

What Soft Skills Software Architect Should Have? A Reflection from Software Industry

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Abstract. Software architect has pivotal role in software development life cycle. People have different personality traits, and the way they perceive, plan and execute any assigned task is influenced by it. These personality traits are characterized by soft skills. Most of the time, software development is a team work involving several people executing different tasks. The success and failure stories of software projects revealed the human factor as one of the critical importance. In this work we are presenting a reflection from software industry about the soft skills requirements for a software architect's job. We analyzed 124 advertised jobs in the title of software architect and explore the soft skills requirements. The results of this investigation help in understanding software skills requirement set for a job of software architect and presents the current status of their use in job advertisements.

Keywords: Soft Skills, Empirical Software Engineering, Software Architecture

1. Introduction

Software architecture is gaining increasingly attention in the software development community due to its significantly important role in overall development cycle. Bass et al. [1] state that the software architecture of a program or computing system is the structure or structures of the system, which comprise software components, the externally visible properties of those components, and the relationships among them. A software architect as role participates individually or as a team member in creating software architecture. According to [2] responsibilities of an architect include articulating the architectural vision, conceptualizing and experimenting with alternative architectural approaches, creating models and component and interface specification documents, and validating the architecture against requirements and assumptions. Psychological theories assert that not everybody is fit for every task, as people have different personality traits and abilities. Often, personality traits are expressed in people's soft skills or we sometime call it, people's emotional intelligence. That is, the way people perceive, plan and execute any assigned task is influenced by their set of soft skills. Most of the studies carried out on the human factor in software development concentrate primarily on personality types; soft skills have been given comparatively little attention by researchers. This work provides vital information about soft skills requirements in case of software architect's job from software industry.

2. Research Motivations

Software engineering has been roughly characterized as set of activities comprising of phases such as system analysis, design, coding, testing, and maintenance. Logically they are different tasks which are coupled together to achieve the objective of software construction and operation. The psychological hypothesis that not everyone can perform all tasks effectively reveals that personality traits play a critical role in the performance of people executing the same task. Although there is huge diversity among software architecture principles, we can find common principles that are applicable to the architecture of any artifact, whether it is a poster, a household appliance, or a housing development. Although software architecture is still a young field and far from having a consensus on its relevant principles, software architecture will always requires the human creativity. Software architecture is an exploratory process, the architect looks for

components by trying out a variety of schemes in order to discover the most natural and reasonable way to refine the solution. There has been a tendency to present software architecture in such a manner that it looks easy to do. Nevertheless, in the architecture of large and complex software, identification of key components is likely to take some time. Repetitions are not unusual, since a good architecture usually takes several iterations. The number of iterations also depends on the architect's insight and experience on the application domain. It is true by virtue of experience and theoretical foundations that not everybody is fit for all kind of tasks. We can achieve better results if we assign people with particular soft skills to different phases in a project. The advertisement of the jobs in the area of software engineering generally divides the skill requirements into two categories of "hard skills" and "soft skills". Hard skills are the technical requirements and knowledge a person should have to carry out a task. This includes the theoretical foundations and practical exposure a person should have to comfortably execute the planned task. Even though soft skills are the psychological phenomena which cover the personality types, social interaction abilities, communication, and personal habits, people believe that soft skills should complement the hard skills. The objective of this work is to review the job advertisements of software architect and explore the soft skills requirements. The results of this investigation help in understanding software skills requirement set for a job of software architect and presents the current status of their use in job advertisements.

