

Mapping human values and scrum roles: a study on students' preferences

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ABSTRACT

Traditionally, human values were studied in various domains, but the most important contributions come from social psychology. Despite this long tradition, the impact of human values in the software engineering domain is rarely studied. To these regards, this study focuses on applying human values to agile software development process, more specifically to scrum roles. Thus, the goal of the study is to explore possible associations between human values and scrum roles preferences among students. Questionnaires are designed by employing the Short Schwartz's Value Survey and are distributed among 57 students. The results of the quantitative analysis process consisting of descriptive statistics, linear regression models and Pearson correlation coefficients, revealed that values such as power and self-direction influence the preference for the product owner role, the value of hedonism influences the preference for scrum masters and self-direction is associated with team members' preference. Further research is needed to validate these findings under different conditions and settings.

CCS CONCEPTS

Software and its engineering→Software creation and management→Software development process management→Software development methods→Agile software development

KEYWORDS

Scrum Roles, Values, the short Schwartz's value survey.

1 Introduction

Software work is an intellectual activity [13], that is highly dependent on human factors [26]. As many other aspects inside human factors, human values are important factors to consider in the software production processes [6]. Some authors even contemplate the consideration of human values in software systems design as priority for organizations, software users, and practitioners [11]. Though, and in spite of the growing

interest, the impact of this research field in software engineering literature is quite limited [14], maybe rooted in the intrinsic difficulty of studying values [25].

However, the study of human values has a long tradition in literature. Maybe the most important contributions on the study of human values come from social psychology and in particular from the works of Shalom H. Schwartz. According to this author, values are guiding principles which provide individuals with motivation to identify goals and criteria to guide actions and achieve them [15]. In other words, values are general principles in life that form attitudes and opinions [17]. This author and his colleagues identified a set of universal values that evolved over the years [15, 17–19] that can be found consistently across cultures. A set of 56 universal values [15] can be grouped into 10 value types as follows: power, achievement, hedonism, stimulation, self-direction, universalism, benevolence, tradition, conformity and, finally, security. These ten values are part of a circular structure in which values share emphasis with the adjacent ones. In order to collect data for each of the values, the Schwartz's Value Survey [17] and the Portrait Values Questionnaire [20] (a better instrument to measure individuals with less abstract thinking ability) are provided. More recently, the Short Schwartz's Value Survey (SSVS) [10] was designed to rate the importance of each of the ten basic values in a straight forward way by means of a 0-8 Likert scale.

The connection of Values and emotions in Schwartz's theories is present in the formulation of values concept. According to [16], values are beliefs tied inextricably to emotion, not objective, cold ideas. Literature, however, reported complex connections between values and emotion e.g. [9].

Going back to the software engineering field, there is a current move towards incorporating human values in software engineering [23] extending the user-centered design into values-sensitive design [7], an approach that started in the Information systems discipline. Values are also seen as a way

to provide sustainability to software development [24]. However, in the work presented in this paper, authors want to apply human values theory to software development process itself more than to software product. More in particular, authors want to study the mapping of human values on scrum roles in an introductory way.

Currently, agile software development is one of the trends of software work nowadays [3], ruling the current software engineering panorama [8]. Methods embracing the agile approach include extreme programming (XP), Crystal , lean software development and Scrum [1]. Focusing on the latter, Scrum development process was developed by Schwaber and Sutherland in the early nineties. Scrum presents three distinct roles in the Scrum process namely, Product Owner, Developer and Scrum Master. Product owners are responsible for the return of investment representing the interests of the stakeholders in the development process. Developers are aimed to implement needed functionality and finally, Scrum Masters are responsible for ensuring that the Scrum process is observed. Literature has investigated scrum roles and their connection with personal characteristics e.g. personality traits [2] but, to the best of our knowledge, this is the first paper devoted to study the connection of human values with scrum roles preferences.

