

SoftApps, Inc.
Job Analysis Report for Software Engineer
Conducted by: Applied Psychology Consultants, Inc.
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Executive Summary

SoftApps, a software engineering firm, located in Bozeman, Montana has recently encountered a major problem. EEOC investigators are questioning whether female software engineers are being paid less than their male counterparts. To avoid any legal liability, the HR team wanted to ensure that any pay discrepancies were justified by a legitimate performance appraisal system. Before any performance appraisal system can be implemented, a job analysis needs to be conducted. A job analysis is needed to identify the essential tasks performed and worker attributes needed to perform those tasks. Detailed findings from the job analysis include a description of the duties, tasks, knowledge, skills, abilities, and other characteristics (KSAOs) vital to successful performance.

Psychology Consultants Inc (APC) was retained to conduct a thorough job analysis and construct a job description using the information obtained from the job analysis. APC Inc. utilized information from O*Net, a site with information on different occupations, and survey data from 600 Applications Software engineers, and 25 engineer managers. Job incumbents rated the importance and criticality of each job task KSAOs as well as whether certain knowledge, skills and abilities were required for success on the job. The results of the job analysis and the revised job description (see *Appendix A*) are detailed in the report below.

Introduction

SoftApps Corp (SAC) with offices in Montana and Baltimore, develops applications software for businesses. There are 750, over 400 of whom are software engineers. SAC has grown tremendously over the past decade years. Recently, management has been questioned by the EEOC as to whether male and female software engineers are being paid equitably. The Equal Employment Opportunity Commission (EEOC) was established to enforce laws against workplace discrimination. It prohibits pay discrimination based on gender (Fortney, Kramer & Fishman, 2013). To avoid any legal liability SAC needs to ensure that any pay differences are justified by a performance appraisal.

A job analysis needs to be conducted prior to the implementation of a performance appraisal system. A job analysis is useful because it can be used to understand the specific tasks, knowledge, skills, abilities, and other characteristics (KSAOs) required for success on the job. Once that information is collected, it can be used for many purposes, one of which is for constructing a job description and a performance appraisal process (Goffin & Woycheshin, 2006). Applied Psychology Consultants (APC) was retained by SAC to conduct the job analysis. A detailed description of the methods and results of the job analysis are explained below.

Method

Sample

This analysis acquired data from 625 employees. Participants included 450 software engineers, and 25 engineer managers. Each participant had worked at SoftApps for at least a year.

Procedure

The combination job analysis method, or CJAM was chosen (Levine, 1983). Employees were individually asked to generate a list of tasks and knowledge, skills, abilities, and other characteristics (KSAOs) needed to perform the job of software engineer. The tasks and KSAO lists were created by eliminating multiple responses and combining similar responses. In addition to the KSAO's and tasks identified, information was utilized from the US Department of Labor's Occupational Network O*Net to assist in naming some tasks and KSAO's for the final list. The final list of SKAOs were rated by incumbents on the level of difficulty and the criticality of each task (See *Appendices B & C* for the rating scales).

Measures

The C-JAM method (Levine, 1983) uses several scoring categories that employees were asked to rate tasks and KSAO's independently. The Task Difficulty was rated on a 7-point Likert-type scale with "1" signifying *"the easiest task of all"* and "7" being *"the most difficult tasks of all"*. The Task Criticality item was also rated on a 7- point Likert- type scale with "1" defined as "consequences of error are not at all important" and "7" being *"consequences are extremely important."* Using a 5-point scales, KSAO's were rated independently to assess the extent trouble was likely if the KSAO was ignored in selecting applicants with "1" being *"very little or none"* and "5" being *"to an extremely great extent."* In addition, raters indicated the extent to which the KSAO was able to distinguish average from superior employees. The practicality of expecting the KSAO in the job market and necessity of the KSAO for new workers was assessed using "yes" and "no" responses.

