Towards the Understanding and Classification of the Personality Traits of Software Development Practitioners: Situational Context Cards Approach

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***Abstract*—This study explores the personality traits of software development practitioners by using a classification schema based on the personality traits extended on the Myers-Briggs type indicator (MBTI). To extract the information necessary for understanding and classification of software development personnel, we developed a card game playable with either single or multiple participants. The game consists of seventy cards, which have a keyword and a picture on one side and a hypothetical situation typically encountered in software development landscapes with two different selectable options on the other side. The game master (GM) reads a situation by showing the pictures to participants and elicits the most suitable answer in between two selections. Ultimately, the outcome of the game reveals the personality traits of individuals on a compatible scale with the MBTI. To evaluate our game-based personality identification method, we conduct a case study with sixteen individuals at a university environment in seven group sessions. In light of the experience gained, secondly we refine the questions and test the game on sixty software development personnel selected from a set of team based pairings at a middle size software company. Our preliminary results indicate that there are more individuals in software teams, who may perceive to be extroverted not only in a classroom environment but also in an industrial setting. Moreover, the initial results suggest that our method can be a viable to the classical paper based MBTI tests particularly for managing the workforce in software development projects.**

I. Introduction

Software projects face several challenges in their dynamically changing organizational environments. One approach, suggested by several researchers considers *software development as a social activity* [1], which relies on the fact that software teams consist of distinctive personality types, and interact to perform a series of tasks or assignments in a software development project. In fact, one of the key components for success in a software development organization arises from selecting the right employee or a team for the right tasks. From a technical viewpoint, skills of the individuals should match with the required talents and experience. However, to improve software productivity, the social aspects such as individuals' compatibility in a team has emerged as a research interest with a focus on personality traits over software team configuration [2], which directly affects the quality of knowledge exchange among the team members. It is therefore not surprising that several researchers in the field of software engineering focus on the effects of personality types on the software development process and organizational performance [3], [4], [5].

Here, we construct our argument based on the fact that there is a significant correlation between individuals' behaviors and their personality traits in software development landscapes, where these personalities should almost stay consistent with respect to several situations [6]. Consequently, we suggest that behavioral variations among individuals should follow a pattern that we can use to distinguish personality types of the individuals and form team profiles in the form of a *periodic table of personality types*. This study has two main contributions. First, it proposes and tests a new type of personality trait identification technique, which is based on *a personality trait identification game* playable by software development teams. Using previously created situational context cards (SCC) [7], we ask several questions to the participants, and expect them to choose one of the two selections. The questions are crafted on hypothetical situations that are inspired from the real cases. As the second contribution, we develop an preliminary form of a periodic table for 16 personality types.

The rest of this paper is organized as follows: In section two, we introduce a brief history of personality types and the Myers-Briggs taxonomy, and define the Jungian model of functions of consciousness. In the section that follows, we briefly review the literature for personality type research in software engineering. Based on our game model, the next section evaluates our approach by analyzing of the personality type data by using a game based technique, which is gathered from two case studies we conducted at a university environment and at a middle size software company. The final section will include a discussion of our findings and a review of the research for new directions.

II. Personality Assessment

Based on Freud and Adler's study, Jung published his own theory of psychological types [8]. He characterizes individuals in terms of psychological functions identified by understanding the preferences of someone over others. In his classification, basic individuals functions are; (i) differences in style of information gathering, (ii) decision making, and (iii) orientation of individuals mostly interested in self (introverts) or to the outside world for external incitement (extroverts) are the three main indicators for classification of personalities. By following in the footsteps of Jung, Myers-Briggs design the personality type indicator (MBTI) by assuming that personality should be categorized for orthogonal (independent) preference set. MBTI is basically a questionnaire that is designed to implement Jung's psychological types with an addition of a new category for understanding individuals based on their perception and judgment characteristics.