In this paper, authors present the study conducted among computing students in the last undergraduate course. In the reminder of the paper, authors describe the experimental setup (Section II) including the description of the artefacts adopted, the process, the sample and the presentation of results. This section ends with the discussion of our findings and the threats to validity. Finally, in Section III authors present main conclusions and propose future work.

2 The study

In this study, authors aim to explore the possible associations between human values and scrum roles preferences among students. In this section, the design of the study is described along with the data collection and data sampling. Main results are outlined. A discussion is also presented and to end the section, main threats to validity are presented and analyzed.

2.1. DESIGN

The root of the data collection and analysis process lies in designing the underlying conjectures that motivated this research. These underlying conjectures are represented as hypothesis (See Figure 1), that aim to find relationships between each of the scrum role preferences and human values. Bearing in mind these hypotheses, authors chose questionnaires, as the appropriate data collection method to validate them.

The artefact used to measure values is the Short Schwartz's Value Survey [10]. The questionnaire includes a description of

the ten broad values by Schwartz and for each of them asks for a rating of the importance for the subject ranging from 0 (Opposed to my principles) to 8 (Of supreme importance) in a Likert scale. Each of the values is described briefly in the questionnaire using the words provided by the authors. Moreover, each of the values were presented to participants by researchers on site in order to provide a uniform interpretation of these human values.

Ho: Scrum role preferences are not influenced by human values
Ha: Scrum role preferences are influenced by human values
H ₀₁ : Product owner preference is not influenced by human values H ₀₂ : Scrum master preference is not influenced by human values H ₀₃ : Team member preference is not influenced by human values
H _{a1} : Product owner preference is influenced by human values H _{a2} : Scrum master preference is influenced by human values H _{a3} : Team member preference is influenced by human values

Figure 1: Null and Alternative Hypothesis

The questionnaire presents human values and asks participants to code their answers with regards to their feelings. The final part of the questionnaire includes a question on the preference for Scrum team roles using also a 0-8 Likert scale (being 0 the less preferred and 8 the more preferred role).

Participants were assisted on site by researchers who gave them all the directives required to fill out the questionnaires. The questionnaire was anonymous.

2.2. SAMPLE

The sample consists of a set of 57 subjects. Subjects were students in their last year of studies in Computing at Østfold University College (Norway). The average age was 24.23 years old and there is a standard deviation of 3.896 years. With regards to demographic characteristics, the sample included 16 women (28.07%) and 41 men (71.93%). Gender misbalance is a very common issue in computing students' population.

Six questionnaires were considered invalid after their screening (not completed). The number of final valid questionnaires reached 51. In the final set of questionnaires, average age was 24.43 years with a standard deviation of 4.068 years, being 72,55% of the subjects men and 27,45% women.

All students have attended in the previous semester a course on Software Engineering in which Scrum was adopted for group project work in which students played different roles. Apart from that, Scrum was also explained in the course as one of the topics included in the Syllabus.

2.3. RESULTS AND DISCUSSION

In this section, authors will present the results, but also the developed analysis, taking into account data obtained by means of the questionnaire. Authors present basic data and statistical methods to analyze human values and scrum roles preferences.

Table 1 presents means (μ) and standard deviations (σ) of the different results obtained for each of the ten values:

Table 1: Values. Descriptive analytics

	Mean	Std. Dev.
Power	3.76	1.829
Achievement	5.14	1.281
Hedonism	5.67	1.608
Stimulation	4.92	1.481
Self-direction	6.06	1.567
Universalism	5.31	1.975
Benevolence	6.80	1.429
Tradition	5.35	1.885
Conformity	5.73	2.040
Security	6.22	1.553

Interestingly, respondents rated benevolence as the most important human value ($\mu=6.80$, $\sigma=1.429$), followed by security ($\mu=6.22$, $\sigma=1.553$) and self-direction ($\mu=6.06$, $\sigma=1.567$). Given that the means in the three cases are very similar, we conclude that there are not significant differences between these three values. In fact, the three of these values, namely, benevolence, security and self-direction are considered very important to most of the respondents, due to their high mean values.

