# The Sourcerer: An Expert Human Resource Agent

Daniel Loewus-Deitch[1] and Brandon Herdrick[2]

[1]University of California, Irvine, School of Information and Computer Science
444 Computer Science Bldg., Irvine, California 92697 USA
Email: dloewusd@ics.uci.edu

[2]University of California, Irvine, School of Information and Computer Science
444 Computer Science Bldg., Irvine, California 92697 USA
Email: bherdric@ics.uci.edu

## Abstract

Human resource activities have always been a time-consuming and costly endeavor for project and administrative managers. One frequent type of hire, related to individual projects, is a specialized outside contractor. This is a consequence of today's project-based work environment trends. Hiring managers have traditionally relied on two sources when beginning a search for outsourced expert help: explicit information such as resumes and word-of-mouth. In this paper, we offer a theoretical alternative for getting more detailed, relevant, and complete information about outsourcing candidates. Our proposed technological solution leverages some of the experimental methods in knowledge-based UI research and is based on research that has been conducted with *expert finder* systems.

## Keywords

Human resources, HR, expert finder, knowledge-based, hiring, CSCW, profiling, skill-assessment, job matching

## Table of Contents

# 1 Introduction

Human resource activities have always been a time-consuming and costly endeavor for project and administrative managers. Recruitment and hiring processes often involve a significant amount of cold-searches, resume scanning, and interviews in order to find and evaluate viable candidates. One frequent type of hire, related to individual projects, is an outside contractor. Many times, a specialized person is temporarily needed to help fill a particular role in a project. These independent contractors are common in a large majority of fields, including software development, consulting, and construction.

## *1.1 Outsourcing HR Responsibilities*

A number of corporations choose to outsource these temporary contract recruitment responsibilities to headhunting agencies, as the departments themselves don't generally have the internal resources to continuously devote to these hiring tasks every time a new project is created. In general, the benefits of outsourcing HR can include lower cost, more efficient allocation of person hours, access to specialized expertise, less busy work for internal HR, and increased objectivity. While we agree that outsourcing some HR functions, such as payroll and employee benefits, is a good idea, we believe that there are many advantages to keeping the majority of the recruitment and hiring process in-house. Internally building an HR database and expert finder system can help with this challenge and ultimately provide significant value to the organization. In this paper, we will illustrate how many of the same benefits attained through outsourcing can also be gained by using our hypothetical system, the Sourcerer.

## *1.2 Utilizing the Project-Driven Business Model*

Today's corporate work environment is primarily project-based. Project management is no longer considered a trend or a luxury. It has become a basic necessity. Fortunately, these now standard practices provide a dense trail of information that can potentially be invaluable when outsourcing for new projects.

Often times, a newly initiated project is quite similar to other projects that have been successfully completed in the past. At the very least, there may be various lower-level tasks that are common across these multiple projects. Large projects tend to include many people and span across multiple departments. They involve both internal employees as well as outsourced contractors, who are hired on a per-project basis. Given this project-driven model of business activity, one can understand how important it is to track these projects closely, and continuously collect information on the resources that were used to successfully fulfill the project's objectives. Quality human resources are particularly critical to track, especially when they are not actual employees of the company. Matching the most appropriate expert contractors to dedicated project roles can be a considerable challenge, although it is vitally important to the success of any project. We recognize that an intelligent organization learns from its past ventures. It utilizes its specialized resources efficiently and is able to locate these resources promptly when a new need arises.

## *1.3 New Sources and Techniques for Profiling Candidates*

Hiring managers have traditionally relied on two sources when beginning a search for outsourced expert help: explicit information such as resumes and word-of-mouth. Unfortunately, this type of information is often biased, incomplete, irrelevant, and generally difficult for managers to effectively process. Additionally, many hiring

managers are not necessarily strong interviewers and therefore may not be very good at extracting the right information from the potential candidates, in order to make an informed decision. It is clear that new techniques are needed to efficiently obtain the kind of information that is needed to hire the right people for these temporary dedicated positions. In this paper, we describe our system's architecture, proposing some potential ideas for getting more detailed, relevant, and complete information about outsourcing candidates. We also suggest that some of the experimental methods used in knowledge-based UI research could be effectively integrated into this HR system. Our ultimate objective in this thought experiment is to conceive a tool that is devoted to helping employers more accurately match short-term job needs with people who have the right knowledge, experiences, and skills to successfully complete the specific tasks assigned to them.