Scoring

Means and inter-rater reliabilities (*r*WG) were established for each item. For job tasks, the Task Importance variable was created by adding the means of Difficulty and Criticality. Tasks were then ranked from highest scoring to lowest. For KSAOs, the KSAO Importance variable was created by multiplying the means of Trouble Likely and Distinguish Superior. To be considered for use, tasks and KSAOs had to have an *r*WG value of at least 0.80. KSAO's and tasks had to be deemed by a majority of employees (i.e., at least 450) to be (1) necessary for new employees and (2) practical to expect on the job market. Once tasks and KSAO's were finalized, employees decided the relationship between specific tasks and specific KSAO's, and the results were put into a linkage table.

Results

KSAOs

Thirty Knowledge, Skills, abilities, and Other characteristics were compiled from interviews and information from O*Net. These 30 KSAOs were used in the survey that was administered to the software engineers. These were identified as the specific attributes a software engineer should possess in order to be deemed competent. Five in the knowledge category, 10 items in the skills category, 10 items in the abilities category, and 5 items in the other characteristics category. A list of the KSAOs and their definitions can be found in the table/appendix s 1-3 below.

Table 1. Knowledge

Knowledge	Definition
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Computers and electronics	Knowledge of circuit boards, processors, chips electronic equipment, etc.
Engineering and technology	Knowledge of practical application of engineering and technology
English	
Mathematics	Knowledge of algebra, geometry, calculus, statistics and their applications
Design	Knowledge of design techniques, tools and principles involved in precise production of technical plans and blueprints

Table 2. Skills

Skills	Definition
Programming	Writing computer programs
Systems Analysis	Determining how a system should work
Critical Thinking	Using logic and reasoning to come up with solutions
Active Listening	Giving full attention to what people are saying
Coordination	Adjusting actions in relations to others
Decision making	Making cost effective decisions
Operations analysis	Analyzing needs and product requirements to create a design
Reading comprehension	Understanding written sentences and paragraphs in work related documents
Time management	Managing one's own time and the time of others
Writing	Communicating effectively in writing

Table 3. Abilities

Abilities	Definition
Deductive Reasoning	The ability to apply general rules to specific problems to produce answers that make sense
Information ordering	The ability to arrange things in a certain order
Mathematical reasoning	The ability to choose the right math methods or formulas to solve a problem
Originality	The ability to come up with unusual or clever ideas to solve a problem
Selective attention	the ability to concentrate on a task over a period of time
Problem sensitivity	The ability to tell when something is wrong or right
Near vision	The ability to see details at close range

Category flexibility	The ability to generate or use different sets of rules for combining or grouping things in different ways
Flexibility of closure	The ability to identify or detect a known pattern that is hidden in other distracting material
Inductive reasoning	The ability to combine pieces of information to form general rules or conclusions

Table 4. Other Characteristics

Other Characteristics	Definition
Attention to detail	Ability to achieve thoroughness and accuracy when accomplishing a task
Curiosity	A desire to learn something new
Teamwork	Ability to work well with others
Open minded	Ability to consider new ideas
Conscientious	Purposeful, organized, self-discipline

Tasks

16 Task statements were used to define the software engineer position. The tasks were divided into four categories or duties. The list of tasks divided into their respective duties are shown in table 5 below.

Table 5. Tasks & Duties

Duties	Tasks
Interacting with computers	Coordinate software system installation and monitor equipment functioning to ensure specifications are met
	Design, develop and modify software systems, using scientific analysis and mathematical models to predict and measure outcome and consequences of design.
	Store, retrieve, and manipulate data for analysis of system capabilities and requirements.
	Develop and direct software system testing and validation procedures, programming, and documentation
	Analyze information to determine, recommend, and plan computer specifications