The Myers-Briggs personality types are based on four contrary choices (scales) or sometimes called dichotomies. The four (dichotomies) scales are extroversion versus introversion (E/I), which is established on how an individual is energized, intuition versus sensing (N/S), which is based on how an individual gathers information, thinking versus feeling (T/F) defines how an individual decides, and finally perceiving versus judging (P/J) singles out what kind of a lifestyle choices of people. The preferences of individuals over the others indicate that a person uses it as a dominant psychological function (see Table I).

Extraversion (E)	(I) Introversion
Sensing (S)	(N) Intuition
Thinking (T)	(F) Feeling
Judgment (J)	(P) Perception

TABLE I
DICHOTOMIES (THE FOUR OPOSITE PAIRS OF PREFERENCES) ACCORDING TO MYERS-BRIGGS [9]

An individual preference between extroversion and introversion is used to identify how a person is energized. Extroverted individuals usually prefers to spend time with social groups and activities, while introversion is a preference of individuals who are more interested in one's self. Sensing and intuition dichotomy identifies what a person can concentrate to understand the information around himself or herself. (S) individuals usually aim to observe reality, which (N) individuals use their imagination to foresee. (T/F) dichotomy identifies the preference of individuals on organizing and constructing information. They can either chose to make decisions on a logical and objective way or otherwise personal and value-oriented way.(J/P) scale corresponds with the lifestyle a person prefers either planned and organized life or otherwise a spontaneous and flexible form of life.

However, earlier research suggests that personality traits encompass patterns of action in different situations, which should also need to have features like adapt itself to the environment when needed. In his book *Personality Theory*,

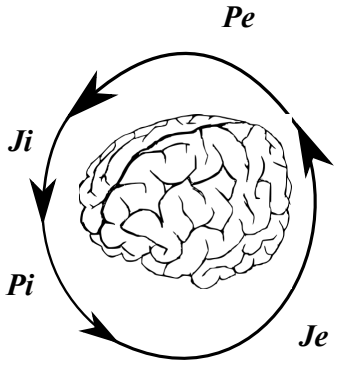

Fig. 1. The Jungian Model of Functions of Consciousness

Jung [8] claimed that *attitudes* and *functions* of consciousness should be differentiated (see Table II). In general, a decision process can be characterized by two actions; (i) retrieving the information from the environment, and (ii) making a decision based on this information. During these activities individuals may evaluate information by either their own memory and intellect, which is called *introverted perception* (*Pi*) functions or otherwise by equating a collective standard as seen in *extroverted perception* (*Pe*). Accordingly for judging trait, there are also introverted and extroverted view points. Individuals who perform *introverted judging* (*Ji*) usually compare their decisions by their own intellectual knowledge bank. Additionally, individuals with *extroverted judging* (*Je*) examine decisions based on the norms or the rules that are previously established. These functions are considered to work synchronously for the process of decision making for every individual, where some might perform better for than others (see Figure 1).

Extroverted *Sensing* **Experimentation**	Extroverted *iNtuition* **Ideation**	Extroverted *Thinking* **Organization**	Extroverted *Feeling* **Community**
Introverted *Sensing* **Knowledge**	Introverted *iNtuition* **Imagination**	Introverted *Thinking* **Analysis**	Introverted *Feeling* **Evaluation**

TABLE II
JUNG'S COGNITIVE MODEL FOR BOTH INFORMATION COLLECTION AND DECISION MAKING ADAPTED FROM [10]