## 2 Related Research

There are a few expert finder systems already in existence. Some of which have had moderate success, but all have essential components lacking to make them practical and scalable systems. They can be classified into two types of systems: information need and expertise need [2]. *Information need* is when someone seeks an expert for use as a source of information and *expertise need* is when someone seeks an expert as someone who can perform a given organizational or social function.

The majority of experimental or working systems are information need. Examples of such systems are: *HelpNet, Expert/Expert-Locator (EEL), ContactFinder, Experts-Exchange, ReferralWeb, Answer Garden, Agentware Knowledge Server,* and more.

The second type, expertise need, is less explored and is the central concern of our system. *ExpertFinder* was developed by Vivacqua and Lieberman [1] and helps Java developers contact fellow employees with greater expertise to help them with their code. This system is simpler than the one purposed in this paper since it is able to gather information from a fixed Java library. *PHelpS* is a highly task-oriented system and tracks users that are doing a step-by-step task and relates it to previous tasks that contained the same steps. Although this system connects the user with a body of work, it does not have the intent of connecting people, as does the system described later in this paper. MITRE's *Expert Finder* is similar to our system in that it tries to answer the question, "Who knows what in your company?" [3] Though the goals of MITRE's *Expert Finder* relate to our system, the Sourcerer (3.0) is a much more complex search and presentation of in-house and contracted employees. *Yenta* is a matchmaking agent that creates personal profiles of people's interests to connect them with people who share the same interests. Finally, what appeared to be the most commercially successful expert finder was from SAP [5]. They sell a piece of software that is essentially a form for entering personal information that will be stored on a database. There is an important distinction between the technique SAP uses and the one that will be described in this paper.

SAP uses entirely explicit information provided by the user. The major goal in the idea of the Sourcerer was to attempt to extract as much implicit information as possible. There are a number of advantages to using implicit rather than explicit methods. In general, people do not like to fill long forms and therefore are less inclined to do so. In addition to the amount of time involved, there is a noted lack of immediate reward. As section 3.1.1 describes, the user is only first aware of the

system when there is already a prototype profile created (in most cases). The user is immediately able to see the benefit in having a detailed profile and what a completed one might look like. Another advantage of automating the profile creation is the reduction of inaccuracies due to people's own opinions of themselves. The system could very well generate inaccuracies also, but the user is able to view and alter their profile. Perhaps the biggest challenge of explicit data is to keep it current. People's interests and skills are extremely dynamic and are constantly in need of updating. If this information is required to be inserted manually, it will rarely occur.

# 3 The Sourcerer: An Expert HR Agent System

The Sourcerer is an intelligent, web-based human resource system to be implemented centrally into a large corporation such as Intel or IBM. It uses multiple techniques and sources to gather detailed, job-relevant information about the knowledge, experience, and skills of outsourcing candidates who have had past or current relationships with a company or its networked partners. Please note that we define *outsourcing candidates* as any independent contractor or internal employee that is being sought after for a temporary role in a specific project. The system also tracks the details of all projects, past and present, including the descriptions and specific tasks of all essential human roles.

Employers can query the Sourcerer system by inputting details of a planned project, as well as various key words relating to the specific job roles and hiring needs of the employer. The system responds with a ranked list of relevant candidates that have been expertly matched, based on the profiles of the candidates, the job requirements, and the general project details.

When one of the list items is selected, the Sourcerer generates a customized report about that particular candidate, emphasizing the most relevant information about that individual, as it relates to the particular vacant job position that the employer needs to fill. This report explains why the candidate is a good fit for the position and provides any available portfolio items or work experiences that might be of interest to the employer in charge of this position. It also can present a summarized subjective evaluation of the candidate based on the opinions of past team members (peers), supervisors, and subordinates.

Depending on the amount of information in the profile, the report may be very detailed or it may be considerably superficial. If the profile is particularly sparse, the system will statistically predict whether this candidate is worth contacting in order to obtain more specific details about him or her. Such predictions are based on resume elements and any information in the profile describing the candidate's past relationship with the company, as this is the minimal information that must be available in any candidate profile.