	and layouts and peripheral equipment modifications
Decision Making/Problem Solving	Analyze user needs and software requirements to determine feasibility of design within time and cost constraints.
	Develop or direct software system testing or validation procedures.
	Monitor functioning of equipment to ensure system operates in conformance with specifications
	Consult with customers about software design and maintenance
Communicating with supervisors, peers, subordinates, clients	Collaborate with programmers, technologists, and other engineering and scientific personnel
	Confer with systems analysts, engineers, programmers and others to design system and to obtain information on project limitations and capabilities, performance requirements and interfaces.
	Coordinate installation of software system with peers and/or clients
	Determine system performance standards
	Ensure that a program continues to function normally through software maintenance and testing
Assess database performance	Store, retrieve, and manipulate data for analysis of system capabilities and requirements
	Modify existing software to correct errors, allow it to adapt to new hardware, or to improve its performance

Discussion

The purpose of this job analysis was to determine the tasks, knowledge, skills, abilities, and other characteristics most relevant to the position of software engineer at SAC. According to employees, the most important task for software engineers was conferring with systems analysts,

engineers, programmers and others to design the system and to obtain information on project limitations and capabilities, performance requirements and interfaces. This emphasizes management's commitment to employing systems engineers who are not only competent but are also able to work well with others. For KSAOs, knowledge of computers and electronics, programming and problem sensitivity were some of the most important characteristics to have which reflects the importance of knowledge needed for the software engineer position. Active listening, teamwork, and conscientiousness were also considered very important.

Implications

The compiled list of job tasks can be utilized in multiple aspects. The list can be used in the selection and evaluation processes. In the selection process, the list could be used to screen applicants so that future candidates will have a correct description of the position. The list could also be used in the evaluation of employees. Thompson and Thompson (1985) stated that performance appraisals should be based on objective, job related standards established through a formal job analysis to withstand scrutiny by courts. In addition to management decisions, the instrument could also be used for developmental purposes. Furthermore, KSAOs can be used in the selection process to screen applicants on characteristics and traits deemed necessary to distinguish those candidates likely to be superior in performance.

Conclusion

A job analysis was conducted for the software engineer position at SoftApps. The job analysis findings provide complete and comprehensive description of the position, the work that is performed, and worker requirements needed to perform the job well. As stated above, the job analysis findings would also be useful for selection, evaluation, and developmental purposes. A job analysis verification for software engineer should be completed every five years to ensure the information is kept up-to-date and will continue to inform the updating of selection and performance appraisal tools.

References

- Brannick, M. T., & Levine, E. L. (2002). *Job Analysis: Methods, research, and applications for human resources management in the new millennium*. Sage pub. Thousand Oaks, CA.
- Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*. Retrieved February 20, 2018, from <http://www.bls.gov/ooh/installation-maintenance-and-repair/mobile/heating-air-conditioning-and-refrigeration-mechanics-and-installers.htm>
- Fortney, D. S., Kramer, J. E., & Fishman, B. J. (2013). Enforcement of Employment Law: What the Next Four Years Will Bring. *TIP: The Industrial-Organizational Psychologist*, 50(4), 43.
- Goffin, R. D., & Woycheshin, D. E. (2006). An Empirical Method of Determining Employee Competencies/KSAOs From Task-Based Job Analysis. *Military Psychology (Taylor & Francis Ltd)*, 18(2), 121-130.
- Levine, E. L. (1983). *Everything you always wanted to know about job analysis*. Tampa, FL: Mariner.
- National Center for O*NET Development. 49-9021.02. *O*NET OnLine*. Retrieved February 20, 2018, from <http://www.onetonline.org/link/summary/49-9021.02>

Thompson, D. E., & Thompson, T. A. (1985). Task-based performance appraisal for blue-collar jobs: Evaluation of race and sex effects. *Journal of Applied Psychology*, 70(4), 747-753. doi:10.1037/0021-9010.70.4.747

Appendix A: Job Description

Job Title: Software Engineer

FSLA Status: Non-exempt

Position Summary: A software engineer develops information systems by designing, developing, and installing software solutions. Employee in this position receives general supervision from an engineer manager or other supervisory position. This position must be able to work with others and resolve conflicts. Must be fluent in comfortable with using Java, C++, Python, or similar software.

