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Hiring Process for Software Developers that Identifies both Cultural and Technical Fit

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Hiring Process for Software Developers that Identifies both
Cultural and Technical Fit

By

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Abstract

This study analyzed existing research on personnel assessment and selection methods used to predict future job performance for its applicability to hiring software developers. This study then looked at the applicability of integrating web-based testing into the selection process as well as considering the effect that corporate culture has in determining if a job candidate was "qualified", that is, having the aptitude and the attitude for a position as a Software Developer.

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Chapter I

Introduction

A recent search on the Borders' web-site, Borders (n.d.), showed a list of 3362 titles for books related to the Java programming language. These books cover not only the Java programming language but all the ancillary technologies written in Java. A search for "Computer Languages" results in over 49,000 titles (Figure 1). The number of technologies available is growing rapidly as is their adoption into corporate software. Objectively assessing a job candidate's skill level in multiple technologies is increasingly difficult. An interview alone is not sufficient for determining technical fit.

While most Human Resource (HR) departments are skilled in recruiting, they often do not possess the technical knowledge required to determine if the candidate has the technical skills needed to satisfy the requirements of the available position. This lack of knowledge places the burden of skill determination to the Information Technology (IT) department. The IT department will have multiple people interview the candidate for 30-45 minutes each. Since these are typically unstructured interviews, meaning the interviewer will ask random questions based on the

candidate's resume, this process can take up to three hours whether the candidate is made a job offer or not.

The screenshot shows a Mozilla Firefox browser window displaying Amazon.com search results for 'COMPUTER LANGUAGES'. The browser's address bar shows the URL: <http://www.amazon.com/exec/obidos/search-handle-form/ref=>. The Amazon.com logo is visible, along with navigation links for 'VIEW CART', 'WISH LIST', 'YOUR ACCOUNT', and 'HELP'. The search results are for 'COMPUTER LANGUAGES' with 49,419 results. The first result is 'Ajax in Action' by Dave Crane, et al. (Paperback), published October 1, 2005, with an average customer rating of four stars. The list price is \$44.95, and the current price is \$28.32. The second result is 'Head First Design Patterns'. The page also features a 'Listmania!' section with a 'My Favorite Java Certification...' list by Vipin.

Figure 1.

Unstructured interviews, interviews without predetermined questions sets and scoring, performed by three different people will often yield three different opinions about the applicability of a candidate to the position. The unstructured interview can help to determine if the person performed the job

in the past but it can not determine how well the person performed the job. This process provides a hiring manager with very little quantitative data to determine whether a candidate should be hired or not.

Research Question

Is it possible to develop an efficient hiring process that determines if a Software Developer is a technical, behavioral, and cultural fit for an organization? This study will analyze existing research on hiring processes and apply this research to the specific task of hiring software developers. The study will also review commercial on-line testing facilities for their applicability to the hiring process and provide recommendations for which testing facility to use.

Subsidiary Questions

In order to develop a complete hiring process for software developers it will be necessary to consider the following questions:

1. How to identify the culture of your organization?
2. How to develop a structured interview?
3. What features must an on-line test provide to simulate actual work experience?

Answering these questions is important for developing a complete end-to-end hiring process. The answer to these questions will drive the content and the effectiveness of the entire hiring process.

Need for this Study

This study is written for Human Resource and IT managers who find it difficult and time consuming to assess the attitude and aptitude of a candidate software developer. It is also for organizations whose hiring process takes as long to identify a candidate to hire as it does to identify a candidate who it will not hire. The technical knowledge required to thoroughly evaluate a candidate does not exist in most Human Resource departments and IT departments are assuming more of the responsibility for hiring candidates. A process is needed that can make Human Resource departments more effective and can reduce the hiring responsibilities of IT. A well developed assessment and selection process can produce better employees who are less likely to leave the company.

Objectives

The objective of this study is to develop an efficient hiring process for Software Developers. The hiring process will consist of two main assessment methods. The first method will focus on determining behavioral and cultural fit. The second method will consist of determining technical ability. This study will review existing assessment methods and choose the best assessment method for determining behavioral and cultural fit. This study will then provide an outline for adapting that assessment method to software developers.

Commercial on-line skills assessment tests will be reviewed for their applicability as an assessment method for technical fit. The study will identify the type of on-line tests that are most effective and will provide a recommendation for a commercial on-line skills assessment test.