## *3.1 HR Profiling*

The Sourcerer maintains a comprehensive HR database that holds an extensive record of each outsourcing candidate. The fields of a record gradually become populated as more information is gathered about the candidate, over time.

By connecting to the company's directory services, all current employees, permanent and contracted, are automatically registered in the system. Each one is also

automatically sent an initiation email that explains the system and its benefits. Past employees can be added manually. We will describe more of the initiation process in the following section (3.1.1).

The system is designed to be administrated within the company's internal HR department. It is here that all permissions are set, based on specific, pre-defined user groups. These groups include *HR administrators*, *internal hiring managers*, *external hiring managers*, *project managers*, and *basic employees*. Customized groups can of course be added and defined by users with administrative privileges. In addition to the user group that the user belongs to, permissions are also determined by each member's personal preferences. For example, a user might choose to block any subjective evaluation submitted by a particular individual.

Information is gathered about each candidate through 7 sources: (1) the candidate's published resume, (2) the detailed tracking of all company projects, including the tasks involved and the resources used, (3) a dynamic portfolio of past deliverables, (4) the tracking of significant project team relationships and communications that may have enhanced a candidate's own skills and knowledge, and (5) subjective evaluations submitted by former/current supervisors and other project team members that the candidate closely worked with, (6) previous publications (if any), and (7) documents that contain links between the candidate and particular topics and people (such as in a corporate newsletter).

### 3.1.1 The Resume

Most employees and previous contractors will already have a resume in the company database. Although potentially out-dated, this is used as the initial piece of information in the profile building. A reader module walks through the resume text, pulling out key information to populate the basic fields of the HR database record. We see an opportunity here to use some AI techniques to help users avoid spending excessive time manually filling in the information into a form.

Resumes tend to have a very common and standard structure, which makes the organization of their content considerably more predictable than most other natural language-based documents. In general, each section of a resume is clearly labeled (i.e. *Objective*, *Education*). To additionally train the reading module, during the system's development, we might feed it a considerable number of real resume documents (perhaps 100 or more) that has been manually tagged by humans, using XML. The tags will be named according to common resume elements. The module could use the XML tag structure (order, grouping, etc.) in each training document to help generate a categorized resume model with which to match each submitted resume document to. It will record the frequency of various words in between each set of tags (defined categories). When "reading" a resume document, the module could then statistically assign a confidence score to predict which category it is reading, based on the key words it is coming across. An emphasis and/or enlargement of font, along with a blank line, will initially alert the system that a new section is beginning. Moreover, the emphasized/enlarged words will be assumed to be the name of the category or section. Once the system recognizes a category, it will use the resume model to help it determine which words are most important to extract in this section and what section of the candidate's profile to add these keywords to (i.e. *Education*, *Computer Skills*).

After an attempt at creating a profile is made, an initiation email is sent to all newly registered members. This is to notify the user either of the profile or of the

insufficient information available to generate one. However, the occurrence of insufficient information should be very rare if the employee has worked with the company previously. The generation of their profile before any information is explicitly provided by the user should offer an idea of how the final product will look. In turn, this will offer incentive for the user to enhance their profile throughout by providing explicit information. The benefit of receiving increased work is immediately apparent to the new member.

The member's profile is not considered "active" until they approve of the final product. At this time the user can choose to add a more current resume, add recent work, or hide any sensitive information from the public domain. The hidden information, though not viewable, is still used by the Sourcerer for its user modeling. The user would also have the opportunity to correct any inaccuracies made by the automated profiler at this time. Once the user is sufficiently satisfied with the final profile and submits it, the profile is activated and immediately available for potential employers to access.

### 3.1.2 Project Management Tracking

The heart of the system lies in its use of project management data. This means that in order for the system to function correctly, all company projects must be managed and tracked using project management software, such as Microsoft Project. All project files must be stored on a centralized project server. This is a procedural necessity that the company must uniformly adopt in order to maximize the benefits of the Sourcerer system.

Project management software is primarily designed to define work breakdowns, track resource allocations, and monitor progress. Much of this information can be very valuable and useful for getting detailed information about what a particular candidate has actually experienced and accomplished, as well as who they have worked with in the past. This information can also be helpful for tracking when a candidate might be available to take on a new project contract.

