A multicultural comparison of software engineers

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ABSTRACT: In this study, the Myers-Briggs Type Indicator (MBTI) is used as a tool to identify personality types of software engineers from Brazil, Cuba and Pakistan. Subsequently, the similarities and differences in the personality profiles of Brazilian, Cuban and Pakistani software engineers are presented and the implications of such comparisons for software development are discussed. Results show that Cuban software engineers tend to be extroverts, whereas Brazilian and Pakistani developers tend to be introverts. There were substantial differences among specific personality types in the last two samples regarding the types: ESTP (Extroverted, Sensing, Thinking, Perceiving), ESTJ (Extroverted, Sensing, Thinking, Judging) and ENTJ (Extroverted, Intuitive, Thinking, Judging). Moreover, neither sample follows a normal distribution considering the United States adult population as a basis for comparison.

INTRODUCTION

Software has become ubiquitous in today's society. However, software engineering is a field that many outsiders and even insiders have strongly stereotyped. It is commonly believed that software engineering is similar to mathematics, with no regard for soft skills. People stereotype the behaviour of software professionals, seeing them as introverts working alone in a corner of their office, avoiding interaction with others; in other words, as typical nerds. Nevertheless, expertise within software engineering today is as diverse as that of the medical profession, with software engineers working as systems analysts, interface designers, programmers, testers, maintainers, help-desk troubleshooters, and so forth. Thus, it can be deduced that the evolution of the software industry requires rigorous studies of personality traits in the profession. In view of that, studies related to the human aspects of software engineering have increased since the 1980s, thus, demonstrating the motivation to understand the personality profiles and social factors that influence software development.

Sitton and Chmelir, for example, listed a number of stereotypes about programmers, such as what they were like and what attracted them to the field [1]. They painted a picture of creative professionals merrily and irreverently solving complicated problems, untrammelled by routine and humdrum details. However, they gave no specific statistics to support their findings. Bush and Schkade tested 58 professionals in one high-tech aerospace company involved with scientific programming only [2]. They found that ISTJ (Introverted Sensing with Extroverted Thinking) at 25%, was the most common type. Further, the second most frequently reported type was INTJ (Introverted Intuition with Extroverted Thinking) (16%), with ENTP (Extroverted Intuition with Introverted Thinking) (9%) third; thinking (74%) and judging (70%) were well represented, too.

Nevertheless, there is more to software engineering than programming. The engineering of software comprises systems analysis, design, programming, testing and maintenance of software systems; each of which demands different abilities. Indeed, each phase involves varied tasks that require different skills. For instance, the skills and activities involved in designing a software system are quite different from the skills and activities necessary to test the software properly [3].

Lyons surveyed 1,229 computer professionals (such as programmers, analysts, engineers and managers) employed by more than 100 different companies in the United States, Australia and Great Britain, including insurance companies, financial institutions, utilities and hardware manufacturers [4]. He too found ISTJ (23%) to be the most common type, with INTJ (15%) in second and INTP (12%) a close third. He also noted that these three types comprised 50% of his sample. Lyons also found thinking (81%) and judging (65%) types to be in the majority; furthermore, 67% of his subjects were introverts. Lyons was the first to observe that R&D companies that do a lot of state-of-the-art development attract and hire more Ns (Intuitive) than Ss (Sensing). The opposite occurs in information systems

departments of ordinary companies, where the bulk of the work involves maintaining and enhancing production systems.

Smith assessed 37 systems analysts (information systems professionals) at a large insurance company in South Africa [5]. The most frequent types in the sample were ISTJ (35%) and ESTJ (30%); there were slightly more introverts (57%), with a heavy bias towards the sensing (81%), thinking (89%) and judging (86%). Interestingly, the four NF (Intuitive-Feeling) combinations were not present at all in this small sample. Larger and diverse samples would allow more comprehensive data and definitive conclusions.

The common thread running through the results of these studies is the prevalence of introvert, thinking, judging, and almost as many sensing as intuitive types among software professionals. In the past, it seemed reasonable to think of computer work as a practical application of mathematical concepts as in the aerospace industry, but this is no longer true. Today, software permeates almost all activities of modern society, a fact which makes software engineering a very broad field of study as opposed to specialised scientific programming of a few decades ago. Software developers can act in occupations without knowing or using mathematics; consequently, the profile of software engineering might have changed.

In addition, software engineering has become a broad field of study; as a result, some skills necessary to work successfully in this area 30 years ago may no longer apply. For example, software design is much more than manipulating formal or semiformal notations. It has everything to do with interactions between designers and users, i.e. the designer's perception of what the user wants, and the user's perception of what he/she really needs, and vice versa. Nowadays, successful software applications are those developed after a tremendous amount of time has been spent with the user in the form of prototyping, experimenting and feedback. This is the proper development life cycle of any useful software system. Obviously, with the change in demands on software engineers, further research is needed to establish up-to-date job descriptions of software developers [6].

