



Soft skills requirements in software development jobs: a cross-cultural empirical study

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Abstract

Purpose – Most of the studies carried out on human factor in software development concentrate primarily on personality traits. However, soft skills which largely help in determining personality traits have been given comparatively little attention by researchers. The purpose of this paper is to find out whether employers' soft skills requirements, as advertised in job postings, within different roles of software development, are similar across different cultures.

Design/methodology/approach – The authors review the literature relating to soft skills before describing a study based on 500 job advertisements posted on well-known recruitment sites from a range of geographical locations, including North America, Europe, Asia and Australia. The study makes use of nine defined soft skills to assess the level of demand for each of these skills related to individual job roles within the software industry.

Findings – It was found that in the cases of designer, programmer and tester, substantial similarity exists for the requirements of soft skills, whereas only in the case of system analyst is dissimilarity present across different cultures. It was concluded that cultural difference does not have a major impact on the choice of soft skills requirements in hiring new employee in the case of the software development profession.

Originality/value – Specific studies concerning soft skills and software development have been sporadic and often incidental, which highlights the originality of this work. Moreover, no concrete work has been reported in the area of soft skills and their demand as a part of job requirement sets in diverse cultures, which increases the value of this paper.

Keywords Jobs, Recruitment advertising, Skills, Computer software, Interpersonal skills, Soft skills, Non-technical skills, Diversity in software development, Human factors, National cultures

Paper type Research paper



I. Introduction

Software is a by-product of human activities, which often include problem solving capabilities, cognitive aspects, and social interaction. The simple overall software development process can be characterized as a set of activities comprising system analysis, design, coding, testing, and maintenance. Logically these are separate tasks which when coupled together enable software construction and operation.

Each of these tasks also requires that the individuals involved have a particular set of skills which may not necessarily be common across all activities. The psychological hypothesis that not everyone can perform all tasks effectively implies that personality traits play a critical role in the performance of people executing the same task. Although the field of software psychology was fashioned many decades ago (Shneiderman, 1980), it has been neglected due to the complexity of human nature and difficulty in effectively assessing its impact on software development. In our society today, the software industry has become a major employer and the specialties within software development are as diverse as those in any other profession.

Software development job descriptions (either on- or off-line) normally divide required skills into two broad categories; “technical requirements” and “non-technical requirements”. Figure 1 shows a sample job advertisement which clearly highlights the two categories of skill requirements. The text inside the “Solid line” rectangle highlights the technical requirements of the job whereas the text inside “dotted line” rectangle shows non-technical requirements also commonly known as soft skills. Whilst technical skills also known as “hard skills” refer to the technical knowledge and abilities that an individual should have to carry out the tasks associated with the position. Soft skills grew from the domain of psychology and pertain to a broad range of characteristics involving personality traits, social interaction abilities, communication, and personal habits. It is also important to highlight here that the term soft skills often interchangeable with “people skills”, “non-technical skills”, “emotional intelligence”, or “social skills”

Job Title: Java Programmer

JOB REQUIREMENTS

This position offers extensive opportunity for growth, a fun working environment and includes a fully paid company benefits package.

The successful candidate will be responsible for the following activities: analysis of business requirements, and development of application proprietary systems. To accomplish the primary responsibilities, a solid understanding of Java, JavaScript and SQL are necessary. Programmers must work closely with the Project Manager to interpret business requirement, and effectively develop the application according to the requirement. Programmers must also maintain a functional understanding of database architecture and be able to write reports using the iReport toolkit as well be able to write custom jsp pages. Programmers may be responsible for meeting directly with clients and assisting the project manager with the gathering and organization of system requirements. Programmers also may be responsible for generating documentation about the system being developed, and should be capable of writing clear and polished documents.

Required Skills

Technical Skills Requirements

Programming experience in SQL, Java, java script, web application and relational database (SQL Server, Oracle), Experience in J2EE architecture,

Strong analytical skills (ability to digest requirements and produce design).
 Excellent verbal and written communication skill.
 Strong interpersonal skills and problem solving abilities.
 Ability to work independently, and a fast learner.

Soft Skills Requirements

Figure 1.
A sample job advertisement from a job portal

in literature. In order to perform the job successfully, an employee should not only master specific technical skills, but he or she should possess other important soft skills, e.g. team work ability, a work ethic, and communication skills (Stolte and Munjanganja, 2008). Soft skills are the personal individuality that has a major impact on the behavior of a person during their interaction with others in a work environment. Denning and Dunham (2001) conclude that employers say that information technology graduates lack important skills needed in the workplace, notably knowledge of current information technology and various “soft” skills”, including presentation, customer relations, leadership, and team work. In the collaborative environment of software development the possession and use of soft skills enhances the likelihood of an individual’s success and contributes positively towards the common goal of the project. Soft skills are usually overlooked in software development because the relationship between software development activities and soft skills is extremely complex to investigate. It is also because researchers from the software development community primarily concentrate on the “engineering” aspects of the process which mostly deals with technical skills.

A. Research motivations and contributions

Over a period of time trend of global software industry is constantly growing and the main reason for this growth is increase in the supply and demand of software as well as cost reduction. The term global software industry has broad meanings across the world. Software development can mean having development sites at various parts of the world as well as employing people from various parts of the world to carry out software development activities. The result of this global software development activity gives rise to the concepts of software outsourcing, and virtual teams. The global software industry hires people from different part of the world having different cultures and norms. When people interact the complexity of work relationship has an impact on the productivity. According to Gupta and Raval (1999) cultural issues can “make or break an offshore project”. Keeping in view the increasing shift in out sourcing and virtual team development it is worth investigating up to what extent different cultures consider soft skills while hiring a new employee.

Specific studies concerning soft skills and software development profession have been sporadic and often incidental, which highlights the initial motivation of this work. Moreover, no concrete work has been reported in the area of soft skills and their demand as a part of job requirement sets in diverse cultures. The major contribution of this work is to provide an opportunity to empirically understand and investigate non-technical job requirements (soft skills) in diverse cultures for different software development roles. It is important to highlight here that it is not the objective of this work to empirically investigate or show that culture has an impact on the job performance or analyzing which soft skills are more suitable to which software development role. It is also beyond the scope of this work to investigate the importance or significance of soft skills and up to what extent the employers weigh soft skills while hiring a new employee. Whereas, in this work we attempt to find whether the requirements of soft skills changes across culture or remains similar for different software development roles.

B. Study research question

A fundamental motivation of this study is to find out the answer of the following research question from the perspective of the software industry:

RQ. Are employers' soft skills requirements, as advertised in job postings, within different roles of software development, similar across different cultures of the world?

In this study we consider nine soft skills which include 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. We found these nine soft skills are most commonly used in the description of job advertisements and in the literature survey, which highlights the reason for their inclusion in this study. In order to find out the answer to the *RQ* as stated above we further refine here the *RQ* into sub-*RQs* for the purpose of better understanding and segregation of individual roles:

RQ1. Are employers' soft skills requirements, as advertised in the job postings of system analyst, similar across different cultures of the world?