Table 2 presents mean and standard deviation of the three scrum roles:

Table 2: Scrum Roles. Descriptive analytics

	Mean	Std. Dev.
Product Owner	4.82	2.151
Scrum Master	4.14	2.059
Team Member	6.20	1.575

Surprisingly, the team member is the preferred scrum role among students, with the highest mean value ($\mu=6.20$, $\sigma=1.575$), followed by product owner role ($\mu=4.82$, $\sigma=2.151$), and the scrum master role ($\mu=4.14$, $\sigma=2.059$).

However, the goal of this study goes beyond the simple identification of the most important human values and scrum roles preferences, into identifying how elements within these two groups are associated (in case they are). Thus, known statistical means such as linear regression models and Pearson correlation coefficients were employed. To perform this analysis, a statistical software, namely SPSS was used. Authors

prepared the dataset by creating variables and inserting the data collected from the questionnaires for each of the variables. This initial data preparation process was followed by a three-stage analysis process.

Firstly, authors validated if the assumption that scrum role preferences are influenced by human values, statistically holds. Thus, three regression models were developed between each of the dependent variables, i.e. product owner, scrum master and team member, and the independent variables, i.e. power, achievement, hedonism, stimulation, self-direction, universalism, benevolence, tradition, conformity and, finally, security. The results indicate that the three models are not statistically significant (\forall regression model, $p\text{-value} > 0.05$), thus significant casual relationships cannot be identified under these circumstances.

Although the set of independent variables (human values) does not explain each of the scrum role preferences, this does not imply that it is unlikely for a specific set of human values to significantly impact the dependent variables. Thus, authors developed other regression models with the supposition that the elimination of the variables with the lowest level of significance (t-statistic or p-value), could increase the significance of the models.

In the second stage, authors developed three new models, by including the most significant variables. At this point, the three regression models are, as follows:

$$1. \text{ AG_ProductOwner} = 2.415 + 0.396 * \text{Power} - 0.303 * \text{Stimulation} + 0.397 * \text{SelfDirection}$$

The significance level of this model is $p_{\text{value}} = 0.015 < \alpha^1 = 0.05$, thus the model is statistically significant. This model is also valuable for prediction purposes; for instance: a unit increase of the individual importance of power, while the other variables remain constant, implies an increase of 0.396 units on the product owner preference. Regarding the interpretation of the significance of the independent variables (t-statistic or p-value may be considered), the output indicates that power and self-direction are significant variables (p-values= 0.016 and 0.045, respectively), whereas stimulation does not impact the preference for the product owner role significantly (p-value=0.149). The third analysis stage entails exploring the extent to which the significant independent variables and the dependent variable are linearly associated. Hence, Pearson correlation coefficients were found, and Scatter plots were designed (See Figure 2 and 3).

¹ The symbol α represents the significance level, which is the risk of rejecting the null hypothesis when it is true.

