

PROFESSIONAL PROFILES AND PERSONALITY TRAITS TOWARDS SOCIAL NETWORK TEAM BUILDING

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A b s t r a c t

Today's increasing hurriedness in our way of life along with technology advances demand from businesses to react always in a faster mode, while maintaining or, better yet, improving the quality of their products and services. Towards that objective, businesses can gain benefits by employing redefined team-building processes through which teams will be generated in a more cohesive and efficient manner. Aiming at forming productive and effective teams, we present PROTEAS, a framework where professional profiles and personality traits are both taken into account in the team-building process. The professional portrait of users is drawn from their LinkedIn accounts, while hints for their personality are obtained by a well-defined questionnaire based on the Big Five Factor Model. The significance of personality is substantiated by recent research work where it has been proven that personality traits can play a vital role in group dynamics. Motivated by the latter, PROTEAS defines a series of variables where characteristics of team members (e.g. skills, education) are combined with personality traits towards identifying candidate teams. All candidates are evaluated via a weight-based algorithm which calculates pair-wise similarities among teams' members and ranks the teams accordingly at the end. To assess the effectiveness of PROTEAS an academic setting has been chosen and through the experimentation a number of interesting observations occurred which are analogous to those of similar researches, confirming the significance of personality and professional compatibility between team members.

Introduction

As the years go by businesses aim to create new products and services, ever faster, while maintaining or, better yet, improving quality. In order to cope with the new volume of demand that defines the current business world, they have to utilize every possible „weapon” in their arsenal. One way to do so is to reassess one of the first and most important steps in new product development: **Team Building.**

Teams are more often than not created based on the technical requirements of a given task, project or product. As a result, team members are selected because they have the necessary skills, experience or expertise. Research has indicated, however, that personality can play a significant role in group dynamics (NEUMAN, WRIGHT 1999, THOMS et al. 1996). It is suggested that the cohesion of the group and the right match of its members' personalities also contribute positively to the successfulness of a team (LEPINE et al. 2011).

At the same time, we have witnessed an exponential increase in the use of social media, especially during the last decade. Not only do we encounter a plethora of them, but new types also emerge, such as social networks with a business direction.

These observations instigated our motivation for this paper, which can be summed up in two succinct points:

- Personality traits may contribute to team cohesion and good interpersonal relations, which in turn lead to the greater team efficiency (see Related Work).
- Social media have become very popular, resulting in a world rich with professional-related information.

We would like, for these reasons, to approach the subject of team building under a different light, and provide a way for all these new criteria to be included in the team formation process, so as to create more efficient and productive teams with greater cohesion. This will be the result of the combination of two factors: team members' professional profile and their personality traits.

As a result of our work PROTEAS has been created, a framework combining users' professional profiles acquired through LinkedIn, a business-oriented social network, as well as their personality characteristics, based on the Big Five Factor Model, which are acquired through a personality test we provide. A rough outline of this procedure is presented in Figure 1. PROTEAS starts by

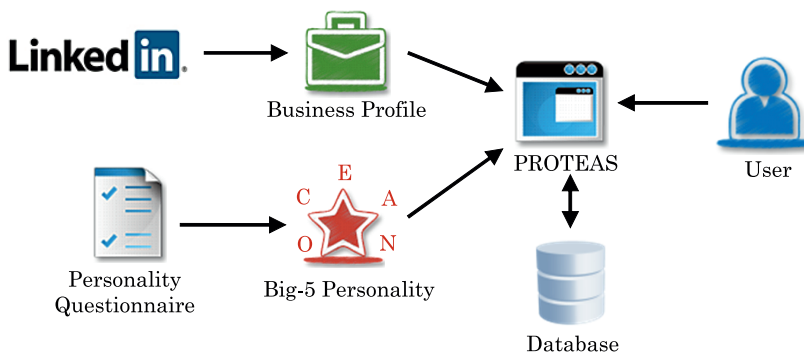


Fig. 1. Collection of user information

creating candidate teams with similar users based on their professional profiles and then, as a second-stage process, those candidates are evaluated in terms of the personality parameters of their members.