3. Related Work

Many people believe that soft skills are essential in carrying out a job along with hard skills but software engineering community has not given much attention to this vital issue. A more concentration has been given to the hard skills requirements set. Few studies are carried out to look at the personality characteristics of software development life cycle title roles such as programmers, software engineers, and system analyst and have investigated the relationship between human skills and software life cycle phases. Using the 16PF test [3], Acuna et al. [4] measure the matching between individual capabilities (intrapersonal, organizational, interpersonal, and management) to software roles (team leader, quality manager, requirements engineer, designer, programmer, maintainer, tester, and configuration manager). Feldt et al. [5] evaluated the personality of 47 software professionals using the IPIP 50-item five-factor personality test [6]. After extensive statistical analyses they found that there are multiple and significant correlations between personality factors and software engineering, and concluded that individual differences in personality can explain and predict how judgments are made and decisions taken in software development projects. There is clear evidence that personality preferences have great impact on the motivation, quality of the work produced, and retention in the field of software engineering [7]. Bishop-Clark [8] investigated the relationship between cognitive aspects, personality traits and computer programming. Walz and Wynekoop [9] derive a methodology for identifying the traits and characteristics of top performing software developers. Even though soft skills are the psychological phenomena which cover the personality types, social interaction abilities, communication, and personal habits, people believe that soft skills complement the hard skills. Soft skills refer to the cluster of personality traits and attitudes that drives one's behavior [10]. They indirectly define the personality traits, ability to have social interaction, and eagerness which individuals acquire as they grow and mature. Other classical sets of soft skills are: active listening, negotiating, conflict resolution, problem solving, reflection, critical thinking, ethics, and leadership skills [11] [12] [13] [14]. Soft skills complement the technical skills requirements of a job [15]. According to Goleman [16] the possession and use of soft skills contributes more to an individual's ultimate success or failure than technical skills or intelligence.

4. Experimental Setup

In this exploratory study we visited some of the leading online job seeking website such as workopolis.ca, eurojobs.com and monster.ca. We looked at the jobs advertised under the title of "software architect". We collected a data of 124 job advertisements. We collected that data about nine soft skills includes communication skills, interpersonal skills, analytical and problem solving skills, team player, organizational skills, fast learner, ability to work independently, innovative and open and adaptable to changes. It is also important to mention here that when we visited a job page the inclusion of the job post in the study dataset

depends on the categorical presence of at least one of the above mentioned soft skills in the job posting. Therefore we looked specifically for these key words of the soft skills.

5. Data Processing & Results

We collected data from some well-known job advertising websites. The target population of the data consists of job titles such as software architect, senior software architect, system architect, lead software architect etc. We collected a data of 124 job advertisements. The jobs were generally belongs to various sectors ranges from wide range of operations such as consumer electronics, telecommunication, avionics, automobiles, financial, and information technology. The experience required for the jobs is classified into three categories of less than 3 years, 3 to 6 years and greater than 6 years. Figure 1 illustrates the distribution of the data in terms of number of experience required for the job. 53% of the data belongs to jobs having required experience of less than 3 years. The jobs that required an experience of between 3 to 6 years constitute a data of about 31%. Whereas 16% of the dataset required an experience of more than 6 years. Table 1 illustrates the frequency distribution of the soft skills requirements advertisements in the job announcement. “Yes” column in the Table 1 indicates the percentage of the jobs where a specific soft skill was categorically required and “No” indicates that respective soft skill was not announced as requirement in the advertisement. The highest percentage of required skill was “analytical and problem solving” of about 55%. Lowest percentage of required skill was “Open and adoptable to changes” about 25%. The required soft skills of about less than 50% include “interpersonal”, “organizational”, “fast learner”, “ability to work independently”, “innovative and creative mind” and “open and adoptable to changes”. “Communication skills”, “analytical and problem solving” and “team player” skills are in high demand of requirements. Figure 2 illustrates the frequency distribution chart of the soft skills requirements in the job of software architect.

The two most important aspects of precision in survey based assessments are reliability and validity. Reliability refers to the reproducibility of a measurement, whereas validity refers to the agreement between the measured value and the true value. The potential threats to the external validity of survey-based assessments are the reliability and validity of the measuring instrument. The reliability of the survey was evaluated by using the internal-consistency analysis method. Internal-consistency analysis was performed using the coefficient alpha. We measured the construct validity using multiple squared correlations. Multiple squared correlations (R^2) are the percentage of response variable variation that is explained by its relationship with one or more predictor variables. In general, the higher the R^2 , the better the model fits your data. Table 2 illustrates the reliability analysis of the survey. We observed positive multiple squared correlations where as cronbach alpha is observed from 0.01 to 0.49. The lower value of the cronbach’s alpha indicates that they are disjoint variables.