RQ2. Are employers' soft skills requirements, as advertised in the job postings of software designers similar across different cultures of the world?

RQ3. Are employers' soft skills requirements, as advertised in the job postings of computer programmers, similar across different cultures of the world?

RQ4. Are employers' soft skills requirements, as advertised in the job postings of software tester, similar across different cultures of the world?

II. Literature survey

We divided the literature survey into three sub-sections; the first sub-section highlights the work carried in the area of human factor and information systems which mainly revolves around personality traits; the second sub-section describes the work related to the soft skills and software development and highlights the absence of related work in the field of information systems; the final sub-section provides information the definition of culture and how it is related to software development.

A. Literature survey of human factor in software development

Software is developed by people, used by people, and supports people's work. Although it is important to understand the characteristics and personality traits of people involved in software development, little attention has been paid to these aspects (Wade and Parent, 2001). Karn and Cowling (2005) investigated the effects of different personality types on the working of software engineering teams. The results of the study indicated that certain personality types were more inclined to certain roles. Using the 16PF test (Russell and Karol, 1994), Acuna *et al.* (2006) measured the correspondence between individual capabilities, such as intrapersonal, organizational, interpersonal, management, and software roles, including team leader, quality manager, requirements engineer, designer, programmer, maintainer, tester, and configuration manager. Feldt *et al.* (2008) evaluated the personality of 47 software professionals using the IPIP 50-item five-factor personality test (Buchanan *et al.*, 2005). After extensive statistical analyses, they found that there are multiple and significant correlations between personality factors and software engineering, and they concluded that individual differences in personality can explain and predict how judgments are made

and how decisions are evaluated in software development projects. Hannay *et al.* (2010) reported the impact of the Big Five (Goldberg, 1990) personality traits on the performance of pair programmers together with the impact of expertise and task complexity. Furthermore, Shneiderman (1980) reported that some programmers performed as much as ten times better than other programmers with similar backgrounds. Wynekoop and Walz (2000) derived a methodology for identifying the traits and characteristics of top performing software developers. Turley and Bieman (1995) also seek to identify the attributes that differentiate exceptional and non-exceptional software engineers and map them to the Myers-Briggs Type Indicator (MBTI) scale. Teague (1998) tried to map the MBTI dimensions into three major subtasks of computing: system analysis, system design, and programming. Bishop-Clark (1995) investigated the relationship between cognitive aspects, personality traits, and computer programming. There is clear evidence that personality preferences have great impact on motivation, quality of work, and retention in the field of software engineering (Kaluzniacky, 2004). Capretz and Ahmed (2010) mapped some opposing personality traits, such as extroversion-introversion, sensing-intuition, thinking-feeling, and judging-perceiving, to the main stages of a software development life cycle. DeSouza *et al.* (2009) observed that human characteristics, behavior, and cooperation are central to practical software development.

B. Literature survey of soft skills

Soft skills refer to the cluster of personality traits and attitudes that drives one's behavior (Roan and Whitehouse, 2007). Some classical sets of soft skills are active listening, negotiating, conflict resolution, problem solving, critical thinking, ethics, and leadership skills (Dash, 2001; Gorman, 2000; Isaacs, 1998; Schulz, 1998). Soft skills complement the technical skills of a job (Lewis *et al.*, 2008). According to Goleman (1995) the possession and use of soft skills contributes more to an individual's ultimate success or failure than technical skills or intelligence. Bolton (1986) reported that 80 percent of individuals, who fail at work, do not fail due to their lack of technical skills but rather because of their inability to relate well with others. A lack of soft skills is more likely to get an individual's employment terminated than a lack of cognitive or technological skills (Behm, 2003). McGee (1996) reported that 68 percent of CIOs said that "soft skills", i.e. skills of a non-technical nature such as communication and team building, are more important today than five years ago. Young and Lee (1996) and van Slyke *et al.* (1998) found that employers tend to rate non-technical skills higher than technical skills. Cappel (2002) concluded that non-technical skills such as oral and written communication, problem solving, and the ability to learn apply to virtually all information systems jobs. According to the survey of Green (1989) behavioral skills such as diplomacy, politics, and sales are important in performing the job of system analyst. Khan and Kukalis (1990) concluded that both hard and soft skills are important, but the hard skills are considered less important than soft skills. Leitheiser (1992) found that people-oriented and organizational skills were more important than technical skills. Trauth *et al.* (1993) examined the perceived importance of skills for information systems professionals and their academic preparation. Leitheiser's (1992) survey of information systems managers ranked interpersonal communication skills as most important. Wade and Parent (2001) found that analysts perceive organizational skill as most important. Litecky *et al.* (2004) presented an overview of studies dealing

with the paradox of soft skills versus technical skills in hiring. On the contrary some surveys such as (Green, 1989; Byrd and Turner, 2004; Lau *et al.*, 1997) concluded that technical skills are most important in managing information systems.

C. Culture and software development

Hofstede (1994) called culture the “software of the mind” because much like an operating system in a computer it provides us with essential code by which we make sense of the world. According to Samovar and Porter (1995) culture is the deposit of knowledge, experience, beliefs, values, attitudes, meanings, hierarchies, religion, notions of time, roles, spatial relations, concepts of the universe, and material objects and possessions acquired by a group of people in the course of generations through individual and group striving. Fiske *et al.* (1998) concluded that culture also molds the way people think: what their motivations are, how they categorize things, what inference and decision procedures they use, and the basis on which they evaluate themselves. There has been a significant volume of research in the area of social sciences to elaborate the differences between cultures. For example, Hofstede (1994) identified five factors to show the difference of cultures such as revering hierarchy, individualism versus collectivism, task- or relationship-focused, risk avoidance, and long-term orientation in a working environment. Faure and Rubin (1993) described culture as a set of shared and enduring meanings, values, and beliefs that characterize national, ethnic, or other groups and orient their behavior. Ein Dor *et al.* (1992) proposed some cultural variables that affect information systems development. Shore and Venkatachalam (1995) elaborate the influence of national cultural factors on the approaches to parts of the systems development lifecycle. Harrison and Farn (1990) highlighted the need for research on the impact of national and cross-cultural issues in case of software development. The soft skills take influence from culture, for example Olson and Olson (2003) mention that in the case of the USA and The Netherlands individualism is very high whereas in the case of China, West Africa, and Indonesia it is more collective. This means that China, West Africa, and Indonesia are more team oriented cultures.

