working for an undisclosed 18,000+ corporation that was undergoing the final stages of one billion dollars SAP implementation in the summer of 2009.

According to SAP’s website, about 80% of Fortune 500 companies utilize their Enterprise Resource Planning system. Other large businesses around the world use other leading ERP providers including Oracle, Microsoft, and IBM. Additionally, in the recent years there have been a number of new players in the ERP community that deliver their offering in a less traditional way called “Software As A Service” (SaaS) which is aimed at small businesses and some enterprise companies. The providers in the SaaS area are Workday, NetSuite, and others.

Presently, these ERP packages with their out-of-the-box configuration connect various internal business units and functions with monetary accounts to allow for better financial control and nearly real time access to shared information for these business units. More specifically, ERP packages include tools to improve efficiency for financial, human capital management operations, corporate services, and performance management areas. Other functions can be added on and purchased separately, including some ERP system providers allowing 3rd party application developed by independent developers to be sold to their ERP clients.

For this project, Human Resources domain of a large ERP powered enterprise is the area of interest. Current offerings in the space include SAP ERP Human Capital Management application that enables companies the “automation of core HR processes, such as employee administration, payroll, and legal reporting, increases efficiency and supports compliance with changing global and local regulations.” ("SAP ERP: Enterprise Resource Planning") Similarly, PeopleSoft Enterprise Human Capital Management offers to companies the ability to “manage HR globally on a single system of record while
complying with local laws and regulations with our global core HCM system.” ("PeopleSoft") As a result, Human Resources department in the ERP powered enterprise is responsible for tracking pay, reimbursement and other functions for the current employees. In addition to managing current employees, HR department is also responsible for hiring or recruitment functions. Unfortunately, SAP and PeopleSoft, two of the major ERP providers today, do not have a built in way to track spending on recruiting employees and automate reimbursement process for these perspective employees.

In this project, the objective is to design a working application in a form of a proof of the concept for a 3rd party plug-in to existing Enterprise Resource Planning systems to connect the recruitment function directly with the financial side of the ERP. The application will be limited to being a proof of the concept due to the delicate nature of the ERP and lack of an ERP training systems available. As a result, the application will be able to work with a mock up financial tables, but contain all of the functions that the final working version of the ERP system may have.
**Background**
Understanding of this project and its benefits is dependent upon understanding of the basic capabilities of the Enterprise Resource Planning and the functions of employee recruitment performed by Human Resources department. The Enterprise Resource Planning system is explained first in this report.

**Understanding ERP**

Enterprise Resource Planning systems integrate most departments and functions across a company into a single system that can serve most, if not all, needs of each department needs. Prior to ERP, most companies have different applications that they use for different business function. This approach is illustrated in Figure 1. For example, Finance & Accounting, Manufacturing, Human Resource and Sales & Marketing all used their own software that, more likely than not, was made by completely different vendors and in different programming languages. The problem with this approach was that these applications did not typically allow sharing of information with one another and therefore required a lot of customization and extensive use of middleware to enable the limited communication that may have been achieved. Even after the customization has been done, the results were less than perfect and often times the same account for a vendor or an employee had to be entered more than ones into each software creating many redundancies in the enterprise and thus reducing company’s overall throughput and efficiency.
ERP system, on the other hand, controls most functions of the enterprise with its Modules. These Modules are specifically designed to handle the function of each business unit. This is illustrated in Figure 2. For example, Accounting & Finance department uses an Accounting & Finance Module of the ERP system to create budgets, allocate costs, manage account payables and conduct other important activities. Each Module is capable to serve the majority of the needs of each business unit. As a result, this approach allows for each employee or a vendor to be entered only once in a commonly shared database and for this information to be used by all different business units in nearly real time. Subsequently, this allows for greater visibility of different performance indicators such as costs per unit and work in progress (WIP) inside the enterprise. Additionally, the benefits of implementing the ERP system include:

1. Cycle time reduction
2. Improved maintenance
3. Business process optimization
4. Increase in data accuracy

![Diagram of Enterprise Configuration With Enterprise Resource Planning System]

Figure 2 - Enterprise Configuration With Enterprise Resource Planning System

Ones a company is using the ERP system, their internal structure will look like similar to the one illustrated in Figure 3. The flow of information, as illustrated in Figure 3, starts with database that contains various data. Next, on the way to be accessed by the user, the data passes through Enterprise Resource Planning engine where data gets applied with the specific business rules and gets rendered into the way that can be understood by a browser. After these two steps, an employee with appropriate access level is finally able to view the information in his or her computer’s internet browser.

Due to difficulty of gaining access to the business enterprise that would be willing to grant even limited access to both database and ERP engine of their ERP system, the plug-in being developed for this senior project will be limited to the proof of concept in the form of a working prototype. The more information
about the way the application was is found in the Design section of the report.

Lastly, it is important to note that in order to implement the proof of concept plug-in developed in this senior project two of the possible scenarios might be approached:

- Create a middleware to allow Enterprise Resource Planning database to communicate with the database used for the developed plug-in.
- Rewrite the plug-in to be natively integrated with the Enterprise Resource Planning system.