The Sourcerer maintains a project management database that compiles information from all past and present project files, company-wide. This database is updated by the system at the end of every day, as the system analyzes any new or modified project files, looking for information that it needs to change or add to the database. Each project is assigned a record that includes such information as the names of all human participants, the specific tasks involved in the project and who they are assigned to, and the current number of hours per week that each project participant is committed to. This PM database communicates in real-time with the HR database to keep each profile updated with all known work commitments the candidate currently is obligated to, as well as the tasks that the candidate has participated in and successfully completed. The profile is also updated with all project and dedicated job descriptions that the candidate was assigned to. These descriptions must be explicitly added by a project manager whenever a new project is planned, because project management software unfortunately does not tend to require very detailed descriptions to be inputted. We discuss this more in section 3.2.

### 3.1.3 Portfolio (The Deliverable Showcase)

Whenever the system discovers from the project file that a project is finished, it generates an email to all participants, suggesting that each of them submit any tangible deliverables that they completed in the course of the project. The email

provides a link to a web form where the participant can easily add the deliverable to his personal profile. The web form includes a required description field where the participant must explain what the deliverable is. It also includes a list of the tasks assigned to the employee in this particular project. The participant selects one or more tasks to link the deliverable to.

The deliverable might be in any number of forms, depending on the nature of the work, and the level of participation. If it was a graphic design assignment, the deliverable might be a website link or a picture file. If it was a technical writing assignment, the deliverable might be a user manual in a PDF format. The deliverable also could be some sort of multimedia file (audio, video, Flash, etc.).

At any time, a candidate can also submit work examples that are not linked to any project within the organization. The main difference here is that the candidate must provide a short description of the project and his specific role within the project, along with the literal explanation of what the deliverable is. All work example submissions are of course voluntary and their entries are entirely managed by the candidate only.

The Portfolio is the only component that is not analyzed by the Sourcerer system. Portfolio items do not play a part in the processing or ranking of candidate match recommendations. Instead, these items are used simply for enhancing the detailed presentation of relevant job candidates, which is tailored to the query and planned project details inputted by the employer. Based on the project and the specific tasks that the portfolio items are linked to, the system determines which ones are relevant and therefore should be emphasized in the presentation. More about this tailored candidate report generation is described in section 3.3.3.

### 3.1.4 Collaborative Mentoring (Project-Related Associations)

In any organization that involves team-based work projects, knowledge and skills are naturally transferred between team members. The people that a candidate has closely worked with and the knowledge and skills these team members bring to the table can be an important factor when considering a candidate's experience. For example, if a graphic designer or software developer collaborates frequently with a usability engineer, within the context of a project, he likely will absorb some basic knowledge from the usability expert that he may even be able to apply in his own future work. The usability expert may have even spent some time explicitly training the candidate in order to make his own job easier. At the very least, the experience of working with a professional with a usability background and perspective will make it easier for him to communicate with a similar professional in the future.

Because of the value of these associations, we feel that this is an important source of information for enhancing candidate profiles and getting a complete picture of their true, applied experience. Our system can track and quantify these associations in three ways: (1) through the project management database, (2) through email tracking, and finally (3) through meeting schedule tracking.

The project management database contains a recording of all participants involved in every project throughout the organization, as well as their specific roles. Therefore, it can be easily determined how many instances that a candidate worked with another particular individual, both within a single project and across multiple projects. The degree of association can also be approximated from the information in this database. If two people simply worked on the same project, but on entirely

different tasks, they probably only interacted a few times, in the context of general team meetings. On the other hand, if they were both assigned to the same tasks or closely related tasks, then they probably interacted one-on-one, on a very frequent and more in-depth basis. These interactions can be weighted accordingly based on number of instances and degree of proximity.

Using a simple email tracking system, the Sourcerer can query the company's mail server logs to determine the frequency of emails sent between two parties, as well as the length of time that one of more of these clustered frequencies occur. For example, while working on the same task together, two project participants may send 50 emails back and forth between each other within a two week period. This two-week cluster of emails strongly suggests that the two parties spent a considerable amount of time interacting and communicating as they worked together during this period. These regular exchanges are potentially rich learning opportunities that allow the team members to learn from each other and absorb each other's relevant knowledge, as well as discover new skills.

All large corporations have a meeting management and calendaring system in place. Sometimes, Outlook Exchange serves this purpose. In other cases, more sophisticated systems are implemented. Regardless, all these systems allow users to propose meetings with other employees in the directory system, which the proposal recipients must then confirm. The Sourcerer can track these confirmed appointments, looking at the frequency of meetings in which two parties both attended.