III. Survey setup and data

In this survey of the software job market we analyzed the soft skills required by the software industry for various names of software development roles. We collected data concerning nine soft skills which 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. In order to better understand the usage and significance of these soft skills we provide here some elaboration of these concepts. Communication skills are the set of skills that enables a person to convey information so that it is received and understood (Kushal and Ahuja, 2009). The term interpersonal skill refers to the person’s ability to behave in ways that increase the probability of achieving the desired outcomes. This means that it is a goal-directed behavior of individual used in face-to-face interactions in order to bring about a desired state of affairs (Hayes, 2002). Analytical skill is the ability to break a situation down into its component parts, recognize what needs to be done and plan a suitable course of action in a step-by-step way (Parkinson, 2008). Problem solving skills are the ability to evaluate a situation and to identify an appropriate solution that meets the customers’ needs (Parkinson, 2008). Being innovative is the ability to produce

or propose imaginative and practical solutions to business problems (Parkinson, 2008). Being a team player refers to an individual who is good at working closely with other people (Parcon, 2007). Organizational skill is the ability of an individual to assess and prioritize tasks and ensure that they are completed in a timely manner (Beard *et al.*, 2009). Being open and adaptable to change reflects the personality of an individual to accept changes in the carrying out of tasks without showing resistance. An employee can be defined as a fast learner if they are able to adapt to new tasks, roles, or challenges effectively and with ease (Goleman, 1998). The ability to work independently narrates the individual's capability to operate with a reduced level of supervision in order to plan and successfully complete tasks independently (Beard *et al.*, 2009).

A. Data collection procedures and description

The survey consists of 500 jobs advertised across four major regions of the world, i.e. North America, Europe, Australia, and Asia. In this survey study we visited some of the leading online job seeking portals such as workopolis.ca (North America), eurojobs.com (Europe), monsterindia.com (Asia), and seek.com.au (Australia). A complete web site address and sample web site link of survey data is illustrated in the Appendix. It is also important to mention here that since the advertised jobs normally remains on the web site for about one month or so and later they are removed from the website therefore the sample link in the Appendix provide the message of "Job no longer exists" now:

- *Dataset description.* Figure 2 shows the geographical distribution of the survey data. The geographical distribution of the dataset covers North America (31 percent), Europe (26 percent), Asia (23 percent), and Australia (20 percent). Figure 1 also shows the job classifications of the survey data. The total dataset of 500 jobs covers system analysts (23 percent), software designer (21 percent), computer programmer (28 percent), and software tester (28 percent). Figure 3 shows the summary of the data collected for this survey with respect to geographical region (North America, Europe, Asia, and Australia) and job category (system analysts, software designer, computer programmer, and software tester).

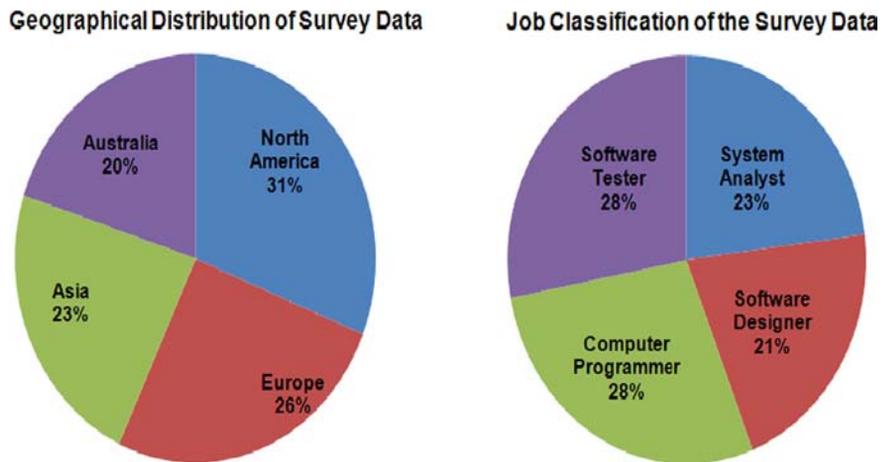


Figure 2.
Geographical distribution
and job classification
of the survey data

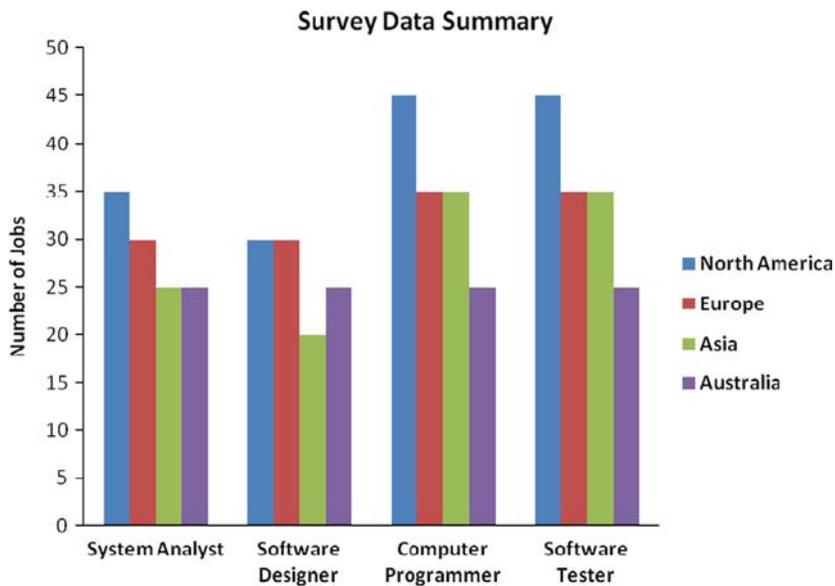


Figure 3.
Data summary of the survey geographical and job classification

We stopped our search after collecting 500 records. We assumed that the size of the dataset is reasonable enough to conduct empirical study.

- *Data collection period.* We visited manually each of the above mentioned online job portals to collect the data. No specific consideration was given to the selection of timing for the data collection the choice was simply random or opportunistic and falls into the tenure we worked on this research project.
- *Job title criteria.* We examined jobs advertised under the exact and related titles of “system analyst”, “software designer”, “computer programmer”, and “software tester”. The examples of related titles for computer programmer are such as “software developer”, “coder”, and “application developer”. Similarly in case of system analyst some of the related titles were “business analyst”, “requirements analyst”, “technical analyst”, and “application analyst”. In the case of software tester they were “application tester”, “quality assurance & tester”, “system tester”, and “web tester”. While for software designer we also considered the titles of “software architect”, “application designer”, and “solution architect”.
- *Soft skills criteria.* When we visited a job page the inclusion of the job post in the study dataset was dependant on the categorical presence of at least one of the above mentioned soft skills in the job posting. Therefore, we looked specifically for the key words which related to these soft skills. In some cases we found the exact match of the soft skills and some cases we made the selection on the basis of synonymous use of these soft skills. An example synonymous use of “communication skills” can be “good oral and written skills”, “good presenter”, “presentation skills”, etc. If we did not find any match then we skipped the job and moved on the next advertisement sequentially. The reason behind the selection of these nine soft skills in this study’s dataset is primarily based on the literature survey depicted in Table I. We found these nine skills most commonly