The implementation of this project, however, lies entirely outside of the scope of this project.
Understanding Recruitment Process

Recruitment refers to the process of attracting, screening, and selecting qualified individuals. Each company may have a different recruitment process in place. For example, Figure 4 illustrates general steps in the recruitment process while Figure 5 illustrates the recruitment process specific for Cisco Systems, Inc. This is typically done through posting of the soon-to-be-filled position online and then initially screening the applicants by reviewing their resumes. Next step following the initial screening is interview over the phone or eventually in person. Since it is usual for bigger companies to conduct the interviews on one of their sites, the perspective employees are required to travel various distances to attend the interview. Depending on the company and distance traveled by the perspective employee, he or she may be reimbursed for the airfare, meals, hotel stay, transportation to or from the airport and other spending.

Figure 4 - General Steps In Recruitment Process (Image Source: http://www.mwrecruitment.com.au/recruitmentprocess.html)
Figure 5- Recruitment Process at Cisco Systems, Inc (Image Source: http://www.cisco.com/global/EMEA/career/popup/)

Since functionality to keep track of the applicants in the Enterprise Resource Planning systems such as SAP or PeopleSoft is currently unavailable, the large companies of 10,000+ employees are using Applicant Tracking Systems. In the pre-ERP times the large companies did not relying on Applicant Tracking Systems as the standalone systems to manage all of the Human Resource functions including recruitment were set in place. These applications were also able to handle other Human Resource department functions including payroll and management of current employees.

Today, Applicant Tracking System or ATS enables the electronic handling of recruitment needs while Enterprise Resource Planning system handles management of current employees. In an essence, it is very similar to Customer Relationship Management applications but is designed to manage applicants as opposed to customers. Some of the large providers of the Applicant Tracking Systems are Taleo and MaxHire.
Understanding Redundancy
Based on the concepts of Enterprise Resource Planning analyzed and the functions of Human Resources department, there is a redundancy in the way most large corporations utilize SAP or PeopleSoft Enterprise Resource Planning system to conduct and document recruitment process. In other words, Enterprise Resource Planning systems, in respect to Human Resources function are capable of handling the following:

- Current employee management (including professional skills, expertise, contact information, etc)
- Current employee payroll

As you can see from the list, no recruitment functionality is currently handled by the Enterprise Resource Planning Human Resources Module. That is why the large enterprises rely on Applicant Tracking System discussed earlier to cover the gap in functionality and provide the following features:

- Perspective employee management (including professional skills, expertise, contact information, etc)

The redundancy in the recruitment process is created by entering the recruitment information multiple times. First, the full information about each perspective applicant is captured inside the Applicant Tracking System from the moment applicant is selected for interview process. If the applicant is selected for the position and accept a full time job offer, a Human Resources staff member will be responsible for entering the applicant’s information into Enterprise Resource Planning system such as SAP or PeopleSoft. For a visual representation of this redundancy, please refer to the Figure 6 below.
From the Figure 6, the highlighted step of entering applicant’s information for Human Resources staff member is repeated twice, which is decreasing overall effectiveness of the Human Resource department. It also makes employees frustrated and adds to overall job dissatisfaction for HR staff. The solution provided in this senior project solves the redundancy issue and subsequently increases effectiveness and throughput of a Human Resources department.
Literature Review
Basic knowledge of Enterprise Resource Planning, Human Resource department function and the pitfalls of the current design to support HR recruitment functions were discussed in the Background section. In this section, the critical points of current knowledge on the matters related to the senior project will be addressed in the greater detail. Moreover, this section also covers the important topics of requirement of Information Technology department in regards to 3rd party SAP or PeopleSoft add-ons as well as reviews the findings on best small software development practices, both of which not addressed thus far in the report.

Historical and Current States of Enterprise Resource Planning System
“Over the last decade, our world has changed dramatically due to the growing phenomenon of globalization and revolution in information technology.” (Gupta, and Kohli) The research paper also states that “there is tremendous demand on companies to lower costs, enlarge product assortment, improve product quality, and provide reliable delivery dates through effective and efficient coordination of production and distribution activities. To achieve these conflicting goals, companies must constantly re-engineer or change their business practices and employ information systems.” (Gupta, and Kohli) “In 1990s, Enterprise Resource Planning (ERP) systems have emerged as an enabling technology, which integrates various functional (operations, marketing, finance, human resources) information systems into a seamless suite of business applications across the company and thereby, allowed for streamlined processing of business data and cross-functional integration.” (Gupta, and Kohli) This peer edited paper also argues that in addition of streamlining the processes, “ERP systems (also) provide an enticing solution to managers who have struggles with incompatible information systems and inconsistent operations policies.” (Gupta, and Kohli)

“Enterprise resource planning (ERP) has come to mean many things over the last several decades” according to the research by Jacobs and Bendoly. According to the same peer edited paper, “divergent applications by practitioners and academics, as well as by researchers in alternative fields of study, has allowed for considerable proliferation of information on the topic of ERP.” (Jacobs and Bendoly) In other
words, as opposed to the emerging technology a decade ago, the ERP packages today are well
documented and better understood by employees on most levels of the organization. This indicated that
the technology is mature and most of the current drawbacks of Enterprise Resource Planning platform
have also been around for years.