Limitations

This study will be limited to Java Programmers with one or more years of professional Java development experience. Programmers with under a year of actual experience will require training in the job itself which is outside the scope of this study. The goal of this process is to identify experienced Java programmers and to be able to rate them. The process itself

should be applicable to software developers of other languages as well as technical disciplines outside of software development.

Definition of Terms

Java - Wikipedia (2006), a technology developed by Sun Microsystems for machine-independent software.

On-Line Assessment Test - A computer-based test available over the Internet.

Coding - The process of writing Java code.

Chapter II

Review of Literature

Most jobs, with the exception of a paper route or a family business, require that candidates go through a selection process before being awarded the position. The goal of the selection process is to determine if the candidate is the right person for the job. This goal is easier to state than it is to achieve.

The most common method for selecting a candidate is the interview. The interview process consists of an interviewer who asks questions of a candidate. The goal is that these questions will elicit answers which the interviewer can use to determine if the candidate is qualified for the job. Most interviews are unstructured. In an unstructured interview the interviewer typically decides what questions to ask. It is also up to that interviewer to decide how well the candidate performed during the interview. A candidate will be interviewed by several interviewers and the interviewers will compare their notes. Without agreed upon standards for assessing the candidate, it is difficult to formulate an objective assessment of the candidate. The interviewers will actually compare their opinions of the candidate to form the basis of the hiring decision for that candidate. McDaniel, Whetzel, Schmidt, & Mauer (1994) show that

an unstructured interview is 26% less effective than a structured interview. In all reality it is even less effective as many interviewers are not trained in good interviewing techniques. Untrained interviewers may ask different questions to different candidates decreasing the ability to objectively measure all the candidates.

One of the attributes most looked at when hiring a person is their level of education. Hunter and Hunter (1984) show that college grade point averages and degree level are not good indicators of programming ability. This fact is reiterated by Schmidt & Hunter (1998) where they determined the validity of education as zero in predicting future job performance. Education level is a better predictor of a person's ability to learn and the job level that they may attain. It is not uncommon for a person with a Masters in Computer Science with no job experience to make the same programming mistakes as a person with a Bachelor in Computer Science and no experience.

According to Schmidt & Hunter (1998), the two most effective personnel assessment methods to predict future job performance are work sample tests and structured employment interviews. Structured interviews are 26% more effective than unstructured interviews and work ability tests are 12% more effective than job knowledge tests. Pulakos (2005) supports

these findings and adds that these two assessment methods have low adverse impact and favorable applicant reaction.

Adverse impact is when an assessment method selects disproportionately more candidates who are not protected than protected. Pulakos (2005) sites the following examples of protected groups: African Americans; Hispanics; females; and individuals over 40. Assessment methods that show high adverse impact can cause legal issues for an organization. Assessment methods which demonstrate low adverse impact are fairer in their determination of qualified candidates.

Applicant reaction considers whether the applicant reacts positively or negatively to the assessment process. According to Pulakos (2005), assessments that are viewed more favorably are those that candidates perceive as being more relevant to the job. According to Smither, Reilly, Millsap, Pearlman, & Stoffey (1993), candidates who feel positively about the selection process used by an organization report higher levels of satisfaction with that organization and are more likely to recommend the organization to others. There is no correlation between applicant reaction and the validity or adverse impact of the assessment method. Applicant reaction is based on the type and content of the assessment method.

While structured interviews and work ability tests have the highest validity, Campion, Campion, & Hudson (1994) determined the validity of a structured interview can be increased by designing the structured interview so that it does not duplicate but rather compliment any skills based tests. This means that structured interviews should not test for any skills that are already being tested during the work ability test. In developing a structured interview that can be combined with the work ability test it will be necessary to focus the interview questions on the behavioral traits that a candidate must possess to be considered for the position. In addition to the behavioral traits, Schein (1988) suggests that a candidate be selected on his ability to fit in with the company culture. A person who is a cultural fit is more productive and will be more satisfied with their job and less likely to leave the organization. The structured interview can be developed to determine if a candidate possesses both the cultural and behavioral traits necessary for the position. If the goal of structured interviews and work ability tests is to predict future job performance and organization culture can affect a person's performance, then it is important that the structured interview try to determine cultural fit within an organization.