Table I.
Literature highlights
of soft skills

Source	Soft skills
Misic and Graf (2004)	Analytical and communication skills
Boivie <i>et al.</i> (2006)	Communication, team player, open and adaptable to changes, interpersonal, analytical and problem solving skills and being innovative
Sterling and Brinthaupt (2004)	Communication, analytical and problem solving, organizational, interpersonal skills and creative
Burnstein (2003)	Communication, analytical and problem solving, team player, open and adaptable to changes and creative
Cappel (2002)	Oral and written communication, problem solving, and the ability to learn
Leitheiser (1992)	Interpersonal, communication skills
Russell <i>et al.</i> (2005)	Interpersonal, team player, analytical and problem solving, creative, organizational skills
Gallivan <i>et al.</i> (2004)	Communication, interpersonal, leadership, organization, self-motivation, and creativity
Coll <i>et al.</i> (2002)	Ability and willingness to learn, teamwork and initiative
Snell <i>et al.</i> (2002)	Team work, communication and interpersonal skills, customer service, leadership, motivation and willingness to learn
Chinn and VanDeGrift (2008)	Communication, interpersonal skills
McGee (1996)	Communication, team player
Wade and Parent (2001)	Organizational skills

reported in the literature. We also found during the data collection that these nine soft skills are most commonly present in the various advertisements of the jobs we visited.

(1) *Hypotheses and testing techniques.* In order to empirically investigate the answers of the research questions *RQ1-RQ4* we hypothesize the following:

- H1.* Employers' soft skills requirements, as advertised in job postings of system analyst are similar across different cultures of the world.
- H2.* Employers' soft skills requirements, as advertised in job postings of software designer are similar across different cultures of the world.
- H3.* Employers' soft skills requirements, as advertised in job postings of computer programmer are similar across different cultures of the world.
- H4.* Employers' soft skills requirements, as advertised in job postings of software tester are similar across different cultures of the world.

We used the Kendall coefficient of concordance (*W*) (van Eye and Mun, 2005) and kappa statistics (Cohen, 1960) to assess agreement or similarity in the soft skills requirements as advertised in the job postings and to test the significance of the *H1-H4*. Cohen's kappa (Cohen, 1960) statistic is a popular measure for measuring the degree of similarity (or agreement) in two samples and extensions to Cohen's kappa measure have been proposed for more than two samples (Unnikrishnan and Hebert, 2005). Kendall's coefficient of concordance (*W*) is a measure of the agreement among several (*p*) judges who are assessing a given set of *n* objects and depending on the application field,

the “judges” can be variables, characters, and so on (Legendre, 2005). The Kendall coefficient of concordance (W) is often preferred to evaluate inter-rater agreement in comparison to Cohen’s kappa (Cohen, 1960) in case of ordinal data (van Eye and Mun, 2005). “ W ” is an index of the divergence of the actual agreement shown in the data from the possible perfect agreement. Values of Kendall’s W and κ -coefficient can range from 0 to 1, with 0 indicating perfect disagreement or dissimilarity, and 1 indicating perfect agreement (Landis and Koch, 1977) or similarity. Altman (1991) and Fleiss (1981) provided interpretation of κ -values shown in Table II. The result of the statistical calculations for the Kendall coefficient of concordance (W) and kappa statistics are reported in Table III and we used Table II to interpret the results.

IV. Survey results and discussion

The results of this investigation will be discussed separately based on the role performed by a software engineer such as system analyst, designer, programmer, and tester. We used a three point scale of “high in demand (>66 percent)”, “moderate in demand (>33 percent and ≤66)”, and “low in demand (≤33 percent) to present linguistically the requirement of soft skills in software industry.

A. System analyst

(1) *Descriptive statistics and hypothesis testing.* In the collection of 115 system analyst opportunities from North America, Europe, Asia and Australia, all four geographical regions of this study show a high demand for communication skills, including North America (100 percent), Europe (83 percent), Asia (96 percent) and Australia (88 percent). In the case of interpersonal skills only Asia (44 percent) shows a moderate demand whereas all other regions, North America (31 percent), Europe (20 percent), and Australia (12 percent) show low demand. Analytical and problem solving skills are in high demand in North America (94 percent) and Australia (68 percent) and in moderate

Altman (1991) κ benchmark	Fleiss (1981) κ benchmark
< 0.20 poor	< 0.40 poor
0.21-0.40 fair	0.40-0.75 intermediate to good
0.41-0.60 moderate	> 0.75 excellent
0.61-0.80 good	
0.81-1.00 very good	

Table II.
Interpretation of κ -vlaues

Job role	Kendall statistics		κ statistics		Z
	Kendall’s coefficient of concordance (W)		χ^2	κ coefficient	
System analyst	0.40		12.54 ***	0.39	3.97 *
Software designer	0.92		29.64 *	0.79	7.90 *
Computer programmer	0.57		18.35 **	0.62	6.23 *
Software tester	0.83		26.62 *	0.68	6.57 *

Note: Significant at: * $p < 0.001$, ** $p < 0.01$ and *** $p > 0.05$

Table III.
Hypotheses testing of similarity

demand at Asia (64 percent) and Europe (46 percent). Organizational skills are in moderate demand at North America (65 percent) and Asia (40 percent) whereas they are in low demand in Europe (20 percent), and Australia (16 percent). The skill of being a fast learner is given little attention in all four geographical regions and is generally in low demand, North America (17 percent), Europe (3 percent), Australia (8 percent), and Asia (12 percent). Team player skills are in high demand in North America (77 percent), Europe (66 percent), and Asia (68 percent), while this skill is in moderate demand in Australia (48 percent). The ability to work independently skill is in moderate demand in the North American job market (51 percent) while the remaining three regions consider this as a low demand skill, Europe (20 percent), Australia (12 percent) and Asia (20 percent). Innovative and creative thinking ability is in low demand in North America (8 percent), Europe (6 percent), Australia (12 percent), and Asia (0 percent). Open and adaptable to changes is only moderately in demand in the North American job market (42 percent) whereas the rest of the regions are not paying much attention to this skill in job requirements, Europe (13 percent), Australia (8 percent), and Asia (8 percent). Figure 4 shows the survey results. The *HI* was tested using the Kendall coefficient of concordance (W) and kappa statistics and the results are reported in Table III. The hypothesis is not accepted based on χ^2 value of 12.54 and Kendall coefficient of concordance 0.40 was not significant at $p < 0.05$. The kappa statistics also further support the rejection of *HI* (κ -coefficient: 0.39, Z : 3.97, $p < 0.01$) because of the low value of the κ -coefficient according to interpretation of kappa presented in Table II. Therefore, we conclude that employers' soft skills requirements, as advertised in job postings of system analyst are not similar across different cultures of the world.