**Ergonomics and Usefulness of Enterprise Resource System**

As with any tool in use today, ergonomics and usefulness are essential to keeping users satisfied with the
product. Despite the fact that billions of dollars have been spent on various ERP packages, some
researches still show that some users may not use the ERP systems as often as the companies would want
their employees to use them. The results of this study indicate that both perceived usefulness and
learnability are determinants of end-user satisfaction with ERP systems. In addition, “… perceived ease of
use and system capability affect perceived usefulness, while user guidance influences both perceived
usefulness and learnability.” (Calisir, and Calisir) This research suggests the following insight into “best
practices” of ERP which should be used in the user interface design for the Human Resource plug-in
developed in this senior project:

- “The design of an ERP system’s interface should enable easy navigation among different
  modules.” (Calisir, and Calisir)
- “Navigation aids can be provided to users to prevent disorientation.” (Calisir, and Calisir)
- “To help users understand the logic flow of the system, broad and shallow menu structures
  should be preferred to narrow and deep ones.” (Calisir, and Calisir)
- “The removal of unnecessary or redundant screens will also help to keep the navigation flow
  uncomplicated.” (Calisir, and Calisir)
- “ERP system designers should pay more attention to user requirements analysis to determine
  their expectations and requirements for the content of ERP systems, and then incorporate relevant
  materials and functions into the systems. With the background of users becoming more and more
diverse, the differences in the domain knowledge need to be accommodated for a system
  successful.” (Calisir, and Calisir)
In conclusion, the usability and accessibility of plug-in need to be made a design goal for developing a user interface. Without it, the plug-in may go unused regardless of its benefits to Human Resource staff.

**Impact of Enterprise Resource Planning on Firms Performance**

Because the ERP system allows for streamlined processing of business data and cross-functional integration as stated earlier, the effects on the non-financial side of the business are often overlooked by the management. As a result, the article written by Juha-Pekka Kallunki, Erkki K. Laitinen, and Hanna Silvola titled *Impact Of Enterprise Resource Planning Systems On Management Control Systems And Firm Performance* addresses the gap in knowledge associate with ERP use and overall improvement in the firm’s performance. Since the proposed plug-in application is aimed not only to improve the Human Resources bottom line, but also to improve the performance of a Human Resources business unit as whole, the results of this research are important. The report addresses the “role of formal and non-formal and informal management control systems as mechanisms which mediate the effect of Enterprise Resource Planning systems adoption on firm performance.” (Kallunki, Laitinen, and Silvola) The analysis is based on the survey of seventy different business units.

In summary of the research project, “findings demonstrate that formal types of management control systems act as intervening variables mediating the positive lagged effect between enterprise systems adoption and non-financial performance.” (Kallunki, Laitinen, and Silvola) In other words, it can be assumed that adding the proposed plug-in will bring overall positive effect on Human Resources day to day functions, but in a way that are often harder to record and measure. Finally, another article titled *Enterprise Resource Planning Systems And Non-Financial Performance Incentives: The Joint Impact On Corporate Performance* further proves the improvement in company’s performance as a result of having their business units utilize Enterprise Resource Planning system for the day to day operations. More specifically, according to the article “…(firms with) ERP obtain significantly higher short-term and long-term ROA (Return on Investment) that the ones without it.” (Wier, Hunton, and HassabElnaby) Subsequently it can be assumed that expanding functionality of ERP system to include new member recruitment will increase ROA even further.
Support Tools and Extensions for Enterprise Resource Planning System
The acceptance of Enterprise Resource Planning systems into the many leading business organizations in the world has enabled many businesses to streamline their financial and processes in the way that were not possible before. This being said, the Enterprise Resource Planning systems often time get implemented with a limited functionality. As a result, there is a room for the company’s Information Technology divisions to code additional extensions and new functionality as well as for 3rd party developers to fill in the gap in functionality. The research paper by De Carvalho and Monnerat titled Development Support Tools For Enterprise Resource Planning talks about a specific tool called ERP5 which is off the shelf extension to enable certain functionality inside the manufacturing company. Accord to the article, the 3rd party applications like that “increasingly gaining acceptance in the market.” (De Carvalho, and Monnerat) The article also states that there is demand and acceptance for the plug-ins like the ones that is being designed in this project out in the real world by large companies both in the United States and overseas.

Human Resource Management and Enterprise Resource Planning In Various Size Firms
The Human Resources department is an integral part of every business and has arguably the most important functionality of any size firm. Without the Human Resources department, the business will not be able to recruit new company employees as well as retain the present employees. What Enterprise Resource Planning currently allows to human resource employees is the ability to keep formal accounts of finances associated with payroll for every employee. However, the functionality that is currently disabled is financial management for the recruitment process through existing Enterprise Resource Planning system. According to the relevant article titled Strategic Human Resource Management in Small Enterprises, “though small enterprises might wish to keep their human resource management practices informal, they will be able to increase their productivity if there is adequate human resource planning and integration of human resource strategies with business strategies.” (Singh, and Vohra) Similarly, in the research paper titled Enterprise Resource Planning Software in the Human Resource Classroom, “Only when the HR function reinvents itself as a service provider and/or business partner of the organization can
HR successfully align itself with—and help to facilitate—the achievement of strategic organizational goals.” (Bedell, Floy, McGlashan Nicols, and Ellis) Both of the papers suggest that Human Resources practices will benefit from more structure and organization enabled by today’s technology.