Assessing Corporate Culture

In order to assess the cultural fit of a candidate, it is first necessary to identify the cultural fit of the organization. Schein (1999), defines culture as the shared tacit assumptions of a group that it has learned in coping with external tasks and dealing with internal relationships. Basically, it is "the way things are done around here". Christensen (2004, pg 6) states, "If the new member does not learn or understand the cultural assumptions of the organization, then the member is likely to feel alienated and uncomfortable, and will be unproductive."

Documenting the environment and culture of an organization provides a basis for developing questions that can help match potential employees with positions within the organization. It is important to make sure that the actual culture is understood and not the culture the organization would like to have. According to Fyock & Brannick (2002), a company's slogan or mission statement better represents what they want to be rather than who they actually are. Members of the organization will need to be interviewed to truly understand the corporate culture. The members interviewed need to represent all levels in the organization. The data gathered from the interviews can be

reviewed to reveal common themes. These common themes are the cultural behaviors of the organization.

Assessing the corporate culture can be a daunting task. It is often easiest to start with one aspect of corporate culture and build from there. Both Schein (1988) and Fyock & Brannick (2002) identify an organization's reward and punishment system as a key determinant of the organization's culture. Fyock & Brannick (2002) suggest that examining what behaviors get rewarded and punished in an organization is often a great way to determine what the organization values.

Asking the following questions can help to identify the culture of an organization:

1. What are the working hours? Are they well defined or flexible? How many hours a week are expected?
2. How structured is the organization? Are job descriptions well-defined or loosely defined? Fyock and Brannick (2002).
3. What comes first? People or the Task? Fyock and Brannick (2002).
4. What determines success? Speed-to-Market, On-time, High-quality, or On-Budget?

It is important to understand the working hours, both published and unpublished. Many companies, especially start-ups, have expectations that an employee will do what it takes to succeed. This often means sacrificing personal time for the company. Identifying this and setting this expectation during the interview is important in the future success of the candidate.

Organization and job structure questions help determine if the job requires a person who can take control and define their own position or if they like to know exactly what their position is. This is also useful in determining the amount of change that a person is comfortable in dealing with.

People orientation and task orientation help to identify what is valued more. Is it person over task, task over person, or is there equal value placed on the task and the person? People oriented organizations believe that their employees are their greatest asset and that the employees drive the productivity and performance of the organization. Task oriented organizations value quality and efficiency. They believe that quality and efficiency drive the productivity and performance of an organization.

Determining success helps to determine how a person is going to get rewarded or punished. A company that values being

first-to-market will likely disapprove of a person who studies all aspects of a problem before starting on a solution. A company that values make delivery dates may forgo testing in order to get a product out. Determining the disposition of the organization will help to identify people with those same dispositions.

In assessing the culture of the organization, it is also important to take into consideration the culture of the individual department within an organization. While the organization's culture may place its highest value on customer service or quality, an individual department may be very laid back in both dress and attitude. If a new member is very proper and prefers wearing suits, they may feel uncomfortable in that work environment. Assessing both the overall organizational culture and the departmental culture will provide a more complete picture of the culture that a new employee will encounter.

Structured Interviews

Structured interviews are interviews where a specific set of questions are asked to each candidate. Campion, Campion, and Hudson (1994) suggest 30 questions in the interview and each question has a defined set of possible answers. The answers are

categorized as excellent, good or marginal and are scored 5 points, 3 points, and 1 point, respectively. This allows the answers to these questions to be scored consistently across all job applicants. These scores can then be used to identify which candidates are better qualified for the job.

All interviewers are required to review the interview questions prior to asking them. It is also recommended that all interviewers meet to go over the predetermined answers so that they are comfortable with how the answers will be scored. Because the candidates will only be asked the questions from the structured interview, the structured interview can be administered as a panel interview. In a panel interview, interviewers take turns asking the questions and all the interviewers score the questions. Administering a panel interview reduces the overall time required to interview a candidate and streamlines the selection process.

Past-oriented and future-oriented questions are the type of questions used during structured interviews. Past-oriented or behavioral questions try to determine what a candidate has done in the past as it relates to the requirements of the job they are seeking. Past-oriented questions are less relevant when interviewing candidates who have little work experience. They may not have had enough work experience to be able to provide

actual examples of what they have done. It may be necessary to design two structured interviews. One targeted at candidates graduates with little or no experience and one for applicants with greater than one year experience.