The Myers-Briggs Type Indicator (MBTI) is the most commonly used model in empirical studies of human aspects of software engineering [7]. Many studies have utilised MBTI scales to identify personality types and traits of software engineers and information technology specialists. A person's proclivity towards a particular method of acquiring information or making decisions influences his/her preference for certain tasks and jobs. This trend is represented in the personality type distribution tables, which characterise the personality profile of software engineers.

The Myers-Briggs Type Indicator, based on Jung's type theory, defines four dimensions, with two opposing personality types apiece, for a total of eight traits. Although individuals may use all eight characteristics in each of these dimensions, most people tend to prefer one trait in each pair. The four pairs and their corresponding traits are explained as follows:

- First: Extroverts (E) are individuals whose attention is focused on objects and people, and they prefer to communicate and process information verbally. Conversely, Introverts (I) concentrate on their inner world of ideas, emotions and impressions; and consequently, they tend to process information inside their heads.
- Second: Sensing (S) individuals are those attuned to the practical, hands-on, common-sense view of events. On the other hand, Intuitive (N) refers to people who pay attention to complex interactions patterns, theoretical implications and new possibilities.
- Third: Feeling (F) individuals consider human factors and make judgments based on their value. Conversely, thinking (T) denotes people who draw conclusions or make judgments dispassionately and analytically in addition to seeking an objective standard of truth.
- Finally: Perceiving (P) covers those individuals who demonstrate flexibility and spontaneity; while Judging (J) aims at people who tend to seek closure, structure and organisation.

Thus, there are 16 possible configurations of personality types. In order to provide an example, if the MBTI results show that a person is ENTP, then, the appropriate terminology suggests that the person prefers ENTP. It must be comprehended that there are no rights or wrongs in the personality types, merely preferences. Table 1 presents the United States personality type distribution of its adult population [7].

Table 1: The 16 MBTI types and their distribution among the US adult population [7].

ISTJ 11.6%	ISFJ 13.8%	INFJ 1.5%	INTJ 2.1%
ISTP 5.4%	ISFP 8.8%	INFP 4.4%	INTP 3.3%
ESTP 4.3%	ESFP 8.5%	ENFP 8.1%	ENTP 3.2%
ESTJ 8.7%	ESFJ 12.3%	ENFJ 2.5%	ENTJ 1.8%

Recent studies have hypothesised upon the existence of patterns related to the personality type distribution for software engineers, digging further to consider different roles in software development [8]. Therefore, this investigation compares software engineers from Cuba [9], Brazil [10] and Pakistan [11] seeking to investigate, if the findings are similar among them or are related to specific location and local factors.

RESEARCH METHODOLOGY AND ANALYSIS

As mentioned earlier, general opinion outside of the engineering field suggests ideas and stereotypes about the personalities of engineers and the factors that attract them to the engineering field. The subjects of this study comprise a group of Brazilian, Cuban and Pakistani software engineers, who were selected to take part in this survey based on their solid backgrounds and interest in software development.

Specifically, 103 Cuban, 68 Brazilian engineers and 110 Pakistani software practitioners were invited to participate in the study, and the participants were administered the MBTI test, in their native languages, to determine their personality types. They were invited to take the MBTI measure either at home or in the workplace, but they were instructed not to complete the test in a works setting.

RESULTS

The MBTI distribution of Cuban, Brazilian and Pakistani software engineers can be seen in Table 2. It is noted that the ESTJ, ESTP and ISTJ types account for 50% of the Cuban sample; the ISTJ, INTP, ESTP and ESTJ types encompass more than half of the Brazilian sample; and the ISTJ, ENTP, ISFJ, ESTJ and ENTP types comprise half of the Pakistani sample. The ISTJ and ESTJ are recurrent personality types throughout the three samples. In addition, there is an overwhelming prevalence of Es over Is in the Cuban data, while predominance was slightly the other way around in both Brazilian and Pakistani data. Regarding Ss-Ns and Ts-Fs dichotomies, predominance prevails on S and T types in all cases. Finally, the Pakistani data shows predominance of P over J types as compared with the Cubans and Brazilians.

Table 2: MBTI distribution among Cuban (n = 103), Brazilian (n = 68), and Pakistani (n = 110) software engineers.

ISTJ C 10% B 19.1% P 14%	ISFJ C 7% B 2.9% P 9%	INFJ C 1% B 1.5% P 3%	INTJ C 6% B 7.4% P 7%	E C 63% B 44.1% P 42%	I C 37% B 55.9% P 58%
ISTP C 5% B 4.4% P 6%	ISFP C 2% B 4.4% P 7%	INFP C 1% B 2.9% P 4%	INTP C 6% B 13.2% P 8%	S C 71% B 58.8% P 59%	N C 29% B 41.2% P 41%
ESTP C 13% B 11.8% P 4%	ESFP C 6% B 1.5% P 6%	ENFP C 3% B 2.9% P 5%	ENTP C 2% B 7.4% P 11%	T C 75% B 79.4% P 60%	F C 25% B 20.6% P 40%
ESTJ C 26% B 11.8% P 9%	ESFJ C 2% B 2.9% P 4%	ENFJ C 3% B 1.5% P 2%	ENTJ C 7% B 4.4% P 1%	J C 61% B 51.5% P 48%	P C 39% B 48.5% P 52%

Note 1: Data from [9-11].