The remainder of this paper is structured as follows: In Section 2 we present some fundamental ideas, which deal with personality and work effectiveness. The theory behind our framework is described in Section 3. Section 4 presents the results of our experiments. Lastly, in Section 5 we conclude and discuss some possible future directions.

Preliminaries and Related Work

In this section we provide both a brief overview of the building blocks of our framework and present a number of representative studies regarding team building.

PROTEAS Fundamental Concepts

The presented framework is comprised of users' professional profiles and personalities, as well as teams and team forming.

– A professional profile is a collection of information mainly regarding a person's working experience and also other qualifications, such as the skills a person has acquired, his academic background, publications, awards and honors.

– In recent years, a new theory about personality is agreed upon by most of the modern personality psychologists: The Big Five Factor Model (JOHN, SRIVASTAVA 1999), whereby each person's personality can be described as a combination of five major traits, or dimensions:

- **Openness to Experience** or **Intellect** is a person's curiosity, imagination, creativity, un-conditionality, level of realism, and resistance to change.
- **Conscientiousness** is linked with organization skills, work ethic, self-discipline and goal realization with persistence and thorough planning.
- **Extraversion** is the level of sociability and enthusiasm, and is in a way a measure of the intensity of the person's interaction with others.
- **Agreeableness** indicates how kind, altruistic and friendly is one person towards others, as well as their level of cooperation or sense of competition.
- **Neuroticism** or **Emotional Stability** indicates whether a person is tranquil and calm or irritable, emotionally unstable or moody.
- A team is a group of people working interdependently, with a full set of complementary skills, required to successfully carry through a given task or

project, for which they are mutually accountable (KATZENBACH, SMITH 1992). In most cases, team members are either chosen because they have the necessary skills or work experience, or because the members have some degree of previous acquaintance (ALDRICH, KIM 2007).

Related Work

Traditional team building criteria are those concerning a team's demographics or members' skill-set. Team building processes of this kind are trivial and widely known. For example, the use of a design structure matrix is used along with sequencing and grouping algorithms (DUNBING, ZHENG 2000, EPPINGER, WHITNEY 1994). In addition, HLAOITTINUN et al. (2007, 2008) propose an array-based clustering process which mostly takes into account the team members' competency for a specific task. A matrix is created denoting each member's competency for the parameters of the task at hand. Then, a clustering algorithm is applied, and for each possible cluster a performance indicator is computed.

We would also like to focus on the role of personality on work efficiency and explore other factors that benefit a team's effectiveness. The study of Personality started in the 50's and the definition of the Five-Factor Model soon followed (JOHN, SRIVASTAVA 1999). A great portion of research has been made in order to establish a connection between personality traits and job efficiency. Conscientiousness has been regularly found to be a valid predictor of job performance, either in general (HURTZ, DONOVAN 2000) or in specific job families (BARRICK, MOUNT 1991). Openness to Experience may validly predict performance in Management and jobs involving Customer Service (HURTZ, DONOVAN 2000). Extraversion is a valid predictor of job performance for occupations that have social aspects (KICHUK, WIESNER 1997). Neuroticism and Agreeableness have showed relatively low correlations (Barrick and Mount, 1991). On a team setting, Conscientiousness along with Agreeableness seem to be highly significant as working in a team involves communication and social interaction (LEPINE et al. 2011, NEUMAN, WRIGHT 1999). Nevertheless, there are cases where having high Agreeableness levels could be detrimental; an individual challenging the ideas of the team could lead to reassessing the problem and producing better results (THOMS et al. 1996), as we have also encountered in our study. Emotional Stability is believed to be positively correlated with team performance (THOMS et al. 1996). The roles of Extraversion and Openness to Experience are not well defined in a team setting (KICHUK, WIESNER 1997).