**Implementation of Enterprise Resource Planning System**  
Despite implementation of the plug-in developed in this project being outside of the scope, the understanding of difficulties with implementation process for the ERP package as whole should be understood and taken into account when developing the plug-in. In fact, the importance of implementation of an ERP system was stressed and supported with relevant cases throughout the time. As a result, a lot of opinions and research is done on the subject of best practices for the implementation. In terms of ERP system implementation, success is defined as on time and on/under budget project completion. The analysis of the findings was conducted in the research paper by Joseph Bradley titled Management Based Critical Success Factors In The Implementation Of Enterprise Resource Planning Systems. In the article, “the findings suggest that choosing the right full time project manager, training of personnel, and the presence of a champion relate to project success. The use of consultants, the role of management in reducing user resistance and the use of a steering committee to control the project do not appear to differentiate successful and unsuccessful projects. Integration of ERP planning with business planning reporting level of the project manager, and active participation of the CEO beyond project approvals, resource allocation and occasional project review, are not found to be critical factors of success. Considering the financial cost and risk associated with these projects, a better understanding of critical success factors will enable practitioners and academics to improve the chance of success in the implementation projects.” (Bradley ) These conclusions are useful to keep in mind when developing the plug-in for this project.

**Best Practices for Small Software Development**  
Knowing best proven methodologies for a small software development are vital part of successful development of the prototype plug-in. The peer edited research paper titled A Theoretical Agile Process Framework for Web Applications Development in Small Software Firms, presented at the Sixth
International Conference on Software Engineering Research, Management and Applications, covers the important best practices for small application development. According to the Haroon Altarawneh and Asim El Shiekh, authors of the research paper, “the objectives of (their) research is to propose a software process model framework that assists the small firms in designing web based-applications so as not to run over budget and time.” (Altarawneh, and Shiekh) In many ways, the objectives of the paper align with the scope of this senior project.

Early application development was done in a haphazardous manner where the trust to develop application was invested entirely on the individuals skills and experience. This is commonly referred to as “Ad-Hoc Development” model. The projects developed in this manner often produce significantly variable outcome and thus overall lower quality product. According to the research paper, the following specific problems were the most damaging to a success of small software development for a small company:

- “Delivered systems didn’t meet business needs 84 percent of the time.”
- “Schedule delays plagued the projects 79 percent of the time.”
- “Project exceeded the budget 63 percent of the time.”
- “Delivered systems didn’t have the required functionality 53 percent of the time.”
- “Deliverables were of poor quality 52 percent of time.”

The best practices in today’s software industry aim at eliminating the pitfalls of the Ad-Hoc Development listed above and its implications. Since each type of development is best for different type of application being developed, in the case of this senior project an agile approach seems to provide the most benefits. According to the authors of the research, agile development “… adopts standard software architecture and is heavily based on frameworks, speeding up system analysis, design and implementation..” (Altarawneh, and Shiekh) This is the methodology that will be used to develop the prototype of plug-in to manage the companies.
Design
Knowing the requirements for the functions of Human Resources department and current capabilities of Enterprise Resource Planning department described in the previous sections creates a foundation for starting the development of a prototype plug-in to demonstrate its benefits. Also, as discussed in the literature review section above, the agile development and its core idea of basic development on a framework will be used in this senior project. Below are the four key steps that were taken to create the final working prototype:

Determine Functionality
Before any programming takes place, it is vital to determine and lock-in functionality. If this step is omitted, the scope may drift or crepe to include unnecessary elements and thus take longer overall.

The goal of the plug-in is to replace the functionality of the Applicant Tracking System that a large enterprise is using as well as improve the way reimbursements are currently handled inside the Enterprise Resource Planning system such as SAP or PeopleSoft. Below is a list of core functionality that the proposed ERP plug-in will need to handle on its own in order to replace Applicant Tracking System:

- Management of Positions (Job Openings)
  - Ability to View, Add, Edit and Delete positions
- Management of Applicants
  - Ability to connect Applicants to Positions
  - Ability to View, Add, Edit, Delete, and Convert applicants to full-time employees once the candidate is chosen

Currently this is the extent of functionality needed to manage information about the Applicants in the recruitment pipeline. In addition, the reimbursement functionality will need to be added to allow the proposed plug-in to take full advantage of Enterprise Resource Planning system capabilities. The functionality to handle the Reimbursements will be the following:
- Management of Reimbursements
  - Ability to connect Reimbursements to Positions
  - Ability to View, Add, Edit, Delete, and Approve reimbursements

In order to make the use of the plug-in easier for Human Resource staff, the dashboard will be developed to aggregate the information about Positions, Applicants, and Reimbursements in the system. As a result, refer to Figure 7 for the diagram of the basic functionality proposed for the proof of the concept plug-in.