(2) *Result discussion.* The descriptive statistics and statistical tests for the significance of *HI* provides us support to conclude the answer of *RQ1*, that there is no similarity in soft skills requirements as advertised in the job descriptions of systems

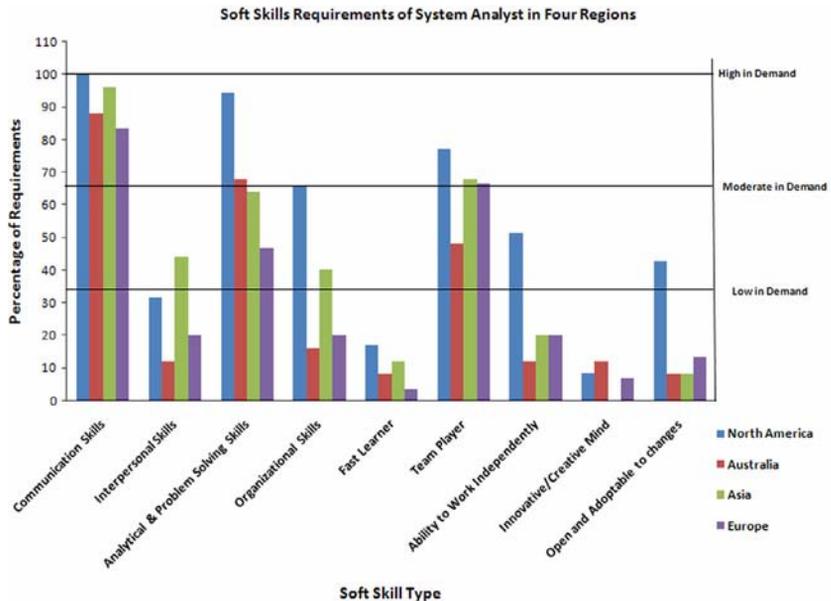


Figure 4.
Soft skills qualifcatons
of system analyst

analyst across different cultures. The descriptive statistics also show that only in cases of communication skills, being a fast learner and innovative, does similarity in requirements exist, and that the remaining six skills have varying requirements across different cultures. The broader job description of a system analyst is a role that requires the identification of high-level components in a real-world application and decomposition of the software system (Kendall, 1992). The analysis shows that the North American job market considers communication, analytical and problem solving, and team player skills to be in high demand while the ability to work independently, open and adaptable to changes and organizational skills are in moderate demand. Whereas interpersonal skills, fast learner and innovative and creative mind are in low demand at the North American market. The Australian job market exhibits a high demand for communication and analytical and problem solving skills while team player skills are in moderate demand. On the other hand the remaining six soft skills under this survey such as ability to work independently, open and adaptable to changes, organizational skills, interpersonal skills, fast learner and innovative and creative mind are in low demand. Asian job market also weights communication and team player in high demand whereas analytical and problem solving, organizational skills, and interpersonal skills are in moderate demand. Fast learner and innovative and creative mind, ability to work independently, and open and adaptable to changes skills are in low demand in the Asian software industry. In the case of European software industry communication and team player skills are in high demand and analytical and problem solving skills are in moderate demand. While fast learner and innovative and creative mind, ability to work independently, and open and adaptable to changes, organizational skills, and interpersonal skills are in low demand.

B. Software designer

(1) Descriptive statistics and hypothesis testing. We collected data for 105 software designer roles from the opportunities advertised in the job market and analysis shows that in case of communication skills all four geographical regions included in this study demonstrated a high demand, with values of, North America (96 percent), Europe (86 percent), Asia (95 percent), and Australia (92 percent). In case of interpersonal skills all four geographical regions of this study also shows a high demand such as North America (93 percent), Europe (83 percent), Asia (95 percent), and Australia (100 percent). Analytical and problem solving skills are in moderate demand in North America (46 percent), Asia (35 percent), and Europe (43 percent) while in low demand in Australia (32 percent). Organizational skills are in low demand in all four geographical regions North America (26 percent), Europe (10 percent), Australia (8 percent), and Asia (20 percent). The skill of fast learner is not being given much attention in any of the four geographical regions and is in low demand, only in North America (10 percent) was it found to be given some consideration while we did not find any job advertisement describing this skill as a requirement in European, Australia and Asia. Team player skills are in moderate demand in North America (66 percent), Europe (53 percent), and Asia (40 percent), whereas in Australia (32 percent) it is in low demand. The skill to work independently is in low demand in all four regions of North America (20 percent), Australia (12 percent), and Asia (5 percent) whereas we did not find any job advertisement describing this skill as a requirement in Europe. Innovative and creative thinking ability is in low demand in North America

(6 percent), Europe (10 percent), Australia (0 percent), and Asia (5 percent). Open and adaptable to changes was found to be in low in demand in the North American job market (10 percent) while the remaining three regions are not paying any attention to this skill in job requirements. Figure 5 shows the results. The $H2$ was tested using the Kendall coefficient of concordance (W) and kappa statistics and the results are reported in Table III. The hypothesis is accepted based on χ^2 value of 29.64 and Kendall coefficient of concordance 0.92 significant at $p < 0.001$. The kappa statistics also further support the acceptance of $H2$ (κ -coefficient: 0.79, Z : 7.90, $p < 0.001$). Therefore, we conclude that employers' soft skills requirements, as advertised in job postings of software designer are substantially similar across different cultures of the world.

(2) *Result discussion.* The descriptive statistics and statistical tests for the significance of $H2$ provides support to conclude the answer of $RQ2$, that substantial similarity exists in soft skills requirements as advertised in the job descriptions for software designer across different cultures. The descriptive statistics also show that seven out of nine soft skills have similarity in requirements across different cultures. Software design is an exploratory process: the designer looks for components by trying out a variety of schemes in order to discover the most natural and reasonable way to refine the solution (Budgen, 2003). The analysis shows that the North American job market considers communication, interpersonal, and team player skills high in demand while analytical and problem solving skills are in moderate demand. Conversely the ability to work independently, open and adaptable to changes and organizational skills, fast learner and innovative and creative mind are in low demand in the North American market. The Australian job market requires communication and interpersonal skills in high demand whereas analytical and problem solving skills, team player, ability to work independently, open and adaptable to changes, organizational skills, fast learner and