Apart from personality traits, demographics (e.g. age, gender) seem to have no relation whatsoever, for the successfulness of a team. For instance, KICHUK, WIESNER (1997), found no significant difference between teams regarding the number of female members participating. Also, REAGANS et al. (2004) com-

pared the efficiency between teams based on demographics and teams based on the social connections of its members and found no sign that the former are more productive.

We observe that team efficiency and cohesion is attributed to different factors, and studies have been carried out for each one of them. We believe that all these factors are important in relation to team effectiveness, and we thus try to utilize them in our framework, as presented in the following section.

PROTEAS: „Automated generation of PROfessional TEAmS in Social networks”

In this section we present a solution to the problem of creating efficient teams, in the form of PROTEAS, our team building framework, which runs as a web application, written in PHP and storing data in a MySQL database. The professional profile of users is drawn from their LinkedIn accounts and through a questionnaire their personality outline can be assessed, according to the Big Five Factor Model. For this purpose, we selected IPIP¹, which is a public domain list of personality items, and we created a questionnaire containing 50 items. The test is a typical 5-point Likert-type scale, where each item can be answered with one of the following options: (i) Strongly disagree, (ii) Disagree, (iii) Neither disagree nor agree, (iv) Agree or (v) Strongly agree.

Teams are created by first setting the desired parameters: team size, users' skills, languages spoken, industries they belong to, geographic location, academic background, and the personality parameters, where each trait is expressed as a relative value (low, medium, high). Then, all possible team combinations are calculated and a process of ranking is employed, so as to propose the best team available. For this purpose, we created a metric in order to compare the available teams.

Similarity Measures

To calculate the similarity between two users, we provide a set of different similarity measures. The available similarity measures are: Skills, languages, industries, location, and education, which we have extracted from users' professional profiles and LinkedIn. The basis for our formulae is the Overlap Coefficient (SIMPSON 1960), which in turn is based on the Jaccard Index (JACCARD 1901).

Skill-based Similarity. Users can define a set of skills that they have acquired. To find the similarity between two users' skills, the overlap coefficient is used:

¹ International Personality Item Pool: <http://ipip.ori.org/>

$$\text{Sim}_{\text{skill}}(A,B) = \frac{|\text{Skills}(A) \cap \text{Skills}(B)|}{\min(|\text{Skills}(A)|, |\text{Skills}(B)|)} \quad (1)$$

Language-based Similarity. In defining a spoken language users also set the level of their proficiency, with 1 being the lowest and 5 the highest. We thus use an altered version of the Overlap Coefficient. We first define the language proficiency range as $\text{maxRate} - \text{minRate} + 1 = 5$. The value between two languages is:

$$\text{value}(\text{Lang}(A), \text{Lang}(B)) = \frac{\text{range} - \text{diff}}{\text{range}} = \frac{5 - \text{diff}}{5} \quad (2)$$

where $\text{diff} = |\text{rate}(\text{Lang}(A)) - \text{rate}(\text{Lang}(B))|$. The final similarity formula is:

$$\text{Sim}_{\text{lang}}(A,B) = \frac{\sum_{i,j}(\text{value}(\text{Lang}_i(A), \text{Lang}_j(B)))}{\min(|\text{Langs}(A)|, |\text{Langs}(B)|)} \quad (3)$$

where $\text{Lang}_i(A) = \text{Lang}_j(B)$, $0 < i \leq |\text{Langs}(A)|$, and $0 \leq j \leq |\text{Langs}(B)|$.