Future-oriented questions are use to determine the goals or intentions of the candidate and how the job itself will or will not support them. Campion, Campion, & Hudson (1994, p. 999) present the following examples of structured interview questions used to assess conflict resolution and collaborative problem-solving knowledge:

Future Oriented Question

Suppose you had an idea for a change in work procedure to enhance quality, but there was a problem in that some members of your work team were against any type of change. What would you do in this situation?

- (5) Excellent - Explain the change and try to show the benefits. Discuss it openly in a meeting.
- (3) Good - Ask them why they are against change. Try to convince them.
- (1) Marginal - Tell the supervisor

Past Oriented Question

What is the biggest difference of opinion you ever had with a co-worker? How did you get it resolved?

- (5) Excellent - We looked into the situation, found the problem, and resolved the difference. I had an honest conversation with the person.
- (3) Good - Compromised. Resolved the problem by taking turns, or I explained the problem (my side) carefully.

(1) Marginal - I got mad and told the co-worker off or we got the supervisor to resolve the problem, or I never have differences with anyone.

The cultural assessment of the organization will determine some of the questions for the structured interview. Questions used to find cultural fit will be mostly past-oriented questions. They are past-oriented questions in order to determine how a candidate has reacted in the past to similar environments. The remaining questions will be based on the requirements of the position.

The first step in understanding the requirements of the position is to perform a job assessment. The goal of the job assessment is to document the knowledge, skills, and abilities (KSAs) that a person must have to perform the job successfully. Pulakos (2005, pg 4) identifies the following five major steps involved in performing a job analysis:

1. Observe or interview job experts to develop a list of tasks performed on the job.
2. Observe or interview job experts to develop a list of the KSAs workers must possess to perform job tasks effectively.
3. Survey a sufficiently large and representative sample of job incumbents or their supervisors, asking them to rate which job tasks and KSAs are most critical for effective job performance.
4. Analyze the survey data to prioritize the most critical tasks and KSAs for the job.

5. Select or develop assessments that measure the most critical tasks or KSAs that a worker must possess upon entry to the job.

The goal is to develop structured interviews that do not duplicate the work ability test. The job analysis is used to identify the skills and abilities that are required and are not the technical skills. Examples skills might be:

- Ability to deal with change
- Ability to work on a team
- Ability to remain calm under stress

The critical skills can then be used to develop the past-oriented and future-oriented questions that will identify if a candidate possesses those skills.

Review of Online Assessment Tests

The review of the online assessment tests consisted of three parts: Review Criteria; Test Site Identification; Test Evaluations.

The review criteria were developed based on the above research on effective predictors of future job performance. We know that work ability tests are better predictors of future job performance than job knowledge tests. Two types of tests exist to test programming ability: Multiple Choice Tests; and

Programming Tests. The multiple choice tests focus on evaluating a candidate's knowledge of Java. Programming tests give the candidate a problem to solve using the Java language, the inputs to the program, and the expected output.

Multiple choice tests and their scores are a reflection of a candidate's job knowledge. These tests evaluate knowledge and not ability. The programming tests, however, provide the hiring manager with the ability to test a candidate's problem solving skills, their programming ability, and their ability to understand requirements. The programming tests are work ability tests. The programming tests are typically timed which adds additional pressure on the candidate which provides the hiring manager a view into how a programmer will perform under pressure. Having the defined inputs and outputs provides quantitative analysis of the results. Programming tests also allow a qualitative review of the Java code and the programming style of the candidate.

The rest of the review criteria were determined by what would be required to make the test fit within a typical candidate evaluation of two to three hours. The on-line assessment should meet the follow criteria:

- Internet Testing
- 24-by-7 Availability

- Timed Test
- 30 - 60 minute duration
- Immediate Scoring
- Source Code Availability
- Question Availability and Selection

Internet testing allows the testing to be done on the employer's site or by the candidate when it is not possible for the candidate to take the test at the employer's location. It is always preferred that a candidate take the test on the employer's site. This is to eliminate the possibility of someone other than the candidate taking the test on their behalf. It also allows the test to be monitored in the event there are system issues.

24-by-7 availability of the testing service provides the employer with the most flexibility in scheduling tests with the candidate. It allows the same testing service to be used at a global company with offices all over the world and in multiple time zones.