Comparisons of the observed results (Cuban, Brazilian and Pakistani) with the United States' general population were performed. Table 3 presents a Chi-Square nonparametric test applied, considering the US general population as expected values, and observing those of Cuba, Brazil and Pakistan; with a 95% confidence level. It can be stated, with high statistical significance, that software engineers do not follow a normal distribution as compared with the US general population, although they have their particularities, which must be studied in order to identify behavioural patterns of people attracted to the software engineering profession.

Table 3: Chi-Square nonparametric test for Cuban, Brazilian and Pakistani software engineers vs US general population.

			MBTI_Type Cuban	MBTI_Type Brazilian	MBTI_Type Pakistani
Chi-Square*			101.552	94.548	49.433
df			15	15	15
Asymp. Sig.			0.000	0.000	0.000
Monte Carlo	Sig.		0.000	0.000	0.000
Sig.	95% Confidence	Lower Bound	0.000	0.000	0.000
	Interval	Upper Bound	0.000	0.000	0.000

The three areas of study indicate similarly a sparse amount of INFJs, ESFJs and ENFJs as shown in Figure 1. The rest of the types show variations of a partial or total character. *Partial* refers to those values addressed by two areas and *total* to where neither of the three points have the same value; as can be seen in Figure 1.

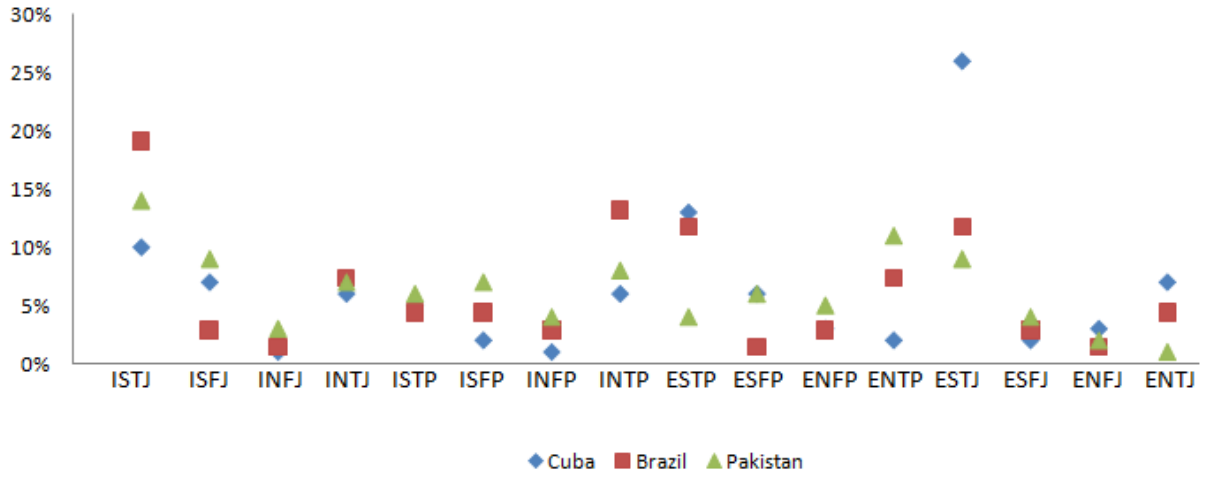

Figure 1: Cuban, Brazilian and Pakistani personality type distribution.

The authors agreed that cultural factors can have a significant influence on personality differences [12]. The particular traits in the software development models for each industry seem to be the main element in determining the required roles and competencies, which consequently explains differences in the personality types among software engineers of various nationalities. Even so, according to Varona et al [9] and Raza et al [13], *Extroverts* dominate over *Introverts* in the software industry.

Organisations must consciously step forward in the search for the personalities they need rather than the ones they currently rely on and actively recognise cultural realities. Software engineering roles may be performed by several personality types, but under different circumstances there will be some types that succeed and some that do not. Consequently, the focus must be on identifying personalities when assigning people to software development roles, rather than only noting these types once candidates are already assigned.

CONCLUSIONS

The types ISTJ, INTP, ISFJ, ESTJ, ESTP and ENTP are overrepresented in the sample. The types ISTJ and ESTJ are predominant in the Cuban, Brazilian and Pakistani samples. The S and T dichotomies were dominant in all cases. Neither Cuban, nor Brazilian or Pakistani software engineers' personality types followed a normal distribution compared to the US general population. This conclusion points towards a particular distribution whose recurrence in different scenarios should be studied.

It is, thus, agreed that all personality types are important for software engineering, as each one of them can contribute towards solving conflicts. Specifically, diverse personalities are increasingly necessary for solving the numerous and complex challenges related to software development; although the authors have to point to the evidence of types who are more attracted to this field as the distribution has indicated. The particular effects of personality type on software engineering can be a research interest to identify patterns related to personality and software tasks. The authors believe this can constitute a helpful tool for selecting better candidates for software projects.

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