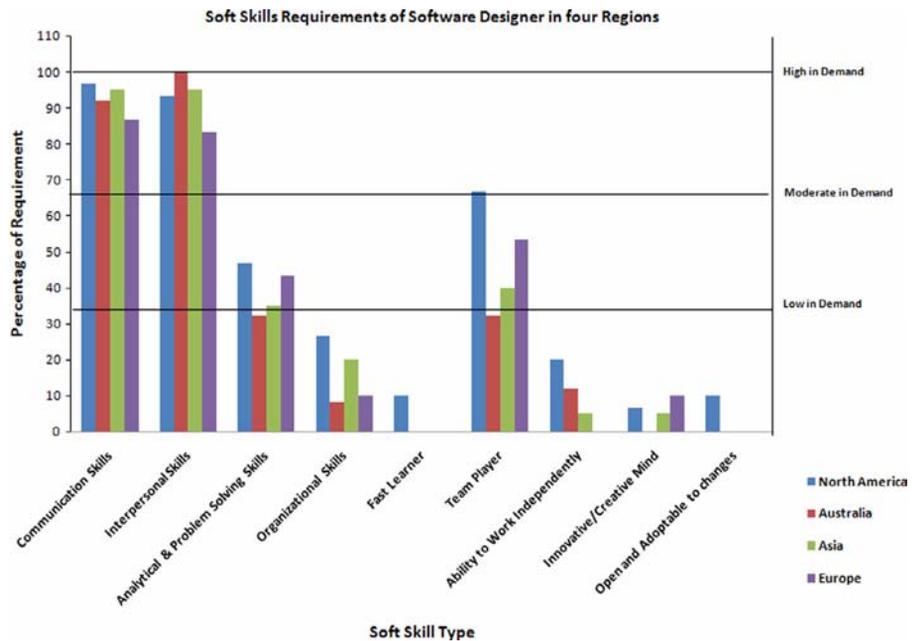


Figure 5. Soft skills qualifications of software designer

innovative and creative mind are in low demand. The Asian job market weights communication and interpersonal skills to be in high demand while analytical and problem solving and team player skills are in moderate demand. Skills in low demand in the Asian software industry are being a fast learner, organizational skills, having an innovative and creative mind, the ability to work independently, being open and adaptable to change. In the case of the European software industry, communication and interpersonal skills are in high demand and team player and analytical and problem solving skills are in moderate demand. Whereas fast learner and innovative and creative mind, ability to work independently, and open and adaptable to changes, and organizational skills, are in low demand.

C. Software programmer

(1) *Descriptive statistics and hypothesis testing.* We collected data from 140 job descriptions for computer programmers from the software job market and analysis shows that in the case of communication skills all four geographical regions of this study exhibit a high demand such as North America (88 percent), Europe (91 percent), Asia (85 percent), and Australia (96 percent). In case of interpersonal skills two geographical regions of this study also show a high demand, Australia (80 percent) and Asia (71 percent) while North America (62 percent) and Europe (54 percent) demonstrated a moderate demand. Analytical and problem solving skills are in moderate demand in North America (62 percent), Asia (51 percent), Europe (54 percent), and Australia (36 percent). Organizational skills are in moderate demand in the three geographical regions of North America (48 percent), Europe (34 percent), and Asia (40 percent) and are in low demand in case of Australia (20 percent). The skill of fast learner not being given much attention in any of the four geographical regions and is in low demand, North America (4 percent), Europe (5 percent), Asia (2 percent) and Australia (0 percent). Team player skills are in high demand in North America (80 percent) only, whereas in the case of Europe (60 percent), Asia (42 percent), and Australia (64 percent) it is in moderate demand. The skill to work independently is in moderate demand in the case of North America (51 percent), and is in low demand in the remaining three regions of Australia (20 percent), Asia (25 percent), and Europe (28 percent). Innovative and creative thinking ability is in low demand at North America (17 percent), Europe (20 percent), Australia (4 percent), and Asia (2 percent). Open and adaptable to changes is only low in demand in the North American (6 percent) and the European (2 percent) job market whereas the remaining two regions are not paying any attention to this skill in job requirements. Figure 6 shows the survey results. The $H3$ was tested using the Kendall coefficient of concordance (W) and kappa statistics and the results are reported in Table III. The hypothesis is accepted based on χ^2 value of 18.35 and Kendall coefficient of concordance 0.57 significant at $p < 0.01$. The kappa statistics also further support the acceptance of $H3$ (κ -coefficient: 0.62, Z : 6.23, $p < 0.001$). Therefore, we conclude that employers' soft skills requirements, as advertised in job postings of computer programmer are substantially similar across different cultures of the world.

(2) *Result discussion.* The descriptive statistics and statistical tests for the significance of $H3$ provides us with support to conclude that the answer of $RQ3$ is that there exists a substantial similarity in soft skills requirements as advertised in the job descriptions of computer programmer across different cultures. The descriptive statistics also show that five out of nine soft skills have similarity in requirements across

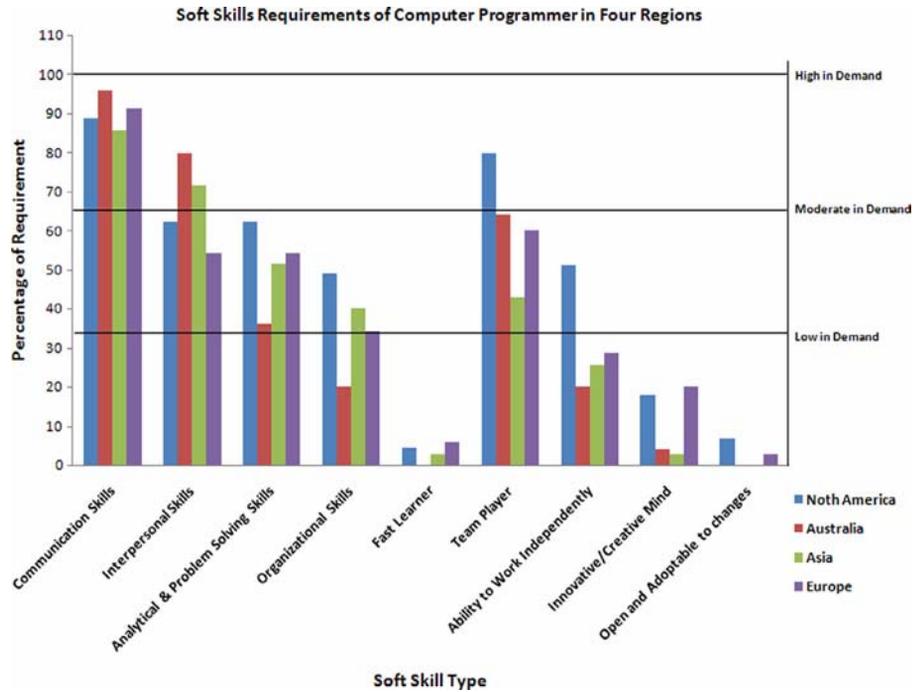


Figure 6.
Soft skills desirable for
a computer programmer

different cultures. The simplest definition of a programmer’s job is translating a refined version of the design into a computer executable program (Weinberg, 1971). The broader technical aspects of this phase requires the identification of control structures, relevant variables and data structures, and a detailed understanding of the syntax and specifics of a given programming language. The analysis shows that the North American job market only considers communication and team player skills high in demand whereas interpersonal skills, analytical and problem solving, ability to work independently, and organizational skills are in moderate demand. By contrast, being open and adaptable to change, a fast learner, an innovative and creative mind are in low demand in the North American market. The Australian job market requires communication and interpersonal skills in high demand whereas analytical and problem solving and team player skills are in moderate demand. The ability to work independently, be open and adaptable to change, organizational skills, fast learner, an innovative and creative mind are in low demand. The Asian job market weights communication and interpersonal skills in high demand while analytical and problem solving, team player and organizational skills are in moderate demand. Being a fast learner, innovative and creative mind, ability to work independently, and open and adaptable to change skills are in low demand in the Asian software industry. In the case of the European software industry only communication skills are in high demand whereas team player, analytical and problem solving, interpersonal and organizational skills are in moderate demand. In addition it was found that fast learner and innovative and creative mind, ability to work independently, and open and adaptable to changes, are in low demand.

