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Mathematical Models for the Evaluation of the Satisfaction Level of the Members of an Agile Teamwork

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Abstract. The introduction and the development of the web 2.0 technologies have facilitated the collaboration between the departments of a company or between companies. This implies that about agile businesses should be able to adapt too many situations and to choose optimal solutions. In this context one can take into account the process of building teams of experts regardless of the location that should solve certain tasks. However, it can be considered that building teams means putting together different characters, temperaments and cultures and this process is not always successful. For this reason the purpose of this paper is to describe an evaluation model of the satisfaction level of the agile teamwork members and implicitly of the companies involved. This research is using the heterogeneous algebras theory for defining a solution for the reunion of a team of individuals such as the team should achieve optimal performance levels. As a result, the paper presents a set of rules that should be fulfilled in order to create an efficient team. This research will be helpful for the implementation of the main engine of a tool that can be used for building agile teamwork.

Keywords: team building, algebras theory, network enterprise, social affinities, correlation, web 2.0

INTRODUCTION

The term agile teamwork started to be used in the software development field but it was extended later to other fields as a result of their connections to the Internet. The first generation of agile business strategies appeared in the nineties (Goldman *et al.*, 1995, 2009; Janneck *et al.*, 2008) as a result of the increasing speed and coverage of the businesses that determined the introduction of the "network enterprise" concept. Agile team work is built by 2 or more enterprises in order to solve a common problem. The communication between the team members is done by Internet. The goal of these teams is to solve tasks with minimum cost and time (Goldman *et al.*, 1995, 2009; Janneck *et al.*, 2008). The setting up of an agile teamwork raises the problem of selecting the individuals for which best collaboration relations can be defined. In order to define such relationships, it should be necessary to identify the temperament type of each individual involved in an agile team and define the basic rules underlying team work.

In this context, let us present briefly temperament types, next to set up rules for building and organizing agile work teams and finally to use heterogeneous algebras for defining a solution for team building so that it achieves optimal performance levels. In the end of our study, conclusions and future research directions are provided.

RELATED WORKS

In the paper (Oliveira da Silva *et al*., 2009), we present a social model of matching individuals, which combines social and emotional skills, factors and roles that one person can play to support teamwork. The research is based on the premise that people who have social affinities work together more easily and do not require cooperation and transaction rules because their mode of interaction can be easily understood. Starting from this idea, it follows that whether collaborating individuals have social affinities or not is not important in order to set rules for team work. In addition, it seems that team members should not hold social affinities because the personality can be learned, so individuals can define their behaviour in relation with the environment in which they work. This idea is consistent with the literature (Garibaldo, 2004) that claims that the group is seen as a source of control and as a tool for manipulating individuals. Moreover, the group is seen as the most appropriate tool in altering peripheral elements of individual personality. (Garibaldo, 2004) Furthermore, the paper (Preda *et al*., 2002) claims that individual personality is learned during its existence. When talking about personality, it is more important to refer to temperament because in our opinion this plays an essential role in team building.

According to the literature (Preda *et al*., 2002; Rignet, 1948) people are divided into four personality types (temperaments), namely phlegmatic, choleric, sanguine and melancholic. The great majority of individuals do not belong to a single group but share temperamental traits from all four temperaments because they were raised and educated by people with different temperaments.

The first description and classification of temperaments seems to date from the fifth century BC and is formulated by Hippocrates; later it was developed by Kant, Jung, Benziger and others (Garibaldo, 2004). Temperaments are classified and characterized as follows: ((Radu *et al*., 1991; Garibaldo, 2004).

- Choleric: energetic, unrestrained, tendency toward impulsivity, aggression, agitation, intense emotions, tendencies to dominate the group, penchant for exaggeration, emotional instability.
- Sanguine: intense emotion and superficial feelings, the need for continuous change, dynamism and high degree of adaptability, talkative, effusive, adaptable, quick decisions, mental balance in extreme situations, extensive work capacity.
- Phlegmatic: slow, emotional balance, sustainable feelings, calm, pedantic, sober, conservative, able to work hard, meticulous.
- Melancholic: hypotonic, reduced work capacity under stress, sensitive, affected by failures, dependence on others, meticulous work oriented, anxious, decompensate rapidly.

When addressing the notion of temperament, Jung's theories play an important role. He identifies four functions of the psyche ranging in the interval rational and irrational. Functions belonging to the rationality, that is thinking and senses (something is good or not), allow the individual to make decisions while irrational functions account for sensations and intuition (Garibaldo, 2004; Radu *et al*., 1991).

Starting from the idea that individuals are characterized based on the four temperaments mentioned above plus a set of rules that will be exposed in the next section, we will be able to build agile teams to work in collaboration to solve problems for which they were formed.