The type of skills and knowledge that were likely shared between two project participants can be predicted by each participant's profile, as well as their job requirements for the particular projects that they collaborated on. The roles that each of the participants played and their relevant background knowledge, are indicative of the kind of information that was shared between the two parties during their working partnership.

Combining the evidence from these sources, the system can effectively predict when and how often two people have collaborated together, what kinds of tasks they collaborated on, the specific knowledge and skills they may have shared, and the frequency of communications that occurred. Obviously, a candidate cannot be considered to have a particular skill, simply because he collaborated with someone who was trained and experienced with this skill, but it is still very useful to know that a candidate is *familiar* with a certain domain and can communicate and work effectively with experts who work in that domain. It is also helpful to know what people have worked together successfully in the past, so that these people can be matched up again in future projects.

### 3.1.5 Subjective Evaluations

Contacting references is another time-consuming task that is inherent in the hiring process. This can be a nuisance for both parties and often provides only superficial information about the candidate. We do feel that a subjective component is a useful and somewhat necessary piece of any candidate's profile though. Therefore, we have included this input in our system.

Our Subjective Evaluation component is based on other current evaluator systems currently out on the market. There are a number of commercial products that exist, including the Halogen e360. We base the privacy features, methodology, and

content of the questions on established principles recommended by industrial organizational psychologists and human resource experts.

When the system detects the completion of a project, it automatically emails each participant's direct supervisor, a random team member (peer) who worked closely with the subject (the pool of potential team member evaluators is determined in a similar fashion as the Collaborative Mentors, described in section 3.1.4), and a random subordinate, related to the project (if the subject supervised anyone). Each of these individuals is asked to complete a web-based evaluation form. The questions are tailored to the type of relationship the evaluator has with the subject: superior, peer, or subordinate. Administrators can also modify questionnaires to make them more relevant to particular groups of candidates (i.e. their field of work). The questions are centered around 5 different categories: quality of work, quantity of work, work habits, communicative skills, and team participation.

The peer and subordinate evaluations are anonymous and none of the answers for any of the 3 evaluations can be viewed by the subject. This anonymity and hidden results will hopefully lead to more objective evaluations with less socially-influenced bias. Although the subject cannot see the results or know the identity of the evaluator (except for his supervisor); he does always have the option of blocking one or more of the evaluator categories within a particular project. This can help protect the subject, if he feels his relationship with his team members or supervisor was unrepresentatively poor or that he was singled out unfairly for certain shortcomings in the project.

When a tailored candidate report is generated, all quantitative evaluation questions are compiled and averaged. Each of the 3 evaluation categories is analyzed and presented separately. Evaluations are presented in a section of the candidate report, titled *"How others feel about working with this candidate."* This section is then divided into the 3 evaluation categories: *superiors*, *peer collaborators*, and *subordinates*. The averaged quantitative results are presented with graphs, while the qualitative answers are presented in their original form. These results can also be filtered to only show evaluations from related job positions.

### 3.1.6 Previous Publications

Today, it is very common for many employees in large technical companies to have a minimum of a master's degree. Therefore, a thesis or dissertation is frequently available as further data from which to extrapolate the employee's knowledge. Employees involved in research also often continue to publish works concerning their field. These publications can be searched to record specific keywords associated with areas of knowledge. They can also be used to form chains of association with coauthors and weaker chains with authors cited.

However, information gathered from publications can be susceptible to what Vivacqua and Lieberman call "decaying expertise" [1]. As with all of the information gathered for the profiles, the system should weigh the data according to recency. If someone has published a work years ago and never revisited the topic, there is a good chance they have forgotten much of it (or it has become obsolete).

### 3.1.7 Newsletters and Related Documents

Company newsletters or press releases can highlight people's involvement in certain projects. A final consideration would be to monitor the names and project details of

these items to gather extra implicit information about members. The closer together the names and projects are with each other in the text, the higher confidence the system would have in their association.

Personal web pages could also be used to mine data about a member. The information might be similar to their resume, but anything novel could further be used to expand their skills and therefore their profile.