6. Discussion

A broader conclusion of this survey indicates that soft skills are in demand in the software industry, but only to some extent. This highlights a lack of understanding about the role soft skills play in the makeup of workers. In the recent past software architecture has been gaining tremendous popularity in software development projects due to large scale project sizes. The objective of this work was to review the job advertisements of software architect and explore the soft skills requirements. The area identified by the study as in high demand is Analytical and Problem Solving skills. This skill is more in line with the job function of a software architect and as such one would expect to see this skill in high demand by the industry. The study identified that currently the industry is focused on the ability to communicate effectively and to function well as part of a team. In particular communication skills ranked highly as an in demand soft skill. Coupled with a demand of interpersonal skills we can clearly see that employers are placing a high value on the ability of employees to work well in groups internally to the organization but also externally with customers. Although the study identified Organizational Skills as being a soft skill in low demand by employers, but we assume that this skill points to an individual who is capable of managing their tasks, time and projects with potentially limited supervision. Coupled with the demand for high levels of communication and interpersonal skills, we can foresee that employers may require individuals who are capable of taking on a task as part of a

team, articulating their work to colleagues and customers and operating with high levels of organization, but perhaps with limited supervision. However the study identified a number of soft skills which are in surprisingly low demand by employers. The ability to be a fast learner is not in high demand. Neither is being an ability to work independently nor open and adaptable to change. These findings are surprising as these skills are related to the creative abilities, which are central to the creation of inventions such as software. However the study has shown that the role of software architect is significantly different from the typical software development roles. The emphasis in skills for an architect is in the areas of communication and management, rather than creativity and technical ability, which is relatively surprising. Clearly the finding of the study highlight the differences of both role and function for software architects who are typically more closely involved with customers and senior management. This specialist role requires a dissimilar soft skill set to more typical software engineering roles, despite architects being involved in the same core function, the design of software products.

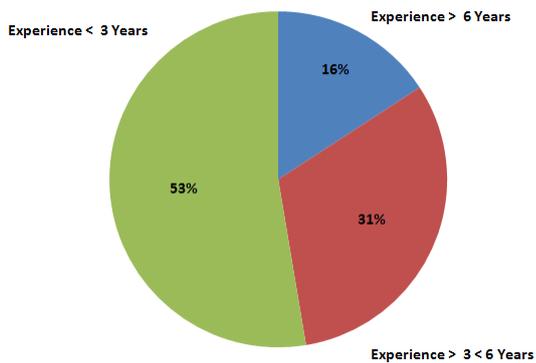


Fig. 1 Data Distribution with respect to Experience Requirements

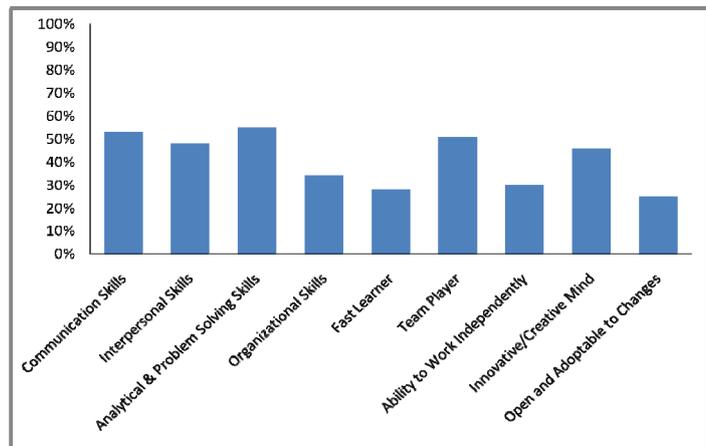


Fig. 2 Frequency distribution of Soft Skills Requirements in Software Architect’s Job

Soft Skills	Yes	No
Communication Skills	53%	47%
Interpersonal Skills	48%	52%
Analytical & Problem Solving Skills	55%	45%
Organizational Skills	34%	66%
Fast Learner	28%	68%
Team Player	51%	49%
Ability to Work Independently	30%	70%
Innovative/Creative Mind	46%	54%
Open and Adoptable to Changes	25%	75%