AGILE TEAMS ORGANISING MODEL

In our view and according to the specialist literature (Kotler, 1997; Purdea *et al*., 2003), creating an agile team brought together to solve a problem involves the following

stages:
- Defining the context in which they work to solve a problem/task. This context will not require individual performance. Members will be told that they will work as a team and will be treated as such. Individual failure and success will be the failure and the success of all group members: all for one and one for all. This suggests that successful agile team work consists not of competition, respectively conflict, but of cooperation and collaboration;
- Psychological testing to allow measuring on the one hand the degree of matching/ complementing/interaction of people who will work together and on the other hand the individual capabilities of conflict resolving/avoidance and creating a calm/harmonious work environment;
- When team members come from different cultures, they will be provided all information in compact format about what is acceptable/ not acceptable in each of the cultures involved;
- The exact definition of the roles of each actor within the group with a clear description of their tasks and responsibilities.

The good functioning of an agile team means complying with the following "rules":
- Acknowledging and sharing the problems they face in dealing with situations (not to blame their mistakes on others);
- Not attribute success only to themselves but to all those who participated in accomplishing the task;
- Fair and constructive feedback from other team members in everything they do (Preda *et al.*, 2002).
- Equivalent education and training;
- Direct and honest communication among all members;
- Identical reward for group members depending on the difficulty of the task.

For all team members to attain high efficiency (to perform at their highest level), we believe it is necessary that:
- Team members be considered at their true value, in other words, be given "recognition"/ respect from all members;
- The team consists of persons who have an equivalent level of education and training;
- Members be experts in their field but also possess the art of communication and collaboration in higher proportion than knowledge. In this context, it can be considered that an individual can continuously improve but the two aptitudes of cooperation and collaboration are more difficult to acquire with age. From our observations, most experts do not possess the art of communication;
- In case of conflict, individuals must be able to assess/identify the situation/opponent's position and have the reasoning ability in view of mitigating the conflict in an early stage.

So, the group will be characterized by distributed power, direct and flexible communication, relationships defined by respect and friendship. This statement is in correspondence with (Goldman *et al.*, 2009). Starting from this idea, the traits that can successfully integrate an individual into an agile team are: (Goldman *et al*., 2009; Preda *et al.*, 2002; Radu *et al.*, 1991; Kotler, 1997).
- Trust, which is the epicenter of relationships.
- Loyalty to the team to which they belong.
- Capacity to work in various communities, which are based on honesty, integrity.
- Altruism, namely the desire to assist otherwise unknown members of the community, information exchange.
- Motivation - each group member must be deeply motivated to be part of the group.
- Patience, which is a key feature of collective work.

- Authenticity, namely all individuals are unique and therefore they should be approached as such.

In our view, identifying temperament traits that an individual must have in order to successfully be part of an agile work team can be done either by a traditional questionnaire.

RESEARCH GOALS

Gathering together groups of experts from different companies or even from just one company is an apparently easy job but in fact it is quite troublesome because different characters and personalities have to be put together in order to accomplish in good conditions a certain task, and this implies having a good collaboration climate. This research was started from the following working assumptions:

- The personality factors: strong ego, high self confidence level, sociability, emotional maturity correlates with a good adaptability in an agile workgroup;
- Frictions can be determined by self dissatisfaction, anxiety, depression generated by domestic problems or the adaptation to the environment;
- The correct identification of role of each team member and the respect towards all those implied in the team, are allowing a proper functioning of the team and not as least important, the merits recognition for each individual.

METHODOLOGY

For accomplishing the research goal the following working tools were used:

- For the identification of the personality factors that correlates with a high adaptation level inside the group, we used the Cattel R.B. questionnaire (Minulescu, 2004);
- For the estimation of the degree of adaptation to a group determined by the self dissatisfaction and/or domestic problems, sociability, and introversion we used the Freiburg Psychological Inventory (Minulescu, 1996, 2004);
- For determining the degree of social adaptation to a group, our own questionnaire was used;

In order to develop a tool for the estimation of the ability/difficulty of the experts to adapt to working in an agile teamwork, checking the specialty literature it results the following items:

- Problems identification and sharing [support 40%, confidence 66%];
- Identical pay of the team members [support 50%, confidence 66.7%];
- Constructive and correct feedback [support 74%, confidence 85%];
- Direct and sincere communication between the all team members [support 84%, confidence 98%];
- Not assuming the success to himself [support 79%, confidence 98%];
- Equivalent level of education and instruction [support 78%, confidence 98%].

A sample of 30 people that have already been part of agile teamwork's were asked to respond to the questionnaire that was built for determining degree of adaptation of a person to an agile teamwork. The resulting data was processed using the Likert scale (1- means weak adaptation and 5 means a strong adaptation). All the items were validated so it was not necessary to review the questionnaire.