III. Personality Research in Software Engineering

There are several tests, which can be performed for assigning personnel to the right job or skill prediction issues such as primary mental abilities test, wonderlic personnel test, programmer aptitude test, etc [11]. Concurrently, there has been a body of software engineering research that contributes to the research of personality traits in software development organization. A number of studies have found that impact of personality factors significantly affects software organization's success [12], [13]. Rutherford [14] uses Keirsey Temperament Sorter (a personality type sorter) for creating teams for software engineering class projects which brings good results for

having teams with distinctive personalities. Carpetz [15], on the other hand, investigated the types of personalities by a survey through software engineering students. This research concluded that introverted and thinking types, especially sociotype *ISTJ* is found more than the other types. Moreover, this work have no specific suggestion of any types suitable for situational contexts. In fact, it is suggested by Carpetz that variety of personality types with their joint effort might be helpful for better team performance. Da Cunha and Greathead [16] examined the relationship of types of personality versus the performance of practitioners where there was a productivity difference among the individuals equipped with the same knowledge but that had different characteristic types. Therefore, they concluded that aligning types with the appropriate tasks will definitely improve the total productivity.

Gorla and Lam [12] conducted a survey for personality analysis on 92 software professionals structured in 20 teams. The personality traits were identified by using Keirsey's Sorter. They argued that team leader with a type (IF) is better performed than a leader with type (ST). For the role of a system analysis, thinking type (T) is found better than feeling type (F) as a result of their survey. In addition, team with extroverted programmers found better than with the types with introverted (I) type of programmers. According to researchers, it is because of programmers need to develop better interactions with other roles during the software development process, and several evidence suggest that information collection and healthy interactions are heavily affecting the team performance.

Mazni el at. [3] proposes a framework to investigate the relationship personality traits versus software team diversity by using the notion of rough set theory. This study reveals that heterogeneous types of personalities in a software team supports creativity and effective when there are challenging tasks. Lewis and Smith [4] suggest that understanding the problem solving style of the participants significantly affects the positive team outcomes. To understand the implication, they conduct a *paper based team dynamics survey*, which is based on the literature for the team process and conflicting issues on the interrelationships of team members. However, this study is constrained by the limited size of its sample. By using a set of university students, Su-li and Ke-fan [5] conduct a research on personality types of entrepreneurial team members' especially in the process of decision making by understanding team's risks and favorable outcomes. This study suggests that it is important to reveal personality traits of individuals, which directly affects several decision-making factors for entrepreneurial teams.

To sum up, the idea of using personality trait theories in software engineering research is an attempt to explain practitioners' differences in terms of their social behaviors such as collaboration, aggression, cooperation, and individuals' affiliation with other individuals. Several variants of the trait theories suggest that patterns of personality should sequentially actualized and reformed through the interactions among the individuals [17].

IV. Game Design

In this section, we describe the game model, which is inspired from psychiatric evaluations. One of the goals of these evaluations is to understand the relationship between participants' perception on images and their personality traits. A well-known variant of these tests uses inkblot technique in which a card is shown to the subject one at a time and the subject describes what these cards remind him. In modern psychology, similar tests are also used for understanding the participants' social behavior and personality types. These tests, for example, may aim to determine whether answers of a participant are apologetics (i.e. speaking in defense) or argumentative.

There are several techniques used in psychology for personality assessments mostly categorized as *projective techniques* [18]. For example, *associative approach* requests from the subject to respond to cards, words, etc. with the first thought comes into mind. Secondly, a *constructive approach* demands a task to be done by the subject such as creating a story from the objects shown. Thirdly, *completion technique* in which the subject is requested to finish an incomplete statement or a sentence. Fourth, ordering or *sorting technique* the participant is requested to do a sorting or ordering of objects, cards, pictures, etc. Finally, in the expressive approach, participant is asked to express himself or herself freely.

In light of this remarks, we design the rules of our game. The first form of our card game should be managed by an individual as the game master (GM) and is playable with either a single person or a software team. The outcome of the game is to reveal the true personality types of individuals. The primary job of GM is to show cards and ask questions to the participants. GM requests from the participants to fill a special type of form, which will be used to identify the personality traits of an individual. The time projected for one session is about thirty minutes. After giving the instructions to the participants, GM draws a card from seventy situational context cards deck within a sequential order (i.e. a game deck set up with a specific rule). Next, GM show the picture of the card and further reads the situation on the card with two different selection. Participants, than, is asked for his or her selection between two possible actions. After choosing the closest option to their mindsets, GM waits for all participants to finish marking answers and continues with the next question until full deck is done.