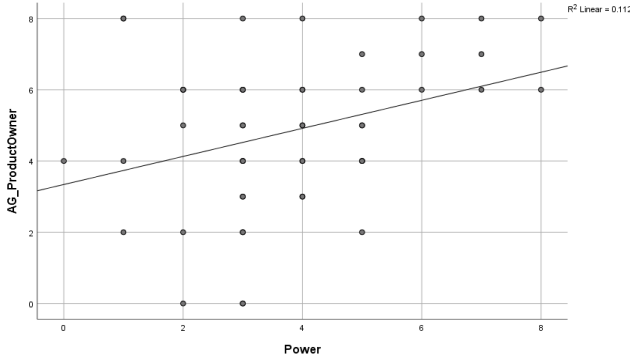


Figure 2: Scatter plot between the value of power and product owner preference

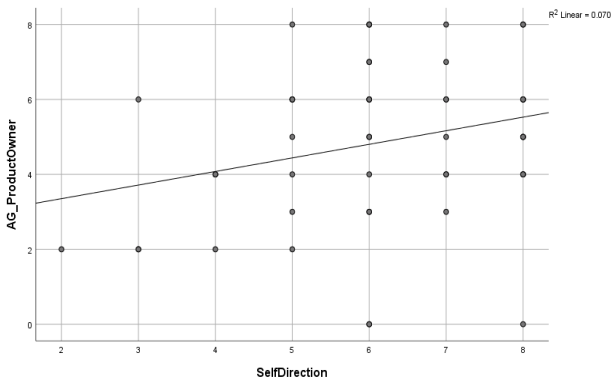


Figure 3: Scatter plot between the value of self-direction and product owner preference

As can be noticed in Figure 2 and 3, the human values of power and self-direction are positively correlated with the product owner preference with correlation values, $r = 0.335$ and 0.264 , respectively. It is worth mentioning that these correlations are moderate. Throughout this study, we refer to moderate positive correlation to correlation values that are close to 0.5. Moreover, using the explanation provided by Draper and Smith [4] in regard to positive correlation, authors state that in general, values of variables lie on a straight line with positive slope in the (Power/SelfDirection, AG_ProductOwner) plane. In a nutshell, when the respondents prioritize human values such as power and self-direction, their preferences for the scrum role of product owner increases.

$$1. \quad AG_ScrumMaster = 0.924 - 0.298 * Conformity + 0.417 * Benevolence - 0.106 * Universalism + 0.466 * Hedonism$$

The same procedure is followed in the second regression and only the variable hedonism was identified as significantly influencing the preference for scrum master role (p -

value = $0.009 < 0.05$). A unit increase of the individual importance of hedonism, while other variables remain constant, implies an increase of 0.466 units on the preference for the scrum master role. It is worth noting, that the significance value of conformity is very close to the significance level ($\alpha = 0.05$), however, this variable cannot be considered statistically significant. Furthermore, the Pearson correlation coefficient between hedonism and scrum master preference is $0.340 \neq 0^2$, which demonstrates the existence of a moderate positive association between the two variables (See Figure 4). Thus, the values of variables lie on a straight line with positive slope in the (Hedonism, AG_ScrumMaster) plane.

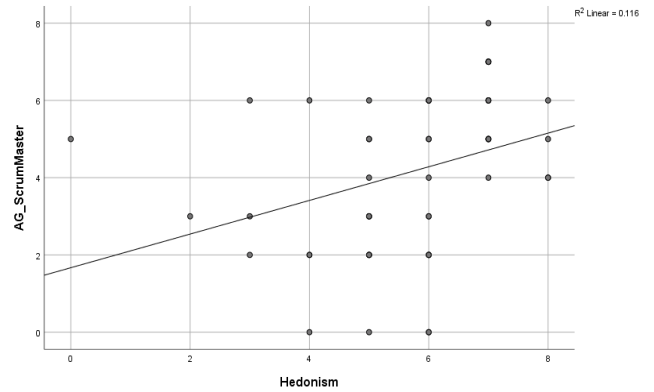


Figure 4: Scatter plot between the value of hedonism and scrum master preference

$$1. \quad AG_TeamMember = 3.41 + 0.148 * Stimulation + 0.471 * SelfDirection - 0.15 * Universalism$$

In the third regression model, the only variable statistically important is self-direction with a p -value of 0.004. In fact, the unit increase of the individual importance of self-direction, while the other variables remain constant, implies an increase of 0.471 units on the preference for the team member role.

The correlation between the value of self-direction and the preference for the team member role emerges as moderate, yet positive with a correlation coefficient of $r = 0.425$ (See Figure 5). Hence, the values of both variables lie on a straight line with positive slope in the (SelfDirection, AG_TeamMember) plane.