Duty: Interacting with computers

1. Designs, develops and modifies software systems, using scientific analysis and mathematical models to predict and measure outcome and consequences of design.
2. Stores, retrieves, and manipulates data for analysis of system capabilities and requirements.
3. Develops and directs software system testing and validation procedures, programming, and documentation
4. Coordinates software system installation and monitor equipment functioning to ensure specifications are met

Duty: Decision Making/Problem Solving

1. Analyzes information to determine, recommend, and plan computer specifications and layouts and peripheral equipment modifications
2. Analyzes user needs and software requirements to determine feasibility of design within time and cost constraints.
3. Develops or direct software system testing or validation procedures.
4. Monitors functioning of equipment to ensure system operates in conformance with specifications.

Duty: Communicating with supervisors, peers, subordinates, clients

1. Consults with customers about software design and maintenance
2. Collaborates with programmers, technologists, and other engineering and scientific personnel
3. Confers with systems analysts, engineers, programmers and others to design system and to obtain information on project limitations and capabilities, performance requirements and interfaces.
4. Coordinates installation of software system with peers and/or clients

Duty: Assess database performance

1. Determines system performance standards

2. Ensures that a program continues to function normally through software maintenance and testing
3. Modifies existing software to correct errors, allowing it to adapt to new hardware, or to improve its performance

Qualifications/ Requirements:

Education: Bachelor's degree required in computer science, software engineering, or a related field

Experience: 3-5 years

Work environment: Ability to sit for extended periods of time

Appendix B: Task Importance Scale

Task Importance Rating Scale

Please rate each task for its “Frequency,” “Importance,” and “Criticality.” Please refer to the descriptions below to get a better understanding of what each level of the scale represents.

1. **Frequency:** **N/A** = Not applicable; **R** = Rarely <1% of the time; **O** = Occasionally 1 – 33% of the time; **F** = Frequently 34 – 66% of the time; **C** = Continuously 67 – 100%

2. Task Difficulty Rating Scale

Task Difficulty: Difficulty level in performing a task correctly relative to all other tasks within the job.	
Rating Level	Rating Description
1	One of the easiest of all tasks
2	Considerably easier than most tasks performed
3	Easier than most tasks performed
4	Approximately half of the tasks are more difficult and half are less difficult
5	Harder than most tasks performed
6	Considerably harder than most tasks performed
7	One of the most difficult of all tasks

3. Task Criticality Rating Scale

Task Criticality/consequence of error: The degree to which an incorrect performance would result in negative consequence	
Rating Level	Rating Description
1	Consequences of error are not at all important
2	Consequences of error are of little importance
3	Consequences are of some importance
4	Consequences are moderately important
5	Consequences are important

6	Consequences are very important
7	Consequences are extremely important

Appendix C: KSAO Importance Scale

KSAO Importance Rating Scale

Please rate each KSAO for its “Necessity,” “Practicality,” “Trouble Likely,” and “Superiority.” Please refer to the descriptions below to get a better understanding of what each level of the scale represents.

1. Is the K, S, A, or O necessary for newly hired employees? (yes/no)
2. Is the K, S, A, or O practical to expect in the labor market? (yes/no)
3. **KSAO Trouble Likely** Rating Scale

KSAO Trouble Likely: To what extent is trouble likely if this K, S, A, or O is ignored in selection (compared with other KSAOs)?	
Rating Level	Rating Description
1	Very little or none
2	To some extent
3	To a great extent
4	To a very great extent
5	To an extremely great extent

3. **KSAO Superior from Average** Rating Scale

KSAO Superior/Average To what extent do different levels of the KSAO distinguish the superior from the average worker (compared with the other KSAOs)?	
Rating Level	Rating Description
1	Very little or none
2	To some extent
3	To a great extent
4	To a very great extent
5	To an extremely great extent