![Dashboard]

**Figure 7 - Graphical Representation of Plug-In Functionality**

Not displayed but important to the prototype’s functionality are the Cost Centers. In the final application that is connected to an Enterprise Resource Planning system such as SAP or PeopleSoft, the cost centers used will be the ones already stored inside the company’s Enterprise Resource Planning system. Since the plug-in is prototype, mock-up Cost Center’s will need to be created. Similarly to the Positions, Applicants and Reimbursements, the Cost Centers will have the following functionality:

- Management of Cost Center:
  - Ability to connect Cost Centers to Reimbursements
  - Ability to View, Add, Edit, and Delete cost centers
Select Technology
Now that the specification of the project and a scope are established, it is important to determine a technology to use for the development of the proof of the concept plug-in. It is important to remind that the application is a prototype and thus will not be compatible with the existing Enterprise Resource Providers such as SAP or PeopleSoft.

Currently there are two large schools of thought in regards to the type of programming language one chooses. They are open-source programming languages such as PHP and Ruby on Rails or proprietary programming languages such as Microsoft .NET framework. In this senior project I will use the latter, Microsoft .NET framework, due to the more enterprise oriented nature of the project. Moreover, I am going to be using Microsoft ASP.NET MVC 3 framework. According to Microsoft website, the advantages of this framework as opposed to other .NET frameworks available are the following:

- **Separation of Concerns:** From the programmer point of view, the organization of code within this framework is organized with 3 separate levels: Model, View, and Controller (hence the name MVC). This allows for a clean, organized, and more scalable application. These are important characteristics for this plug-in.

- **Better Control:** Allows web developer absolute control over the way the information appears inside the Web browser as it is seen by an application user.

- **Test Driven Development:** The testing is an integral part of any ASP.NET MVC 3 project. As a result, the glitch in the system will be discovered before making the version accessible to the public.

Due to the reason listed above, the MVC application is used for the development of the application. Additionally, the application also uses relational database to store information entered into the system. SQL is a declarative computer language and is a relational database used for this project.
Combining the SQL database and Microsoft’s ASP.NET MVC 3 framework, the final developed product will be displayed in any standard Web browser that supports HTML tags. For the diagram showing the full framework for this project, refer to the Figure 8 below:

![Diagram showing the full framework for the project](image.png)

**Figure 8 – Technological Framework for the Plug-In**

**Create Database Schema**
Creating database schema is important step in the application development. Failing to spend the appropriate time on this development step may result in a longer development time and need to go back and add new fields to capture important information inside the database. The database table structure will need to be designed to capture all the necessary information for positions, applicants, reimbursements, and (in the case of this prototype) cost centers. Each of these categories will have multiple fields. Below is a list of fields being captured for each category:

- **Positions:**
  - Title
  - Department
  - Added By
  - Date Added
  - Manager Name
  - Close Date
- Salary
- Job Description

- Applicant:
  - First & Last Name
  - Major
  - School
  - Notes
  - Email
  - Address
  - Home Phone
  - Mobile Phone
  - Email
  - HR Contact
  - Resume

- Reimbursements:
  - Description
  - Type
  - Date Added
  - Approved By
  - Date Approved
  - Amount

- Cost Center:
  - Number
  - Amount
  - Date Added
The table structure needs to also include additional fields to maintain relationship between different tables. For instance, Applicant table needs to maintain fields to record its relationship to Position and Reimbursement table. After the full business logic and the entire table with their respective requirements were entered into SQL, the final SQL schema was created. The schema is displayed in Figure 9. It is appropriate to note that the knowledge gained in taking IME 312 (Databases) was beneficial to conducting this part of the project.

Create Wireframe
Last step before starting to program the application was to develop a mock up of what the final interface for the user may look like. One way develop the most usable interface is by utilizing the concept of wireframing. In short, it is a low-fidelity visual representation of a website’s layout design. In a way, it is a blueprint for what the final product will look like. One of the wireframes created for this project is displayed in the Figure 10 following this paragraph.
Figure 10 - Wireframe of Layout for the Plug-In

The benefits of this approach to the overall quality of the application are the following:

- Test and improve navigation between pages
- Study and rapidly refine the user interface design of web forms and interactive elements
- Determine the usability of the overall design

The skills and methodologies learned in IME 319 (Human Factors) course were also applied to the wireframes to determine the best layouts. This step concludes the implementation of best practices created to assure the successful development of the application.
Solution Walkthrough
After following the best development outlined in the previous section, the actual development of the application took place. This section will showcase some of the functionality created in the application along with the visual representation of the plug-in by the means of utilizing screenshots of the final working product.