² The Pearson correlation coefficient (r) takes on any values from the interval $[-1, 1]$, with -1 meaning perfectly negatively correlated, 1 meaning perfectly positively correlated and 0 meaning no correlation.

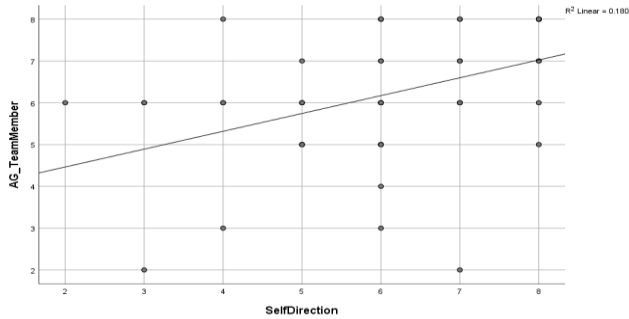


Figure 5: Scatter plot between the value of self-direction and team member preference

Ultimately, values such as power and self-direction are associated with the preference for the role of product owner. Unsurprisingly, individuals who are guided by the values of authority (power) and independence (self-direction), tend to prefer the role of product owner. The product owner is responsible for setting the vision and goals regarding the product that will be developed and conveying this vision to the scrum team. Differently from traditional project management, the product owner does not have any authority over the Scrum team. However, the product owner has to make decisions on what to implement and what not and to do so, it is important to have unrestrictive authority [21]. In this way, misunderstandings are minimized and the chances for the result to meet the expectation of stakeholders are maximized. Hedonism is another human value which was associated with the preference on the scrum master role. Individuals with self-indulgent attributes tend to aim to become leaders, in this case, the leaders of the scrum process are scrum masters. While values such as conformity and security may be expected to significantly impact the preference on team members, the results of this study do not confirm this expectation. Surprisingly, the preference for the team members' role is associated with the value of self-direction. In fact, self-direction may be defined as creativity and curiosity, characteristics that are often affiliated to developers. Individuals who prioritize creativity and curiosity, tend to be the ones who prefer implementing functionalities and keeping abreast with new emerging technologies, rather than managing products or people.

The identification of the associations between human values and scrum roles may have important implications in enhancing the teaching style of software engineering courses, where scrum projects are adopted. Prior to the project start, the professor could build profiles for each student focused on their human values and consequently allocate them to specific scrum roles within the project. This will make students more comfortable, while enhancing their learning experience. The

same approach could be followed in organizational settings. Scrum roles may be allocated based on individual characteristics, in particular human values. We believe that this role allocation will significantly improve the working experience and as a result enhance the productivity.

2.4. THREATS TO VALIDITY

In this section, four types of validity threats, namely conclusion, internal, external and construct validity, that may impact the results of this study, are discussed.

Conclusion validity refers to the reliability of the results. In this explorative study, one possible threat consists of obtaining invalid questionnaires, where not all the questions are answered, or more than one answer is selected for each question. Acknowledging this threat, authors conducted a careful screening of questionnaires before collecting and analyzing their data. Due to this screening process, 6 questionnaires were considered invalid and only the data of the remaining 51 questionnaires were collected and analyzed.

Internal validity refers to factors impacting variables without the awareness of the researchers, e.g. biases in the research methodology. Biases are inevitable especially while designing the questionnaire. Using Schwartz's value survey was researchers' choice and results could have been different if other values were chosen. Despite a recognizable level of subjectivity, authors believe that the selected groups of values cover most of the aspects that may be associated with scrum roles. In addition, the main contributions in the literature regarding human values come from the field of social psychology and specifically from the work of Shalom H. Schwartz. This ensures that, the results of this study are well grounded. Another threat to internal validity is related to the analysis process and specifically to the determination levels of regression models. The determination level measures the proportion of the total variation of the dependent variable, explained by means of the independent variables in the model [4]. The determination levels in our models were reasonably moderate, i.e. 30-50%, which demonstrates the fact that there are other external variables, not considered by this study, that explain or determine scrum roles preferences. We argue that these determination levels are quite reasonable, due to the acknowledged difficulty in predicting human behavior, emotions and values. In fact, the interpretation of determination values is domain-dependent, for instance; in fields such as psychology a determination level below 50% is quite common, whereas in physics or mathematics, it is considered low, thus affects the relevance of the model.