* “Yes” = Job advertisement categorically required skill
 “No” = Job advertisement did not categorically required skill

Table 1: Frequency Distribution of the Soft Skills Requirements

Soft Skills	R ²	Cronbach's Alpha
Communication Skills	0.47	0.01
Interpersonal Skills	0.44	0.16
Analytical & Problem Solving Skills	0.49	0.42
Organizational Skills	0.23	0.28
Fast Learner	0.37	0.14
Team Player	0.20	0.20
Ability to Work Independently	0.22	0.22
Innovative/Creative Mind	0.21	0.19
Open and Adoptable to Changes	0.31	0.01

Table 2: Reliability of the Dataset

7. Conclusion

Software development is a team effort. The team constitutes of humans therefore directly or indirectly the human factors which characterized the personality traits and soft skills are significantly important in team management. The objective of this work is to review the job advertisements of software architect and explore the soft skills requirements. The study found that some of the soft skills such as communication, team player, analytical and problem solving, and interpersonal are in demand even though not more than 50% whereas others are in lesser demand such as ability to work independently, fast learner and open and adaptable to changes. This study concludes that there is a requirement in the field of software engineering to understand the significance of soft skills requirements set.

8. References

- [1] Bass, L., Clements, P., Kazman, R., *Software Architecture in Practice*, Addison-Wesley, 1998.
- [2] <http://www.bredemeyer.com/who.htm>
- [3] M.T. Russell and D.L. Karol, *16PF Fifth Edition Administrator's Manual*, Institute for Personality and Ability Testing, 1994
- [4] S.T. Acuna, N. Juristo, and A.M. Moreno, "Emphasizing Human Capabilities in Software Development," *IEEE Software*, vol. 23, n. 2, 2006, pp. 94-101.
- [5] R. Feldt, R. Torkar, L. Angelis and M. Samuelsson, "Towards Individualized Software Engineering: Empirical Studies Should Collect Psychometrics," *Proc. Workshop on Cooperative and Human Aspect of Software Engineering*, Leipzig, Germany, 2008, poster, 4 pages.
- [6] T. Buchanan, J. A. Johnson and L.R. Goldberg, "Implementing a Five-Factor Personality Inventory for Use on the Internet," *European Journal of Psychological Assessment*, vol. 21, n. 2, 2005, pp. 116-128.
- [7] E. Kaluzniacky, *Managing Psychological Factors in Information Systems Work*, Information Science Publishing, 2004.
- [8] C. Bishop-Clark, "Cognitive Style, Personality, and Computer Programming," *Computers in Human Behaviour*, vol. 11, n. 2, 1995, pp. 241-260.
- [9] D.B. Walz and J.L. Wynekoop, "Identifying and Cultivating Exceptional Software Developers," *Journal of Computer Information Systems*, vol. 37, n. 4, 1997, pp. 82-87.
- [10] A. Roan and G. Whitehouse Women, Information Technology and Waves of Optimism: Australian Evidence on Mixed-Skill Jobs. *New Technology, Work and Employment*, 22 (1) 21-33, 2007
- [11] Dash, J. (2001). Schools push soft skills for info security majors. *Computerworld*, 35(6), 24.
- [12] Gorman, H. (2000). Winning hearts and minds?—Emotional labour and learning for care management. *Journal of Social Work Practice*, 14(2), 149-158.
- [13] Isaacs, N. (1998). Use job interviews to evaluate 'soft' skills. *InfoWorld*, 20(14), 104.
- [14] Schulz, Y. (1998). New world puts emphasis on softer skills. *Computing Canada*, 24(45), 21-22.
- [15] T. L. Lewis, W. J. Smith, F. Bélanger, and K. V. Harrington Are technical and soft skills required? *Proc. 4th Workshop on Computing Education Research*, 91-100, 2008.
- [16] Goleman, D. *Emotional Intelligence*, Bantam Books, New York, NY, 1995