Dashboard Walkthrough

Figure 11 - Dashboard Screenshot
The Figure 11 above displays the final view of the application’s Dashboard. From the dashboard, a Human Resource staff member is able to see an overview of two graphs. The first one is a pie chart that showcases percent of applicants in the plug-in per each position. The table on the right is an “Approval Queue”. The idea for the queue is that the first submitted reimbursement will be the first in line for the approval. In a sense, this is an example of First In First Out (FIFO) methodology. By clicking “Details” button, a Human Resources staff member will be able to look at the details for that particular reimbursement and have an option of approving it. Also, from the dashboard and elsewhere on the application, one can use the shortcuts in the top right corner to access “Positions” list and “Cost Center” list by clicking respective links.
Positions Section Walkthrough:

![Positions List Screenshot](image)

**Figure 12 - Positions List Screenshot**

The **Figure 12** above showcases the view for the “Positions” list. In a nutshell, this is a view where a Human Resources staff would create, edit, delete, and view job openings for their company. The **Figure 13** (Appendix A) shows the detailed view of information collected for each opening. From this page, a user is able to edit a job opening, delete it, or return back to the list of the positions. The interface used for capturing the information about new job openings is shown in **Figure 14** (Appendix A) as well. After Human Resource professional is done entering the new information through the visual interface, he or she will add it to database by clicking “Create” button on the bottom of the page. In order to view applicants for each position, user clicks on the underline title for the opening. It is important to know that the large companies may utilize the working “Search” function to perform a keyword search on opening title, date added, and other information displayed in the list on the “Positions” page. After clicking the title’s name, the plug-in will redirect user to the “Applicant” section that is showcased below.
Applicant Section Walkthrough:

The list of applicants displayed in the applicant section shows all of the applicants for the selected position. Refer to Figure 15 above for the screenshot of Applicants page. On the Applicant page, a Human Resources staff is able to create and view applicants for the selected position. If a user clicks on “Details” link, he or she will see the details screen for the selected applicant similar to the one shown in Figure 16 (Appendix A). From the Applicant “Details” page, one is able to delete and edit an applicant in a similar fashion to the options available from the “Details” view for the position. Unlike the Positions page, however, a Human Resource staff is able to use “Convert” button in the top right corner to convert the employee from the applicant to full time employee and subsequently close the job opening for that specific position. Since this plug-in is a proof of the concept and is not connected to any Enterprise Resource Planning system, the ability to “Convert” employee is limited to closing the job opening.

Next, each perspective employee may have reimbursements or money owed to him or her by the company for travel or other interview related expenses. In order to check if an applicant has any outstanding...
reimbursements or to add a new reimbursement to an applicant, the name of the applicant must be selected and clicked from the Applicant list.

**Reimbursements Section Walkthrough**

*Figure 17 - Reimbursement Page Screenshot*

*Figure 17* above represents the Reimbursements list page for an applicant. Using this page, Human Resources staff is able to view currently available reimbursements for the selected applicant or create new reimbursements by selecting “Add New Reimbursement” in the top right corner. By clicking “Details” a user will be redirected to a page similar to the one displayed in *Figure 18*. From the “Details” screen, a staff member is able to edit and delete the selected reimbursements. Additionally, he or she is also able to “Approve” the reimbursement. This means that the amount of reimbursement will come out of a selected cost center, save information about the transaction, and (if the plug-in was connected to Enterprise Resource Planning system) send the request to mail the reimbursement using established infrastructure.

For the obvious reason, the last functionality is not available for this proof of the concept as the plug-in is not connected to an Enterprise Resource Planning system.
Lastly, it is important to quickly glance at the Cost Centers page as it has not been covered yet. In order to view the list of Cost Centers available, a staff member needs to click “Cost Centers” link located at the absolute top of every page, on the right side.

**Cost Centers Section Walkthrough**

![Cost Center Page Screenshot](image)

**Figure 19 - Cost Center Page Screenshot**

**Figure 19** displays the list of all cost centers available for the use by Human Resources department. Of important note is the fact that cost centers do not directly correlate to the number of departments that company has. In fact, marketing department on their own, for example, may have up to 10 different cost centers set up for different purposes. From the screen showed on **Figure 19**, a Human Resources staff is able to create a new cost center by selecting “Add New Cost Center” or view details about an existing one by selecting “Details” link next to each cost center’s 4-digit number combination. Selecting the “Details” view will yield the view similar to the one showed on **Figure 20** (Appendix A). There, a staff member will be able to view a history of recent reimbursement that came out of the selected cost center located in the bottom half of the page as well as being able to edit the existing cost center information by clicking “Edit” button. This is the last section of the plug-in.
Methodology
In order to evaluate the benefits, if any, offered by the plug-in mockup developed in this senior project, the process analysis and financial analysis have to be conducted. Also, it is important to understand the current state of the process outlined in the Background section of the report. Before evaluating the process financially it is important to realize and compare the differences in the process and their effect on large enterprise operations.

Process Analysis
Recalling from the Background section of the report, the current solution to handle new employee recruitment for most Enterprise Resource Planning powered large companies is a combination of an ERP system itself and Applicant Tracking System. Figure 6 earlier in the report illustrated visually the redundancy associated with this flow of information between two systems. More specifically, the redundancy was cause by the lack of middleware between two systems and the subsequent need to enter applicant’s information multiple times after he or she becomes a full time employee.