The test must be timed to insure it fits within the scheduled evaluation and to simulate the deadline for having an assignment complete. 30-60 Minute tests are required to fit within the evaluation time and to leave enough time to perform the structured interview or other assessment method.

Immediate scoring by the testing service insures that the test can be used for the immediate determination of the candidate's ability and a decision can be reached as to hire or not hire a candidate.

Source code availability allows a qualitative review of the programming style of the candidate. Having the source code allows the technical interviewer to understand how the candidate solved the problem and the thought process that they went through to solve it. This adds some additional qualitative data in the selection process.

Question availability and selection is important in determining that the problem given to the candidate to solve has direct applicability to the job position for which they are applying. It is important to select a testing service that has multiple problems that can test the same technologies. This is important to be able to vary the tests and to keep them current. Test question security is important so that a person cannot show up with a pre-developed solution to the problem. A candidate who has prior knowledge of the test problem will invalidate the test.

The Google search engine was used as the mechanism to identify possible candidates for on-line assessment. The keywords "online", "Java", "employment", and "testing" returned

over 32 million matches. Reviewing the first 200 matches yielded four potential online assessment web sites. The websites are: brainbench.com, whizlabs.com, topcoder.com, and expertrating.com. Each of these sites offered pre-employment testing services for not only Java, but many other languages and technologies.

In reviewing the websites, brainbench.com, whizlabs.com, and expertrating.com provided multiple-choice tests. They were designed to examine the knowledge of a candidate not their ability. To get an understanding of how the tests worked, the author took two sample exams provided by whizlabs.com. The tests consisted of 25 questions depending on the test. The candidate is allotted 45 minutes to take the test. Two scores were provided upon completion of the test. The first score, on a scale of 1 to 5, represented the percentage of questions answered correctly. The second was the overall percentile that the candidate is in. The percentile determines how well one candidate has done as compared to others who have taken the test. A single report documenting the candidate's results is available for the hiring manager to review. Whizlabs tried to rate ability but it was based off the candidates self-rating of there experience. A candidate is asked to provide the number of years that they programmed Java and to rate their own

proficiency in Java. Whizlabs then tries to correlate that proficiency with how many questions were answered correctly. Whizlabs did not provide any information as to the validity of correlating Java knowledge to Java programming ability.

It was clear from topcoder.com website that they provide a programming test, or what they like to call a programming challenge. The challenge is comprised of a problem statement which includes the exact name of the java class that needs to be built and the java methods that must be included in the class. The challenge also provides the exact input and expected output of the java class. There are two time limits associated with the challenge. The first is the time that the candidate is allotted to take the challenge. The second is how long the candidate's program is allowed to run to solve the problem. These are important measurements. The time limit to take the test is important as it simulates the pressure of completing an assignment by a specific deadline. The second time limit requires that the executable code not only solve the problem statement, but that it solves it efficiently. This efficiency time limit in effect tests the candidate's computer science knowledge and their ability to apply it to problem solving.

The Topcoder.com test is taken on a computer that is connected to the Internet. This allows the candidate to use any

reference materials that are available on the Internet to help the pass the test. This is an online version of an open-book test. A Java programmer, on the job, is allowed to use language and programming references to get there job done. Therefore, the same references are available in taking the test. It is not important that a programmer have every aspect of the java programming language memorized, but rather they know how to lookup the features that they need and efficiently apply them to solving a problem.

The Topcoder.com coding environment allows the candidate to test all the inputs and insure that they achieve the expected output. Once the candidate submits the solution, the clock is stopped and the coding environment automatically tests the solution. It tests the solution against the predefined input and insures that it generates the expected output within the time allotted. The candidate is given a pass/fail grade and a report is available that shows whether the candidate passed and the time they took to complete the test.

Topcoder.com provides three reports for the hiring manager. The first report is the candidate profile. Topcoder.com can capture job application information from the candidate. This information is captured in the candidate profile. The candidate profile also includes the candidate's self-rating of their java

programming proficiency. The second report is a copy of the actual problem statement that the candidate was given to solve. It documents the problem statement, the class definition, and example inputs and outputs that the java code must handle. The last report is the candidate's results. This report shows if the candidate passed or failed. It provides the specific inputs and outputs that passed or failed. It also provides the actual java code that was submitted by the candidate.