A. Periodic Table Form

To illustrate the individuals in software teams based on their traits, we use a periodic table-like structure. A periodic table is a compilation of the characteristics in a compact form for classifying sixteen forms of personality traits. It is a tabular depiction of the personality traits (see Figure 2), organized with respect to their similarities. In our periodic table form, rows and column represent a classification with different attitudes, where a continuum may become visible based on the features of the taxonomy. The traits horizontally divided into two layers based on the social interactivity,

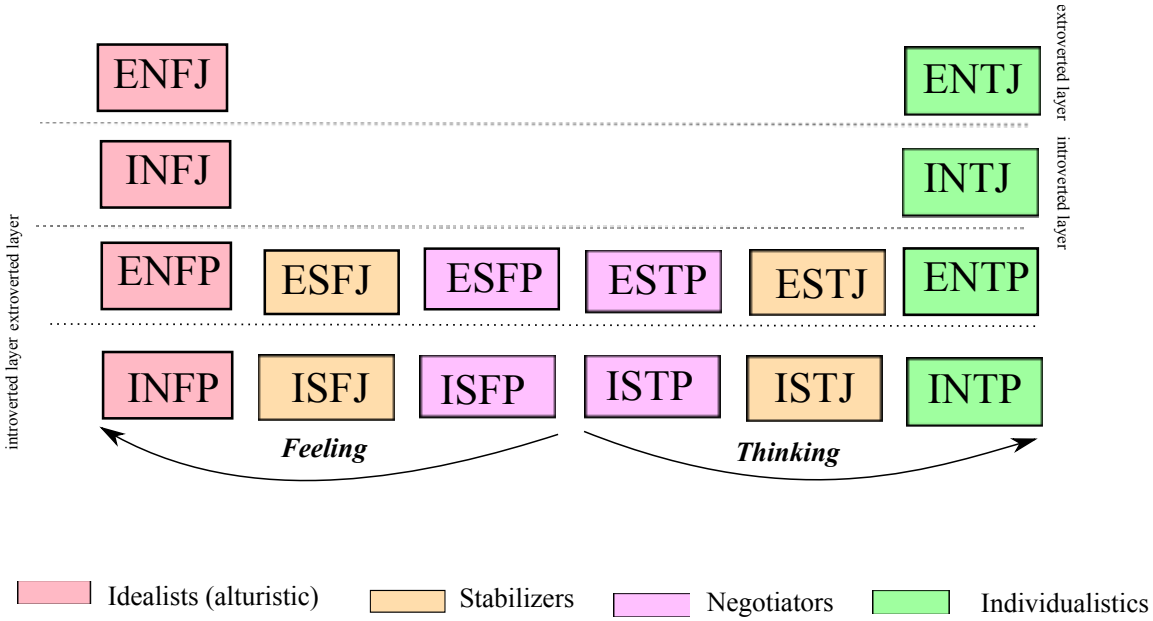

Fig. 2. The periodic table type classification for personality types

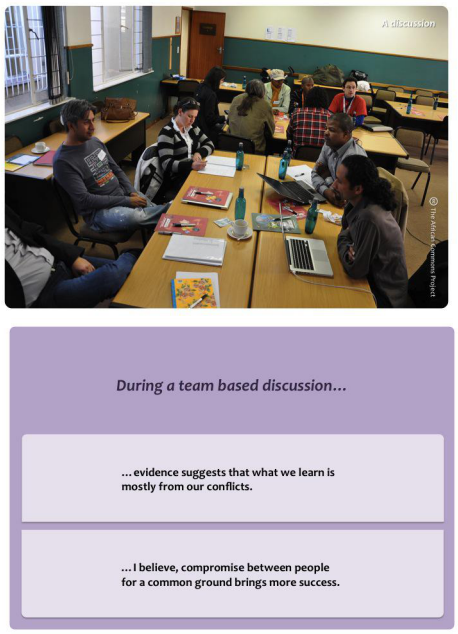

Fig. 3. A Two-faced Situational Context Card Example

i.e. extroversion and introversion. The vertical columns on both sides of the table designate the level of rationality and emotionality of the traits, i.e. altruistic through individualistic. The vertical columns inside the table classified regarding to the characteristics of stabilization and negotiation.