Industry-based Similarity. LinkedIn defines 147 different industries, which can belong to one, two, or three of 17 general groups. Users may fill in an industry that they believe that describes them, which we define as the main industry. In addition, secondary industries can be assessed from current or past jobs. Comparing two industries we can find them being the same, belonging to the same general group or groups, belonging to some of their respective groups, or belonging to different groups entirely. Sample industries are presented in Figure 2. For each pair, we calculate the Overlap Coefficient of

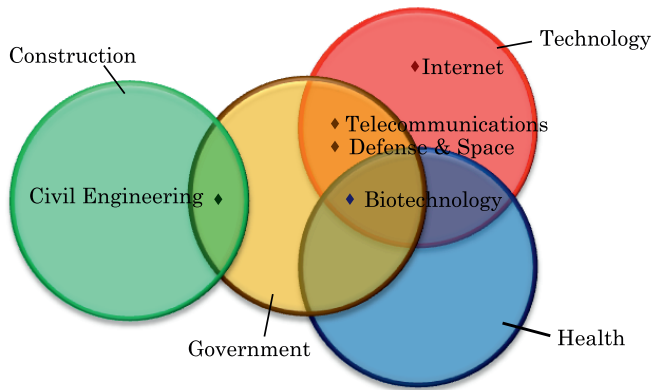


Fig. 2. Sample industries and their corresponding groups

their corresponding groups. We also define the probability of the event that each of these cases happens, and the corresponding reward as $1 - \text{probability}(\text{event})$.

We define the score between two industries as:

$$\text{score}(\text{Ind}(A), \text{Ind}(B)) = \begin{cases} 1, & \text{Ind}(A) = \text{Ind}(B) \\ \text{Over. Coeff} \cdot \text{reward}, & \text{Ind}(A) \neq \text{Ind}(B) \end{cases} \quad (4)$$

As a starting point, we give a weight of 0.35 to the user's main industry and for each secondary industry a weight of 0.15. The total score is:

$$\text{Total}_{ind}(A,B) = 0.35 \cdot \text{main}(A,B) + k \cdot 0.15 \cdot \sum_i^k \text{secondary}_i(A,B) \quad (5)$$

The final score is normalized according to the sum of weights. In the future, the weight values can be re-evaluated, if deemed necessary.

Similarity based on Geographic Location. Two users can be geographically similar when they have a relative distance between them. According to the LinkedIn data available, we have extracted 4 possible distances. These are, from smallest to greatest (and thus denoting higher to lower similarity):

$$\text{Sim}_{geo}(A,B) = \{\text{same city, same country, same continent, no similarity}\} \quad (6)$$

Similarity based on Educational Background. In relation to two users' academic background, we take into account the number and types of degrees that each one has provided. For every type of degree, we have assigned a specific weight, which is a combination of the average years required for it and an extra factor according to their level, as seen in Table 1. The education score is calculated by adding the corresponding values of the user's degrees. The final educational similarity between two users is:

$$\text{Sim}_{edu}(A,B) = \frac{\min(\text{Score}(A), \text{Score}(B))}{\max(\text{Score}(A), \text{Score}(B))} \quad (7)$$

Table 1

Degree weights			
Degree	Years	Factor	Final Weight
Associate/Foundation	2	1	2
Bachelor's	4	1	4
Master's	2	1.5	3
Doctorate	4	2	8

General Similarity Formula. The final similarity formula, comparing two users is defined as:

$$\text{Similarity}(A,B) = \sum_i w_i \cdot \text{Sim}_i \quad (8)$$

where Similarity_i is one of the aforementioned similarity measures and w_i is the weight of each measure. In case there are disabled similarity measures, the final value is normalized according to the remaining weights.

Team Similarity and Ranking Algorithm

In order to calculate the similarity among all members of a team, we follow the example of REAGANS et al. (2004). For each team we calculate all possible pairs between its members. Then we calculate each pair's similarity value and then the average of the similarity values of these pairs. So, for all teams T of size n , the ranking value of each team $t_k \in T$, $1 \leq k \leq |T|$, is calculated as:

$$\text{Rank}(t_k) = \frac{\sum_{i=1}^{i=n-1} \sum_{j=i+1}^{j=n} \text{Similarity}(m_i, m_j)}{|\text{combinations}(n,2)|}, \text{ where } m_i, m_j \in t_k \quad (9)$$

Finally, the teams are sorted and presented in a descending order.