Topcoder.com was the most expensive of all the testing websites. Topcoder.com has a list price of \$250 per candidate test and requires a minimum purchase of 100 tests. An initial investment of \$25,000 is required to get started with topcoder.com. The cost of the multiple-choice based testing sites brainbench.com, expertrating.com, and whizlabs.com are \$30, \$24.95, and \$30 respectively. It should be noted that while the costs to administer these tests are significant, the costs associated with hiring unproductive employees is greater. According to Pulakos (2005), there are enormous costs to an organization from consistently hiring employees who do not perform effectively or who leave an organization after investments have been made in training them. It is important to view the costs for purchasing the assessments compared to the savings received by hiring a productive employee. According to

Schmidt & Hunter (1998), the output of a superior manager or professional produces 48% more output than the average worker for those jobs. These are large numbers and indicate the benefit that an improved selection process can bring to an organization.

There were several ancillary services provided by topcoder.com that are worth mentioning. Topcoder.com holds programming competitions. These are open competitions where programmers compete against each other for points. Points gained during competitions are used to rank programmers. Topcoder.com offers programming services where an organization can contract programmers who have competed in several competitions. Programmer rankings are made public so that anyone can see how well that programmer has done in the open competitions and can choose programmers based on their rank. Topcoder.com also has a large library of existing java code that can be licensed by a company. This library was developed by java programmers that have competed in the competitions.

Chapter III

Methodology

The focus of this study is to determine if it is possible to develop a hiring process that can identify whether a candidate is a cultural, behavioral and technical fit for an organization. In order to make this determination it will be necessary to identify the most effective assessment and selection methods in use today. Once these selection methods are identified it will be necessary to determine if Internet-based testing can be incorporated into the selection process without decreasing the effectiveness of the overall process.

The first step of identifying the most effective assessment and selection methods will be performed by reviewing existing research on the subject. The research will focus on reviewing articles and papers in the areas of psychology, human resources, and organizational development. These areas are the most likely to yield relevant research that has been performed within the last 15 years. The following online sources will be used to identify research that can contribute to this study: Association Psychological Association (www.apa.org); Society for Human Resource Management (www.shrm.org); and the Harvard Business Online (<http://harvardbusinessonline.hbsp.harvard.edu>). These

three organizations are renowned for their contributions to solving business problems. They present a logical first place to begin. References within the research provided by these organizations will be used to increase the sources of information for this study. This research will try to identify edited books, journal articles, research papers, case studies, etc. that can contribute to the objectives of this study.

Literature to be used by this study will be evaluated based on its relevancy to the research question and by the scientific methods used in its construction. The author will be looking for research that uses scientific methods to determine efficiency and effectiveness of the selection processes. While anecdotal information may be included in this study, it is important for the major conclusions of this study to be based on sound scientific data. The credibility of the conclusions of this study will drive the adoption of the selection process that will be defined by this study.

Assuming that the above research indicates that Internet-based testing can be effectively integrated into the selection process then the research to identify Internet-based testing vendor will proceed as follows. First, Google (www.google.com) will be used to identify web sites for the testing vendors. The initial search criteria will include search terms such as

"online", "Java", "employment", and "testing". It is anticipated that this will yield an unmanageable result set in the millions. This is due to the large number of books and websites that exist to help train someone in java, but do not perform the actual testing. Google.com search results are in order of relevance. It is expected that the first several hundred results can be scanned to find several vendors who provide the types of testing required by this study.

Once the vendors are identified, their websites and testing materials will be evaluated. The author will be looking to ascertain the following information about the testing services:

- Type of test
- Availability
- Cost
- Duration
- Scoring
- Question Selection

Type of test refers to whether it is multiple-choice, essay, or requires a candidate to actually write a program. Multiple-choice and essay tests test a candidate's knowledge while programming tests test the candidate's ability to apply the knowledge that they have.

Availability refers to the time a day in which candidate's can take the tests. It is assumed that most vendors would allow testing on a 24x7 basis but this must be validated.

Cost is the cost the vendor will charge for each test administered and duration is the amount of time that the test takes. It is important that the test is no longer than an hour. The goal of this study is to create an efficient process. If the test takes more than an hour it will not be considered efficient. In evaluating duration, the author will look to see if the duration is enforced by the testing vendor. That means that when the duration is reached, the test ends and the candidate can no longer answer any more questions.