The process flow with the plug-in in place to replace the functionality of Applicant Tracking System does not have the same redundancy as the current system. This is due to the nature of the plug-in being directly integrated with the main database of the Enterprise Resource Planning system. As a result, the new flowchart for the process is shown in Figure 21 below:

![Figure 21 - Enterprise Resource Planning & Plug-In for Recruitment Conversion Flowchart](image)

From the Figure 21, it is obvious that the information is entered only once. Assuming that the company want to enter full information about employee, it will take someone up to 2 hours to enter the information in the system, whether that person is a Human Resource professional or a new hire that will have to
reenter his or her own personal information into the system on the first day of work as a full time employee. Having a plug-in eliminates this step altogether. The benefits of removing the redundancy are not solely financial. For instance, it allows for company to know more about each new full time employee as ever before. In order to determine the commercial appeal of the solution, the financial savings associated with implementing the plug-in as opposed to the current process are reviewed in the following section. Note that the economic justification skills were learned in the IME 314 (Engineering Economics) course.

**Economic Justification**

Before analyzing the financial impact of using the plug-in for the company’s recruitment management, the assumptions need to be established. The savings associated with utilizing the plug-in to effortlessly convert perspective employees are displayed in Table 1. The basic assumption that a large company with 10,000+ employees hires approximately 1,650 employees from outside and that it cost approximately $80 in salary to completely reenter full employee application. With these assumptions, such company will save approximately $150,000 each year comparing to the current process where the information is double-entered. Note that the Table 2 (Appendix B) shows the full list of assumptions and calculations to estimate the yearly savings.

<table>
<thead>
<tr>
<th>Employee Conversion Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hired Externally</td>
</tr>
<tr>
<td>Salary</td>
</tr>
<tr>
<td>Time to Enter Information</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
</tr>
</tbody>
</table>

Table 1 – Employee Conversion Savings

In addition to savings associated with not having to enter employee’s information in both Applicant Tracking System and Enterprise Resource Planning system, the savings also come from automating the reimbursements itself. Currently Human Resource staff uses Enterprise Resource Planning system to record the reimbursements for perspective employees for travel or other costs that may have been
associated with attending an interview. Due to the lack of special features in SAP or PeopleSoft to record reimbursements for each employee, Human Resources staff uses the same form they would use to submit a reimbursement for their own travel to receive a reimbursement for a perspective employee or a group of employees. This method does not utilize the level of visibility for spending that is possible with Enterprise Resource Planning system. Additionally, this way is slower than possible as Human Resource staff member receives a blank check and often has to manually complete the check before manually preparing an envelope to send it to the appropriate applicant.

This is not the case for a company that may use the plug-in proposed in this senior project to reimburse the perspective employees. This is due to the plug-in being connected to the Enterprise Resource System directly and being able to utilize the already available ways to pay the current employees.

To be more specific, any large company powered by Enterprise Resource Planning system has an infrastructure set in place to conduct payroll and reimbursement functions for the current employees. The plug-in will utilize this functionality and subsequently free up Human Resource staff from writing checks and mailing them manually, and instead utilize automated direct deposit or mailing services already in place.

This yields savings associated with Human Resources staff saving time on completing reimbursements for the employees. Table 3 represents the savings associated with speeding up reimbursement functionality. With the similar assumptions as before, it is estimated that using plug-in will save a large
company of 10,000+ employees approximately $10,000 every year. For full assumptions breakdown, refer to Table 4 in the Appendix B.
Results
Financial savings outlined in the Methodology section due to use of the proposed plug-in add up to the combined savings of almost $160,000 yearly for a large company with 10,000+ employees. In today’s economy, the saving is significant and may be allocated to improve training for the Human Resource department or elsewhere internally. In addition to the estimated monetary savings, there are also intangible benefits associated with the use of the plug-in. The list below covers the main benefits:

- **Faster Human Resource Department:** With the plug-in, Human Resource department is able to avoid the redundancy associated with double entry of employee’s information. Additionally, the reimbursement efforts to send the money to the necessary recipient now take significant less time.

- **Increase Visibility:** Since the reimbursements are entered into the system directly and associated with an individual applicant, there is more visibility to Human Resource department spending. Additionally, the employees hired via the plug-in will have the most information about their skills and experience stored in the Enterprise Resource Planning system which will increase the knowledge the company has about its own talents as this information may be made searchable internally.

- **Happier Employee:** Human Resources staff’s job with plug-in is a lot less repetitive and the free from some redundant tasks altogether. As a result, Human Resources employee will be happier and keeping them happy is essential to the company’s success as they are the face of the company for all of the external applicants.
Conclusion
The redundancy associated with large companies utilizing both Enterprise Resource Planning system and Applicant Tracking System has overall negative impact on the Human Resources department. This senior project concentrated on successfully removing this redundancy and improving quality of work for Human Resource staff by creating a proof of the concept plug-in to manage recruitment inside the Enterprise Resource Planning system.

In order to develop a working plug-in, the concepts of Enterprise Resource Planning system and the functions of Human Resource department had to be understood. Further knowledge was gained via reviewing related published literature. During the development phase of the project, the best practices were used to assure higher level of quality for the final proof of the concept plug-in. After the plug-in was developed, it was compared to the current design in terms of both financial and intangible benefits.