Experimentation

In order to assess the correctness and efficiency of PROTEAS, we implemented an online application and asked for the participation of students of two undergraduate university courses in the fall semester of 2013, where they were given assignments to complete in teams of up to 4 people. As not all users have a LinkedIn account, we offered them the option to create an account on our application, where they filled in all the relative information manually. Course A was offered to second-year students and included a theoretical assignment, while Course B was offered to fourth-year students and included a programming one. Students also completed the personality questionnaire. Upon completion of the assignment they filled in another short questionnaire, concerning among other things an estimation of the time they invested in the assignment. In our study 16 teams of Course A participated and 15 teams of Course B (i.e. ~ 60 students in each course). We then manually recreated these teams, calculated each team's similarity measures and checked them against their final assignment grade.

– Team similarity measures and assignment’s final grade. As we see in Table 2, although there was no consistent correlation between the general team similarity and the final grade (-0.40 for Course A, 0.25 for Course B), there was a correlation between skill similarity and the final grade (A: 0.22, B: 0.48). We observe that Course B presents a greater correlation value than Course A, a fact not quite unexpected; the assignment for Course B was a programming one and thus required the team members’ skill set to include many technical skills (such as Java, C++, or HTML). The theoretical assignment of Course A didn’t have any specific technical prerequisites. No correlation can be calculated for the geographical similarity, as all users in both courses live in the same city, and there is no significant correlation for the language similarity. As undergraduate students took part in our study, it is reasonable that their educational background is similar, as well as the industry they belong to. As a result, there is an almost insignificant correlation for the former, and an inconsistent one for the latter.

Table 2

Correlations between similarity measures and final grade

Similarity Measures	Course A	Course B
General Similarity	-0.40	0.25
Skill-Grade	0.22	0.48
Language-Grade	-0.19	-0.07
Industry-Grade	-0.28	0.29
Location-Grade	X	X
Education-Grade	-0.24	-0.25

– Personality traits and final grade. In Table 3 we observe that in Course A we have a correlation regarding Conscientiousness, which is in line with observations in Section 3, suggesting that conscientious people have better job

Table 3

Correlations of personality traits with final grade and time

Personality Traits	Final Grade		Weekly Team Hours	
	Course A	Course B	Course A	Course B
Openness	0.08	-0.06	0.17	0.24
Conscientiousness	0.33	-0.01	-0.40	-0.22
Extraversion	-0.19	-0.01	-0.13	-0.18
Agreeableness	-0.04	-0.55	-0.03	-0.35
Neuroticism	0.01	0.20	0.42	0.05

performance. Agreeableness is a trait which reflects one's tendency to be acquiescent with other people's ideas. In the case of Course *B*, there is a negative correlation of -0.55 between the Agreeableness trait and the performance in the assignment. This suggests that through initial disagreement, new ideas were put on the table which eventually led to more robust and effective solutions, as we discussed in Section 3. All other traits do not seem to have a significant correlation.

– Personality traits and weekly team work time. It is interesting to note the correlation between personality traits and the average weekly hours a team spent completing the assignment, as seen in Table 3. We observe a negative correlation of -0.35 between Agreeableness and time. We have seen above that less Agreeable teams had better grades, but apparently it was accompanied by a tradeoff. Another interesting finding is the negative correlation between Conscientiousness and time, which is -0.40 for Course *A* and -0.22 for Course *B*. This means that the more conscientious members of a team were more focused on their goal and thus, completed the assignment quicker. Finally, for Course *A* there is a correlation of 0.42 with time, meaning that teams with members having high Neuroticism (e.g. stressful, anxious) needed more time to complete the assignment.

The two assignments were adjusted to the student knowledge level and had different objectives and time constraints. We have nonetheless extracted some interesting findings, as presented above, confirming that alternative criteria can be included in the team building process.