V. A Pilot Study

For the first test of our situational context cards (SCC), we designed a study based on selected individuals, which had worked as teams at a university environment. We limited our first test group with novice developers with a year of industrial experience who were paired for assignments.

We conducted seven group sessions, all of which were started with a preliminary introduction and an explanation. We request from our participants to record their responses on our structural interview document. The interview form had some feedback questions for some essential updates for the next iteration. The results obtained from the preliminary analysis using SCC are presented in Table III. The table includes gender, role of the participant in a software development environment, and finally SCC test results in MBTI format.

Subject Number	Gender	Role	SCC
1	Male	Tester	ENFJ
2	Male	Customer care	ESFP
3	Female	It helpdesk	ESFJ
4	Female	Tester	ISTJ
5	Male	Developer	INFP
6	Female	Developer	ISFP
7	Male	Developer	ENTJ
8	Male	Developer	INTJ
9	Male	Developer	ENFJ
10	Male	Developer	ISFP
11	Male	Developer	ENTJ
12	Male	Developer	INTJ
13	Male	Developer	ESFJ
14	Female	System admin	ESFP
15	Male	Developer	ESTJ

TABLE III
Preliminary Results for Personality Traits by using Situational Context Cards

In Table III, we use some of the types that we propose for representing individuals that show both characteristics

of a personality trait. Table IV illustrates the psychological functions of individuals both in the ***D***ecision making and information ***C***ollection processes. We use team names instead of individuals name and further based on their Jungian types we portray their distinctive skills in both ***C*** and ***D*** domains.

Individuals in Team(s)	Information Collection	Decision Making	Orientation
A	EN	EF	Ideation/Community
A	ES	EF	Experimentation/Community
B	ES	EF	Experiment/Community
B	IS	IT	Knowledge/Analysis
C	IN	IF	Imagination/Evaluation
C	IS	IF	Knowledge/Evaluation
C	EN	ET	Ideation/Organization
D	IN	IT	Imagination/Analysis
D	IS	IF	Knowledge/Evaluation
D	EN	EF	Ideation/Community
D	IN	IF	Imagination/Evaluation
E	EN	ET	Ideation/Organization
E	EN	EF	Ideation/Community
F	ES	EF	Experiment/Community
G	ES	ET	Experiment/Organization

TABLE IV
MEMBERS OF A TEAM WITH THEIR JUNGIAN FUNCTIONS AND ORIENTATIONS

A. Card Sorting

Card sorting is a participatory method for understanding how a group of participants organize a collection of items. By using a set of cards, it can be considered as a mechanism for information designers and users to collaboratively communicate. There are a limited number of applications of card sorting in software engineering domain. For example, see Maiden [19] for card sorting to acquire software requirements.

Based on a similar technique to *closed* card sorting, in our model, GM instructs the player to organize the situational context cards regarding to his or her answers into two categories based on the selection of the two choices and group them by their colors and through a selection of A or B slots. As stated above there are four different colored categories with two possible answers on each card. A participant starts to organize these cards based on their selection of their choices and regarding to their colors (see Figure 4 for a sample game board). The game finishes when the sorter finishes his or her cards. Next, GM starts counting the cards, which are sorted, based on the selections of a participant. The goal is to find the number of cards that are accumulated in each slot and evaluate the board to identify the personality type of a participant.