D. Software tester

(1) *Descriptive statistics and hypothesis testing.* We collected the data of 140 job descriptions for software testers advertised in the software job market and analysis shows that in the case of communication skills all four geographical regions of this study show a high demand, such as North America (76 percent), Europe (80 percent), Asia (82 percent), and Australia (75 percent). In case of interpersonal skills all four geographical regions of this study exhibit a low demand, such as North America (21 percent), Europe (28 percent), Asia (25 percent), and Australia (13 percent). Analytical and problem solving skills are in moderate demand in North America (60 percent), Europe (52 percent), and Australia (36 percent) while in low demand in the case of Asia (20 percent). Organizational skills are in moderate demand in two geographical regions of North America (47 percent), and Australia (38 percent) whereas in the cases of Europe (32 percent) and Asia (22 percent) it is in low demand. The skill of being fast learner is not given much attention in any of the four geographical regions and is in low demand, North America (6 percent), Europe (8 percent), Asia (0 percent), and Australia (2 percent). Team player skills are in moderate demand in North America (39 percent) only, while in cases of Europe (32 percent), and Asia (11 percent), and Australia (25 percent) it is in low demand. The skill to work independently is in low demand in all four regions, North America (19 percent), Australia (30 percent), Asia (2 percent), and Europe (16 percent). Innovative and creative thinking ability is in low demand in North America (8 percent), Europe (12 percent), Australia (0 percent), and Asia (5 percent). Open and adaptable to change is low in demand in North America (2 percent), Europe (12 percent), Asia (0 percent), and Australia (8 percent). Figure 7 summarizes

Open and adaptable to change is low in demand in North America (2 percent), Europe (12 percent), Asia (0 percent), and Australia (8 percent). Figure 7 summarizes

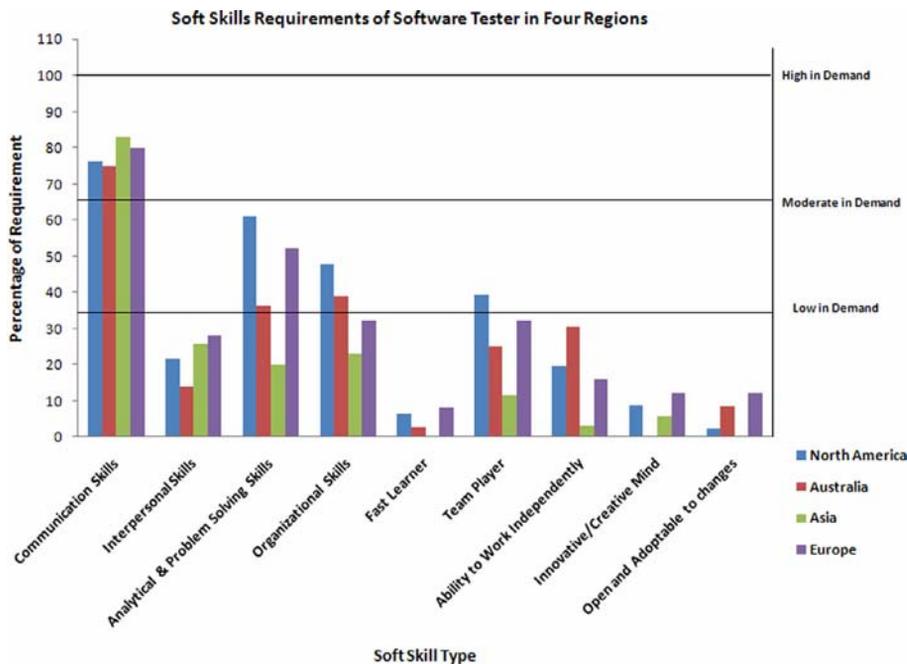


Figure 7.
Soft skills desirable for a software tester

the survey results. The $H4$ was tested using the Kendall coefficient of concordance (W) and kappa statistics and the results are reported in Table III. The hypothesis is accepted based on χ^2 value of 26.62 and Kendall coefficient of concordance 0.83 significant at $p < 0.001$. The kappa statistics also further supports the acceptance of $H4$ (κ -coefficient: 0.68, Z : 6.57, $p < 0.001$). Therefore, we conclude that employers' soft skills requirements, as advertised in job postings of software tester are substantially similar across different cultures of the world.

(2) *Result discussion.* The descriptive statistics and statistical tests for the significance of $H4$ provides us with support to conclude that the answer of $RQ4$ is that substantial similarity exists in the soft skills requirements as advertised in the job descriptions of software tester across different cultures. The descriptive statistics also show that six out of nine soft skills have similarity in requirements across different cultures. Software testers are considered the worst enemies in the software development team because they are the group who carries the bad news of defects, which requires good communication and interpersonal skills to keep the team active and avoid conflicts (Whittaker, 2000). The analysis revealed that the North American job market only considers communication skills high in demand whereas team player, analytical and problem solving, and organizational skills are in moderate demand. By contrast, interpersonal skills open and adaptable to changes, ability to work independently, fast learner and having innovative and creative mind are in low demand in the North American market. The Australian job market also requires only communication skills in high demand whereas analytical and problem solving organizational skills are in moderate demand. The ability to work independently, interpersonal, open and adaptable to changes, team player, fast learner and having innovative and creative mind are in low demand. The Asian job market also weights only communication skills in high demand whereas analytical and problem solving, organizational, fast learner, team player, innovative and creative mind, interpersonal ability to work independently, and open and adaptable to changes skills are all in low demand in the Asian software industry. In the case of European software industry only communication skills are in high demand while analytical and problem solving skills are in moderate demand. On the other hand team player, interpersonal, organizational, fast learner and innovative and creative mind, ability to work independently, and open and adaptable to changes, are in low demand.

V. Kills and job roles: analysis and discussion

In this work we provided an in-depth analysis of soft skills requirements in four job roles from software development life cycle across different cultures. In this section our target was to provide an analysis and discussion of the requirements of soft skills in all those four jobs roles. Ideally the job of system analyst requires communication, problem solving, and interpersonal skills because of the active interaction with the client, capturing requirements and providing solution. In this study we observed that communication, team player, and problem solving skills are in high demand. We also observed a moderate demand of organizational skill, whereas interpersonal skills are in low demand. When people interact there are more chances of conflict and disagreement therefore essentially in case of system analyst more emphasis must be given to improve the requirement of interpersonal skills. Designer provides solution to a given problem thus highly requires analytical and problem solving skills. Designers also work