Conclusion

In this paper we have discussed possible ways that the team building process can be improved. Our contribution is PROTEAS, a framework we have developed, which introduces non-traditional variables in team building, such as personality traits of team members. We completed a study with undergraduate students of two courses participating. Although the presented work is at an early stage, we have laid down the foundation stone for further development in the future, and our intention is to extend our framework in many aspects. We are interested in applying PROTEAS in a business setting, where employees have more diverse back-grounds and teams can be created from scratch according to our framework's recommendations. Also, it could be very useful for PROTEAS to be extended with diversity concepts bearing in mind that the key is to find the right balance between similarity and diversity.

References

- ALDRICH H.E., KIM P.H. 2007. *Small worlds, infinite possibilities? How social networks affect entrepreneurial team formation and search*. Strategic Entrepreneurship Journal, 1(1-2): 147–165.
- BARRICK M.R., MOUNT M.K. 1991. *The Big Five Personality Dimensions and Job Performance: A Meta-Analysis*. Personnel Psychology, 44(1): 1–26.
- DUNBING T., ZHENG L. 2000. *Re-engineering of the design process for concurrent engineering*. International Journal of Computers & Industrial Engineering, 38: 479–491.
- EPPIINGER S., WHITNEY D. 1994. *A model based method for organizing tasks in product development*. Research in Engineering Design, 6(1): 1–13.
- HLAOITTINUN O., BONJOUR E., DULMET M. 2007. *A fuzzy array-based clustering method in team building*. Management and Control Production and Logistics, 4(1): 73–78.
- HLAOITTINUN O., BONJOUR E., DULMET M. 2008. *A multidisciplinary team building method based on competency modeling in design project management*. International Journal of Management Science and Engineering Management, 3: 163–175.
- HURTZ G.M., DONOVAN J.J. 2000. *Personality and Job Performance: The Big Five Revisited*. Journal of Applied Psychology, 85(6): 869–879.
- JACCARD P. 1901. *Étude comparative de la distribution florale dans une portion des Alpes et des Jura*. Bulletin de la Société Vaudoise des Sciences Naturelles, 37: 547–579.
- JOHN O.P., SRIVASTAVA S. 1999. *The Big-Five trait taxonomy: History, measurement, and theoretical perspectives*. In: *Handbook of personality: Theory and research*. Eds. L.A.Pervin, L.A. John, New York: Guilford Press, pp. 102–138).
- KATZENBACH J.R., SMITH D.K. 1992. *The Wisdom of Teams: Creating the High-performance Organization*. Harvard Business Press, Boston.
- KICHUK S.L., WIESNER W.H. 1997. *The Big Five Personality Factors and Team Performance: Implications for Selecting Successful Product Design Teams*. Journal of Engineering and Technology Management, 14(3–4): 195–221.
- LEPINE J.A., BUCKMAN B.R.C.E.R., METHOT J.R. 2011. *A Review of Research on Personality in Teams: Accounting for Pathways Spanning Levels of Theory and Analysis*. Human Resource Management Review, 21(4): 311–330.
- NEUMAN G.A., WRIGHT J. 1999. *Team effectiveness: Beyond skills and cognitive ability*. Journal of Applied Psychology, 84(3): 376–389.
- REAGANS R., ZUCKERMAN E., MCEVILY B. 2004. *How to Make the Team: Social Networks vs. Demography as Criteria for Designing Effective Teams*. Administrative Science Quarterly, 49(1): 101–133.
- SIMPSON G.G., 1960. *Notes on the Measurement of Faunal Resemblance*. American Journal of Science, 258(a): 300–311.
- THOMS P., MOORE K.S., SCOTT K.S. 1996. *The Relationship between Self-Efficacy for Participating in Self-Managed Work Groups and the Big Five Personality Dimensions*. Journal of Organizational Behavior, 17(4): 349–362.