How the vendor scores that test is an important aspect in its ability to be included in the selection process. It is important the scores candidates receive are applied uniformly and can be used as a comparison between candidates. It is important that the test is fair and does not break any laws with regards to hiring practices.

Question selection refers to the ability of the vendor to change the test questions between hiring periods. This means that if a group of 10 people are tested this week for a position and 10 people next month for another position the tests for

those periods are different. This feature prevents the test data from becoming public and undermining the validity of the test.

The final method of evaluating the vendors will be to actually take one or two of the tests. This will allow the author to actually experience taking the test. Taking the test should provide more insight into the process than just reading the information provided by the vendors. This will be a first-hand evaluation of the test.

Chapter IV

Results

The research for this study concluded that two selection methods were the most effective for hiring software developers: structured interviews and work ability tests. The structured interviews are used to rate the candidates' non-technical skills while the work ability tests are used to test the candidates' technical skills. Both tests are designed to provide a quantitative evaluation of each candidate that takes the test.

Structured Interviews

While the structured interview can predict future job performance, there is significant work required to develop it. There are three steps required in developing a structured interview.

1. Perform a job analysis
2. Identify the culture of the overall organization
3. Identify the sub-culture of the hiring organization

A job analysis should be performed for each job that will use a structured interview as part of the selection process. The job analysis is required to be performed initially and any time the job is changed significantly. The goal of the job analysis is to identify skills outside of java programming ability that

are required for the position of java programmer. Example skills might be the ability to work cooperatively with other programmers, or the ability to resolve conflicts with others.

Job analysis is done by interviewing experts in the position. You should also interview the supervisor of the position and anyone else in the organization who may depend on a person in that position. An example of organizations that depend on a java programmer might be the Quality Assurance organization or the Datacenter organization. These two organizations deal with the output, i.e. java programs, which are produced by the java developers. These organizations should be able to describe skills that they feel make a java developer successful.

The required skills should be identified and then reviewed. Only the most critical skills should be tested for by the structured interview. Not every candidate will have every skill identified, but it is important that they possess the most critical skills required to succeed in the position.

The next two steps are required to be able to build questions that determine cultural fit into the structured interview. As with the job analysis, determining the culture of the organization should be done initially, and any time it is perceived the culture may have changed.

Determining the culture of an organization will require you to perform interviews. These interviews will be to a larger group than those for the job analysis. The initial interviews will need a representative sampling of the organization. This sampling should provide representation of all levels and all departments. Your goal is to identify behaviors that are rewarded and those that are punished within your organization. You want to build structured interview questions that can help you identify behaviors that the candidate has that will lead to their success in the organization.

Once you have documented the most critical skills and behaviors that a candidate must possess you can begin to build the questions for the structured interview. The structured interview should consist of 30 questions. Half of the questions should be past-oriented questions and half should be future-oriented questions. Past-oriented questions are used to identify how the candidate has handled actual situations in the past. The candidates' past actions can provide concrete examples of whether or not they possess the right skills or behaviors.

The future-oriented questions allow you to create specific situations where you can find out how a person might act in that situation. Future-oriented questions are effective in assessing

traits such as integrity where the person may not be able to describe a situation where their integrity was challenged.

For each question that you design, you must provide three potential answers. The answers need to be categorized as "Excellent" worth five points, "Good" worth three points, and "Marginal" worth one point. This point system will be used to rate how well the candidate performed during the structured interview.

It is important that Human Resources be included in the development of the structured interview. Human Resources is responsible for the implementation of selection methods and is responsible for insuring that the interview does not discriminate against any potential candidate. They can also provide help and guidance in building the interviews needed for the job analysis and cultural analysis.

The structured interview should be administered as a panel interview. Since the questions are pre-defined, having multiple individual structured interviews provides little benefit. The panel should minimally consist of Human Resources, the supervisor, and a peer. Each person should have been familiarized with the structured interview and should be familiar with the pre-defined answers and their scores. The questions can be asked by any one person or it can rotate

between the panel members. Regardless of who is asking the questions, everyone needs to be keeping track of the person's answers and scoring them. At the end of the interview the panel members will get together, review the scores and to give the final score for the candidate.

Internet-based Testing

The research for an Internet-based test vendor for java developers yielded four possible candidates. The following table documents the results of the web research.