The completed plug-in demonstrated an estimated saving of $160,000 for a large company with over 10,000+ employees. Additionally, the plug-in showcased the potential for improvement in the speed of Human Resource department, increased visibility of Human Resource department spending, and potential for increased job satisfaction for Human Resources staff. As a result, the senior project successfully completed the objective of developing a proof of concept Human Resource recruitment plug-in for Enterprise Resource Planning system.
Bibliography:


Appendix A – Plug-In Showcase

Figure 13 - Details Page for a Position Screenshot

Figure 14 - Create Page for a Position Screenshot
Figure 16 - Applicant Details Page Screenshot

Figure 18 - Reimbursement Details Screenshot
Figure 20 - Cost Center Details Page Screenshot
## Appendix B – Economic Justifications

### Employee Conversion Savings

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of 10,000+ employee companies in the United States</td>
<td>1,000 companies</td>
<td>Source: <a href="http://www.census.gov/econ/smallbus.html">http://www.census.gov/econ/smallbus.html</a></td>
</tr>
<tr>
<td>Number of employees employed by 10,000+ employee companies in the United States</td>
<td>33,000,000 employees</td>
<td>Source: <a href="http://www.census.gov/econ/smallbus.html">http://www.census.gov/econ/smallbus.html</a></td>
</tr>
<tr>
<td>Average employees per company</td>
<td>33,000 / Average company of 10,000+ employees</td>
<td>Calculation: 33,000,000 / 1000 = 33,000 employees per average large company of 10,000+ employees.</td>
</tr>
<tr>
<td>Percent of new hires every year of the total company size</td>
<td>10%</td>
<td>Source: <a href="http://www.bls.gov/news.release/jolts.nr0.htm">http://www.bls.gov/news.release/jolts.nr0.htm</a></td>
</tr>
<tr>
<td>Percentage of the employees hired from outside</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>Number of the employees hired from the outside by a large company of 10,000+ employees</td>
<td>1,650 employees</td>
<td>Calculated</td>
</tr>
<tr>
<td>Number of hours to enter a new applicant’s information</td>
<td>2 hours</td>
<td>Estimated</td>
</tr>
<tr>
<td>Salary (prorated hourly) for HR staff member</td>
<td>$40 / hour</td>
<td>Estimated</td>
</tr>
</tbody>
</table>

Table 2 - Assumption for New Hires Savings
## Reimbursement Savings

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of 10,000+ employee companies in the United States</td>
<td>1,000 companies</td>
<td>Source: <a href="http://www.census.gov/econ/smallbus.html">http://www.census.gov/econ/smallbus.html</a></td>
</tr>
<tr>
<td>Number of employees employed by 10,000+ employee companies in the United States</td>
<td>33,000,000 employees</td>
<td>Source: <a href="http://www.census.gov/econ/smallbus.html">http://www.census.gov/econ/smallbus.html</a></td>
</tr>
<tr>
<td>Average employees per company</td>
<td>33,000 / Average company of 10,000+ employees</td>
<td>Calculation: 33,000,000 / 1000 = 33,000 employees per average large company of 10,000+ employees.</td>
</tr>
<tr>
<td>Percent of new hires every year of the total company size</td>
<td>10%</td>
<td>Source: <a href="http://www.bls.gov/news.release/jolts.nr0.htm">http://www.bls.gov/news.release/jolts.nr0.htm</a></td>
</tr>
<tr>
<td>Percentage of the employees hired from outside</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>Number of the employees hired from the outside by a large company of 10,000+ employees</td>
<td>1,650 employees</td>
<td>Calculated</td>
</tr>
<tr>
<td>Percent of employees that receive a job</td>
<td>5.2%</td>
<td>Source: <a href="http://www.bls.gov/news.release/jolts.nr0.htm">http://www.bls.gov/news.release/jolts.nr0.htm</a></td>
</tr>
<tr>
<td>Total external applicants received</td>
<td>31,730 applicants</td>
<td>Calculation: 1,650 * (100% + 5.2%) = 31,730 applicants</td>
</tr>
<tr>
<td>Percent applicants interviewed out of total number of applicants</td>
<td>50%</td>
<td>Estimated</td>
</tr>
<tr>
<td>Total external applicants interviewed</td>
<td>15,865 applicants</td>
<td>Calculation: 31,730 * 50% = 15,865 applicants</td>
</tr>
<tr>
<td>Percent out of town applicants</td>
<td>30%</td>
<td>Estimated</td>
</tr>
<tr>
<td>Total number of external out of town applicants interviewed</td>
<td>4,759 applicants</td>
<td>Calculation: 15,865 * 30% = 4759 applicants</td>
</tr>
<tr>
<td>Number of minutes to complete a reimbursement</td>
<td>3 minutes</td>
<td>Estimated</td>
</tr>
<tr>
<td>Salary (prorated hourly) for HR staff member</td>
<td>$40 / hour</td>
<td>Estimated</td>
</tr>
</tbody>
</table>

Table 4 - Assumptions for Reimbursements Savings