External validity refers to the degree to which results may be generalizable to other contexts. A potential threat to external validity is the selection of students in one university. The results could have been different if random students from

another university were chosen, given that the values and scrum role preferences may be arguably influenced by the cultural, social and economic environment. However, authors did not see the need to consider other universities for the purpose of this study, since they argue that the values are strongly related to the individual and not significantly influenced by the context. Moreover, the selection of students as subjects is considered as valuable in the identification of trends [22] and is not considered a threat to validity itself.

Construct validity refers to the degree to which the testing instrument measures the construct that it claims to be measuring. To these regards, the widely known methods of linear regression and Pearson correlation coefficients were used in order to explore the connection between human values and scrum role preferences. These means of testing generated results that are consistent with the goal of this study.

3 Conclusions and outlook

In this paper, authors present a mapping between human values and scrum roles preferences among students. Going beyond the mapping, authors motivate the relationships between these two groups, through the interpretation of three significant regression models. It is worth mentioning that to the best of our knowledge, this is the first paper that aims to find associations between scrum roles and human values. To these regards, questionnaires were distributed among 57 students in the last year in Computing at Østfold University College (Norway) and consisted of two main parts. The first part presented human values according to the Short Schwartz's Value Survey, that were rated by participants in a Likert scale. The second part of the survey asked for students' preferences for scrum roles, namely, product owner, scrum master and team member. Furthermore, the hypothesis that this study aims to validate is that human values significantly influence the preference for specific scrum roles.

The collected data was analyzed using SPSS through different statistical methods, such as descriptive statistics, linear regression and Pearson correlation coefficient. This quantitative analysis process went through three stages. Firstly, authors developed linear regression models among each of the dependent variables (scrum roles preferences) and the set of independent variables (human values importance). Unfortunately, these models were not identified as statistically significant, thus it was impossible to interpret the values of coefficients. Consequently, authors reduced the number of independent variables by keeping only those variables with higher level of significance. At this second step, three other significant regression models were developed, and their coefficients were interpreted.

The interpretation of the association between specific human values and scrum roles preferences was the third step of the analysis process. Both significance levels and correlation coefficients, demonstrate that human values such as power and self-direction are associated with the role of product owner,

hedonism is associated with scrum masters and self-direction is associated with team members. Moreover, these human values are not only positively associated with each of the scrum roles preferences, but they also influence the preference for scrum roles, significantly.

The connection of values and emotion has not been studied in deep by literature [5], however, there are some studies devoted to explore the connection. Maybe the most important one is the one developed by Nelissen et al. [12] in which authors underline that associations would be found between values and emotions. However, further research is needed to explore this topic. Authors want to study this connection in the field of Software Engineering.

Moreover, future research is suggested to provide empirical evidence regarding the mapping between human values and scrum roles. Specifically, it is recommended to validate the results of this study, by employing larger and more diverse samples, including different universities, countries and different study levels (master or bachelor) and comparing also with teaching styles in Software Engineering courses. Our future work will focus on replicating the same study with different subjects, e.g. scrum practitioners in organizational settings. Furthermore, authors aim to undertake a more detailed analysis process, by considering other interesting variables that may influence the association such as the gender imbalance. Another aspect to investigate is experience as a factor to map with values and scrum roles. Authors believe experience is an individual aspect that may strongly impact on the relationship between one's preference for a scrum role and their human values.

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