Subject Number	Gender	Role	SCC
Individual 16	Male	Developer	ISTJ
Individual 17	Male	Developer	ENTJ
Individual 18	Male	Developer	ESFJ
Individual 19	Male	Developer	INTJ
Individual 20	Male	Developer	ESTJ

TABLE V
PERSONALITY TRAITS IDENTIFIED BY A CARD SORTING METHOD USING SITUATIONAL CONTEXT CARDS

This part of the study was conducted on five individuals to find their personality traits, and presented on Table V. All of the participants here were males and software developers. We conducted five individual sessions, in which we asked participants to sort SCCs with respect to the rules provided above. Here, we demonstrate that personality types of individuals can also be identified by using a card sorting game (presented above) as an alternative method (see Figure 4).

Fig. 4. A Card Sorting Board Example: Four Different Color Slots with Two Different Selection Piles

VI. INDUSTRIAL EVALUATION

Based on the pilot study experience, we refined our cards by altering some of the questions for clarification (i.e. Q22 for (E/I), Q24 for (S/N), Q26 for (T/F), Q27 for (J/P)). The next step is to test our game of personality type identification on a software company. To industrially evaluate our approach, we conduct a case study on a middle size software company with sixty software personnel. The part of this work is conducted with six different groups mostly around ten to twelve individuals who are working in the same software development team. Firstly, as in the pilot study, we introduce how the game operates and how they record their selections. At the end of each session we ask participants for feedback about our questions about hypothetical situations, and the way that game works for them, where participants find the questions were reasonably distinctive for personality trait identification.

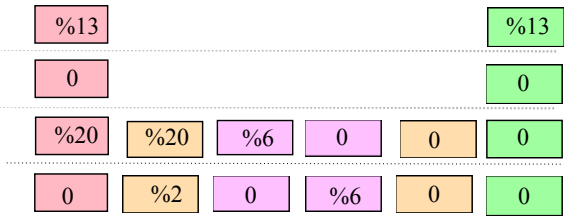

Fig. 5. The Percentage Distribution of a selected SW Team of twenty participants in a Periodic Table Form

As shown in Figure 5, one of productive teams (15 practitioners) of the software company was tested and team's personality traits were reported. In this team, ENFP, ESPJ were both found as %20 of overall population, ENTJ, and ENFJ were reported as %20, while %6 was ISTP and %6 was ESFP, and %2 was ISFJ. Initially, we can report that these types are working corroboratively in this software company. However, further research with more focus on compatibility of personality types is therefore suggested. Traits shown in Figure 5 can be compared with the names in Figure 2, to examine the personality traits. We can confirm that there is a significant amount of individuals shown in the idealistic column. Moreover, it is possible to hypothesize that extroverted people start to exceed the number of introverted individuals in a software engineering domain.

VII. Conclusion

To date there has been little agreement on how personality tests should be conducted, and how to improve their validity [20]. This study seeks to remedy these problems by using a game-based approach. It considers personality as a function of interpersonal relationships, which in theory strongly affected from several situational factors such as the behavioral variability among the collaborators, compatibility of individuals, etc. Therefore, one of the most significant contributions of this paper is to use situational context cards as a methodology for identifying personality traits of software development practitioners. The authors argue that the social characteristics of individuals directly affect team success and therefore building an effective team configuration model can have such a large effect on productivity.

In light of this remarks, we construct a periodic table like structure (i.e. a type of categorization based on the row and column formations) to represent the identified characteristics of team members. The goal is to enhance our understanding of the distribution of personality characteristics of individuals on effective team formations. In contrast to some of the previous studies, another important practical implication is that individuals with extroverted characteristics are now more dominant in both industrial and school settings. One other observation confirms that many individuals who are doing plan driven development are found to be in the judging characteristics (J) and for the individuals in teams using an agile approach are found to be in the perceiving trait (P).

An implication of this study is the possibility that managers should be able to use such an approach while managing the dynamic process of building productive teams. However studies, which take these variables into account, will need to be undertaken. Finally, more research should be done to investigate the distribution of personality types over team configurations.

Acknowledgments

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