closely with users to ensure that design meets the requirements of the user which highlights the requirements of excellent communication skills and interpersonal skills. Organizational skills enable designer to keep track of all the changes introduced in the design and connect the parts of the design. We observed a high demand of communication and interpersonal skills whereas a moderate demand of analytical and problem skills and team player. However, we found a low demand in organizational skills which needs the further acknowledgement from the software industry. The iterative nature of the software designing process requires a personality having the characteristics of openness and adaptability to changes, but this requirement has not been currently supported by the software industry and the skill sets of openness and adoptability to changes is also one of the least required skills set in demand. The computer programmer identifies control structures, relevant variables and data structures, and requires a detailed understanding of the syntax and specifics of a given programming language, which in turn requires analytical and problem solving skills. Typically programmers work independently on their assigned module thus requires the ability to work independently but also participates in a larger group in case working on large-scale software thus also requires the ability to be a part of a team. We observed a high demand of communication skills only whereas there is moderate demand for interpersonal skills, analytical and problem solving, team player, organizational skills and ability to work independently. A software tester's job is very critical, they target to find bugs in the software and communicate it. Thus, analytical and problem solving skills, along with communication skills are high desirable. Organizational skills are also essential because testing is always carried out in steps from unit to module and from module to integration and it further leads to system. Software testers always use innovative ways to find bugs. We observed only communication skills in high demand whereas there is a moderate demand for analytical and problem solving, and organizational skills. The least required soft skills for software testers we observed are team player, interpersonal skills, ability to work independently, fast learner, innovative and creative and open and adaptable to changes. Figure 8 shows the overall picture of the soft skills requirements in the four different roles of system analyst, software designer, programmer, and tester. Over all communication skills is the only soft skill which is highly desirable across all the four job roles under study in this work. Whereas interpersonal, organizational, team player and analytical and problem solving skills are also given mostly moderately demand across these job roles. The least required skills advertised across these job roles are being innovative, open and adaptable to changes, ability to work independently and being a fast learner.

VI. Limitations of the study and threats to external validity

All empirical investigations and surveys are subject to certain limitations and there are always threats to external validity. This is equally true is the case of this study. The following section highlights some of the limitations of this study:

- (1) The first limitation is the selection and participating soft skills variables of the study. In this study we collected data concerning nine soft skills which include communication skills, interpersonal skills, analytical and problem solving skills, team player, organizational skills, the ability to work independently, innovative and creative mind, fast learner and open and adaptable to change. We found these nine soft skills to be the most commonly used in the

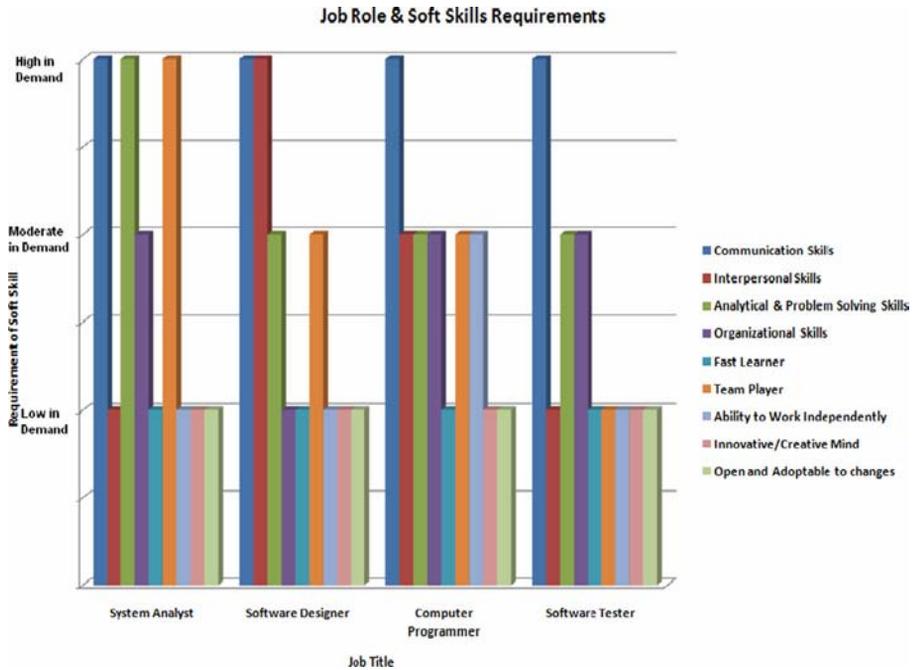


Figure 8.
Job role and soft skills requirements

advertisement of the jobs and in literature. In addition to the selected nine skills there may be other soft skills that influence the performance of software development which have not been included in this study.

- (2) Some other contributing factors to performance of software development are: organization size, economic, experience in software development and political conditions were not considered in this study because we chose to investigate solely the impact of soft skills.
- (3) There are some limitations of this study related to data collection. We collected data from four regions of the world: North America, Europe, Asia, and Australia. This geographical diversity reduces the threats to external validity, however as we used only one source of data collection, i.e. online job portals from each region, this may pose a potential threat to external validity. Conversely, the selection of these job portals for data collection was primarily based on the popularity of these websites amongst job seekers and employers and the volume of data posted.
- (4) Similarly, we collected data about four different roles and their related titles but there may be other denominations of these roles, as well as other types of role in software development which are not considered in this study.
- (5) When we visited each job page we selected a job for inclusion in the dataset only if we found at least one of the nine soft skills under investigation in job description. We did not retain a record of those job advertisements that were visited but which did not specifically list a requirement for at least one of the soft skills under investigation in this study.

- (6) No specific consideration was given to the selection of timing for the data collection the choice was simply random.
- (7) In this study we collected the data from online job portals and after analysis we reported the results. We did not do any further investigation, e.g. who was interviewed, what questions were asked, who got the job, etc.

VII. Conclusion

Software development is a global enterprise with development teams composed of individuals from a variety of countries and cultural backgrounds. The dynamics of how these diverse individuals operate within the development team is an issue that has been generally ignored by researchers and professionals. Soft skills are usually overlooked in the software development profession because the relationship between software development activities and soft skills is extremely complex to investigate. Nevertheless, it has been worthwhile studying which soft skills are required by the software industry and which are overlooked and how the dynamics of this relationship work across different cultures. This survey provides vital information in the form of descriptive statistics about soft skills requirements in different regions of the world. We concluded that the answer to the *RQ* of this study that in the cases of designer, programmer and tester, substantial similarity exists in the requirements of soft skills whereas only in the case of system analyst dissimilarity was presented across different cultures. Overall, we conclude that cultural differences do not have a major impact on the choice of soft skills requirements in hiring new employees.

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Appendix

- (1) North America:
 - Main web site: www.workopolis.com
 - Sample job link: www.workopolis.com/EN/job/11097526

- (2) Europe:
- Main web site: www.eurojobs.com
 - Sample job link: www.eurojobs.com/en/candidate/jobs/49363.html
- (3) Asia:
- Main web site: <http://jobs.monsterindia.com>
 - Sample job link: <http://jobs.monsterindia.com/details/7603842.html?sig=js-1-ef0782457eb60b257b3d1e944e24b512-1>
- (4) Australia:
- Main web site: www.seek.com.au
 - Sample job link: www.seek.com.au/Job/b-designer-b-mainframe-ibm-cobol-and-cics/in/melbourne-inner/16255917

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