### 3.1.8 Central Profile Synthesizer

The Central Profile Synthesizer module takes the input from all of the above sources and compiles it into a single, summarized profile. The Portfolio items and Subjective Evaluations don't require any additional processing. They are simply added into the central profile. The Collaborative Mentoring information is represented as knowledge and skill "familiarity." Along with the newsletter correlations, this collaborative information is also used to match candidates with team members who they have worked effectively with in the past. Common elements in the Explicit Resume, Project Management information, and Previous Publications are compared and combined. In our system, contradictory evidence is not an issue, because each input component delivers different bodies of information. This makes synthesizing the central profile a relatively easy task.

## *3.2 Job Position Profiling*

In addition to the HR database, a project management (PM) database is kept. This database compiles and stores all of the project files (representing all projects, past and present, at the company). The PM database keeps tracks of all project detail information that the project managers maintain with software like Microsoft Project. This central database is updated with modified or new projects once a day. The purpose of the PM is to eliminate the inefficiency of repeatedly mining through hundreds of separate proprietary project files to fill in each record in the HR database. The PM database simply mines through these project files once, stores them in a database, and then maps the fields in the PM database to the fields in the HR database. By doing this, it also links PM database records to HR database records (i.e. participants to projects they worked on) so that both the human profile and the project profile are simultaneously updated.

The PM database directly provides the HR database records with specific information about past projects and tasks, as well as current availability. More concisely, the PM database is used exclusively to build and maintain the HR database.

## *3.3 Query and Results*

Contractors are most often hired in response to a project resource need. They usually work with the company for the duration of the project and then move on to a new project at the same company or somewhere else. When such a need arises, a hiring manager must quickly find a person who can effectively perform the tasks required so that the project can progress successfully and on time.

Using the Sourcerer, a hiring manager can input the details of the project, the details of the specific position, common tasks associated with the position, and any other keywords that come to mind in relation to the job requirements. The system searches for occurrences of terms in these query inputs in the HR database. If a significant number of matching terms are discovered in a particular candidate profile record, that candidate is returned as a potential match. These profile records also

include former project and job descriptions from past projects that were originally extracted from the project management database. If the query descriptions are significantly similar, that candidate will likely be selected as a strong match.

The results are initially filtered, based on relevance. The more query term matches that are found in the candidate's profile, the more likely he is to make it on the match list. The candidate list is then ranked and ordered, based primarily on relevance, but also, to a lesser extent, on associated skill familiarities (Collaborative Mentoring influence), past working relationships with those already selected for the planned project, and high quantitative scores on the subjective evaluations. If the inquiring employer clicks on one of the candidates in the results list, the system generates a tailored report, emphasizing the relevant qualifications and characteristics of the individual.

### 3.3.1 Helping the Employer Refine a Search

When an employer makes a query, he might not know what keywords to include in order to achieve enough relevance and accuracy in his results. To aid the employer, we have implemented a query expansion feature to help the employer refine his search and generate closer match results. To do this, we are borrowing a technique that was also used in the development of the Broadcast News Navigator system [6], which allowed people to type in query items to search for broadcast news stories that they were specifically interested in. The technique is called Local Context Analysis (LCA). It basically involves mining the highest ranked or most relevant *passages* for additional *concepts* that might be used as additional query terms.

The developers of the Broadcast News Navigator defined *passages* as discrete news stories. We define *passages* as candidate profile records. We define *concepts* as any term having to do with common tasks or skills, since this is what we are attempting to match. This relation is determined by searching for each word in a general list of skill and task terms collected from job postings in many different fields of work.

The additional query terms that are discovered through this LCA process are then suggested to the employer, along with the first batch of results, based on the original, unrefined search. The employer can select one or more of these suggested terms and click **Refine Search** to generate a new set of results with potentially closer matches. This refinement process can be repeated any number of times.

### 3.3.2 Relevance Feedback

The employer can also use relevance feedback to refine and improve the accuracy and quality of the candidate matches. After reviewing some of the candidates' profiles that are in the match list, the employer can simply check a box next to the result item called, *"Find more candidates like this."* The user then clicks **Refine Search** and the system will attempt to directly match terms in these marked candidate profiles to terms in other candidate records in the HR database. A new results list is presented, consisting only of those candidates who are highly similar to the marked candidates that were selected in the first round of results. As with the expansion term suggestions, this technique can be repeated any number of times. Of course, a combination of the expansion term and relevance feedback methods can also be used to maximize the search refinement abilities of the Sourcerer system.