Criteria	Websites			
	TopCoder.com	ExpertRating.com	Brainbench.com	WhizLabs.com
24 x 7 Availability	Yes	Yes	Yes	Yes
Timed Tests	Yes	Yes	Yes	Yes
Question Type	Programming	Multiple choice	Multiple Choice	Multiple Choice
30-60 Min Duration	Yes	Yes	Yes	Yes
Immediate Scoring	Yes	Yes	Yes	Yes
Source Code Availability	Yes	N/A	N/A	N/A
Question Availability	Yes	Yes	Yes	Yes
Cost	\$250	\$24.95	\$30	\$60
Other Languages	Yes	Yes	Yes	Yes

Table 1.

Table 1 shows that three of the vendors provide only multiple choice questions. The research shows that work ability tests have a higher validity in predicting future performance than job knowledge tests. In fact, work ability tests are 12%

more effective than job knowledge tests. Based upon this research and the experience of the author with job knowledge tests, the recommendation is to use the work ability test from Topcoder.com in the selection process.

A test area will need to be created in order to administer the Topcoder.com test. The test area will require a computer which has access to the internet. This computer should be located within the Human Resource area. The Topcoder.com test program should be preloaded and test accounts should have been set up. It is also important that the test area be stocked with reference materials on Java. These could be either hard-cover or internet-based reference materials. The goal of the work ability tests is to simulate an actual work situation. Java developers are allowed to use reference materials on the job; therefore they need to be able to use them on the test as well. Having personally taken several of the Topcoder.com challenges of varying difficulty, the references do not decrease the integrity or validity of the test.

When setting up the Topcoder.com test, a problem should be selected that has a difficulty that aligns with the job level that you are hiring for. So if you are hiring for a senior developer, you should select a problem that presents a level of difficulty that only a senior java developer can complete. If

you have existing developers whose skill level you are trying match, then you should have them solve some of the problems so that you can first evaluate their level and use questions of comparable difficulty for the job candidates.

Once you have defined the difficulty of the questions to be administered, the test can be scored on a pass/fail basis. The test can be used as the minimum requirements required to be considered for the position. If you have similar positions at multiple levels, i.e. Senior Java Developer and Java Developer, you may have instances where a candidate applies for the senior position and fails, but when given the Java Developer test they can pass. This increases the amount of time required during the selection process, but it does help identify the appropriate level for which a candidate should be hired.

The work ability test should be given prior to the structured interview. The work ability test requires one person, at most, to administer while the structured interview will take several people to administer. By Administering the work ability test first, the results will be used as a gate as to whether the selection process will proceed or end right there. If the candidate fails the work ability test, the selection process ends right there and the person is allowed to go home. Three hours time is saved by not having the structured interview.

Assuming that three people are performing the interviewing and they average \$40/hr, this saves \$120 which is almost half the price of the test. Imagine how much more you saved by not hiring a person who could not do the job.

Selection Process

The following is an outline of the recommended selection process for a candidate. It is designed to be an efficient process which will take one hour and ten minutes if a person fails the work ability test and two hours and thirty minutes if the person passes the work ability test and proceeds to the structured interview.

Selection Process Outline

I.	Candidate completes application.	15min.
II.	Candidate takes Topcoder.com test	45min
III.	Topcoder.com results reviewed	10min
	Process ends if the candidate fails the test	
IV.	Perform Structured Interview	60min
V.	Review Interview results	15min
VI.	Provide Hiring Recommendation	5min

Step VI of the selection process may not take place immediately after the review of the structured interview results. This process may be used to evaluate many candidates for one position. The results of the structured interview for all candidates should be compared to identify the best candidate for the position.

An alternative to comparing the candidates' results to each other is to set a threshold for the structured interview score. If a candidate meets or exceeds this threshold then they are offered the position. This is useful in situations where you need to hire several developers and the interviews are scheduled over a several week period. Candidates are typically required to provide their current employer with two weeks notice. By utilizing a threshold you may be able have your first developers on payroll while you continue to hire for the remaining openings. Thresholds help to shorten the time from the position being opened to getting the first person on board.

The author currently has 20 years of programming experience that consists of both start-up and Fortune 500 companies. The process described by this study can work effectively in both. It applies scientific methods to interviewing and the latest internet technologies for java testing. What it requires is the

discipline of the organization to use it consistently and not to fall back to using resumes and unstructured interviews.