### 3.3.3 Automatically-Generated Presentation of Relevant Job Candidates

Once a candidate is selected, their portfolio is presented to the potential employer. The portfolio includes details of the candidate's projects, pictures, video clips, or any information in the database deemed relevant to the employer's request. The profile is simply a summary of their skills; the portfolio is the demonstration of those skills.

The portfolio presentation necessarily will be unique to each individual who views it. The amount of information that the system will collect for each user will be completely irrelevant to many of the employers searching for a specific spot within a project. Depending on the skills required for the job, only those which apply will be shown in the presentation. Each user will also have different permission levels on the material they are allowed to view. The security issues of possible classified information can be addressed during the presentation generation. Higher level employers in the company will have less restricted access and be shown greater detail of the candidate's projects during the presentation. Lower level or contracted project managers might not be given permission to view sensitive company information and therefore would only be shown superficial aspects of the candidate's previous work.

## 4 Concerns/Future Work

The most glaring concern is that the system has never seen tested. The scope of the project did not allow enough time or resources to attempt a prototype. A prototype would help determine if there is too much information to handle. There are seven types of information to be accounted for at the same time. Another concern is the accuracy of the matches. Without actual experimentation there is no way to tell if the requested skills and qualifications of a project member will be met in the candidate that the system predicts as a match. Therefore, the accuracy of the profiles is still an important issue.

An interesting point that Vivacqua [1] introduced was to make the expert finder more proactive. This could be useful in the Sourcerer also. While updating the PM database from the project manager's project files, the system could recommend areas where it appeared outside assistance might be beneficial. The Sourcerer could introduce certain profiles of people that it believed would help the project.

Another area of consideration could be to improve the incentives for maintaining one's profile. While largely automatic, a user would want to consistently monitor the status of their profile to assist in its accuracy. There should also be incentives to complete the subjective evaluations. The most active users could possibly be listed at the top of the list when all other factors were equal. Arguably, the most active user would also be the one most eager to find additional work, and therefore more qualified for the position.

A final criterion to possibly consider would be level of expertise when matching for a position of similar expertise. To give an example, a highly trained person in Java programming would not want to be placed on a team where his skills surpass the requirements. The matching of skill level would have to be at, or just above, the necessary skill level for the position. An overqualified person would not necessarily be a good match for the team, both in terms of cost and employee motivation.

## 5 Conclusion

The main goal of this paper was to create a completely automated system that could rely on almost exclusively implicit information to help project managers locate the right person for the job. The only information needed to be explicitly entered is optional. For example, the subjective evaluations, while helpful, do not need to be completed for the system to work. The Sourcerer should take care of itself other than some minor monitoring and user adjustments.

Other than its implicit information gathering, the Sourcerer is unique in that it points project managers to skilled individuals who have proven that they can successfully complete a job. It provides a comprehensive profile of the candidate, from many different angles, rather than just information given explicitly by the individual. It also creates tailored presentations in real-time to give the project manager an enhanced and appropriate view of the candidate's work. The Sourcerer helps the employee maintain accurate information and it helps the employer make accurate, relevant queries about these employees, while not overwhelming the employer with extraneous information that he does not need.

## 6 References

[1] Vivacqua, A. and Lieberman, H. Agents to Assist in Finding Help. Proceedings of the SIGCHI conference on Human factors in computing systems, 2000, 65-72

[2] Yimam-Seid, D. and Kobsa, A. Expert Finding Systems for Organizations: Problem and Domain Analysis and the DEMOIR Approach. Journal of Organizational Computing and Electronic Commerce 13(1), 2003, 1-24

[3] Mattox, D. Expert Finder. MITRE Publications, *The Edge*, June 1998, 1-2

[4] Maybury, M., D'Amore, R., House, D. Expert Finding for Collaborative Virtual Environments. Communications of the ACM 44(12), 2001, 55-56

[5] SAP® ExpertFinder. White Paper: http://www.sap.com/andeancarib/soluciones/hr/documentos/SAP%20Expert.pdf

[6] Maybury, M., Greiff, W., Boykin, S., Ponte, J., McHenry, C., Ferro, L. Personalcasting: Tailored Broadcast News. MITRE Publications.