Then for checking the questionnaire accuracy, the following statistical analysis methods were applied on the collected data:

- The split-half method – computing the accuracy coefficient for the entire test we obtained the value of the a Bavaris Pearson correlation coefficient $r = 0.82$ with confidence level $p < 0.05$;

- The internal consistency method – the computed internal consistency measure α Cronbach was 0.85 that suggests a unitary structure of the used tool.

The reliability of the questionnaire is based on a good correlation with the H.M.Bell test (Minulescu, 1996, 2004) (which takes into account the fact that the sample people are coming from different life environments and social and professional activities) for measuring the adaptability of the experts in the agile teamwork. Based on the statistical analysis it results a correlation coefficient $r = 0.76,\ p = 0.05$. So using the questionnaire proposed in this paper for the identifying the appropriate members of an agile teamwork is valid and reliable.

To verify if the personality factors like strong ego, high self confidence level, sociability and emotional maturity are playing an important role in the evaluation of the degree of adaptation in the agile teamwork, it can be considered that they can be determined only if there is a significant correlation between the ratings results from the Cattel R.B. questionnaire and our questionnaire.

Significant correlations were obtained for the confidence/lack confidence factor ($r = -87,\ p < 0.05$), frustration tolerance/emotional maturity ($r = -68,\ p < 0.05$), boldness/diffidence ($r = -58,\ p < 0.05$), and integration ($r = -70,\ p < 0.05$).

So the personality profile of a person that adapts to an agile teamwork is: sociable, sincere, ability to cooperate, strong ego, self confidence, emotionally mature, frustration tolerant.

After evaluating the sample of 30 people for the adaptability degree to an agile teamwork using the Freiburg Psychological Inventory (Minulescu, 1996, 2004) the following results were obtained:

- Satisfaction with life, an above average result corresponding to level 5 of the standard scoring system;
- Social orientation, an above average result on a 1 to 3 standard scoring system;
- Achievement orientation, a high result on a 1 to 7 standard scoring system;
- Inhibition, a slightly under average result on a 1 to 5 standard scoring system;
- Aggressiveness, a low result on a 1 to 4 standard scoring system;
- Stress, a low result on a 1 to 4 standard scoring system;
- Health problems, a significantly high result on a 1 to 2 standard scoring system;
- Honesty, an above average result on a 1 to 7 standard scoring system.

During this study one can note that those that obtained results close to the average are adapting, collaborating and working in a satisfactory to good manner in an agile teamwork. Instead, those people those were not able to adapt to the agile team working, have obtained extreme results values.

Further it is necessary to use a mathematical model for demonstrating the correctness of the idea presented in this paper.

THE ABSTRACT APPROACH TO THE RULES BASED ORGANIZATION OF THE AGILE TEAMWORK

In our vision, the agile teamwork's can be analyzed using notions and results from the heterogeneous algebras theory. For this reason a mathematical model for the definition of the relationships between a set of people using the criteria enounced in section 3 will be presented as follows.

It can be considered that fair working relationships between people have to be based on rules. More details can be found in the documents, (Purdea *et al.*, 1977, 2003; Rignet, 1948).

Let M be the people set. The temperament classification will become the ρ mathematical relation based on M and defined as:

$$a \ \rho \ b \Leftrightarrow a \text{ and } b \text{ have the same temperament}$$

The ρ relation is:

- reflexive, because $a \ \rho \ a$, for every $a \in M$
- symmetrical because $a \ \rho \ b \Rightarrow b \ \rho \ a$, for every $a, b \in M$
- transitive because $a \ \rho \ b$ and $b \ \rho \ c \Rightarrow a \ \rho \ c$, for every $a, b, c \in M$

This means that ρ is equivalence relation on M and ρ determines a partition of M, in other words a division on M in disjoint classes. This partition denoted by M / ρ is:

$$M / \rho = \{\rho < a_1 >, \rho < a_2 >, \rho < a_3 >, \rho < a_4 >\}$$

where a_1, a_2, a_3 and a_4 are the four different temperaments identified in section II and

$$\rho < a_i > = \{a \in M \mid a_i \ \rho \ a\}$$

So,

$$M / \rho = \{T_c, T_f, T_s, T_m\}$$

where T_c is the set of people with an choleric temperament, T_f is the set of people with phlegmatic temperament, T_s is the set of people with sanguine temperament and T_m is the set of people with melancholic temperament.

The instruction and the education level have an influence on the temperament so it is useful to define two new relations ρ_e and ρ_i on M similar to the ρ relation

$$a \ \rho_e \ b \Leftrightarrow a \text{ and } b \text{ have the same education level}$$

and

$$a \ \rho_i \ b \Leftrightarrow a \text{ and } b \text{ have the same instruction level}$$

The relations ρ_e and ρ_i are also equivalence relations. The classes of the M / ρ_e partition and the M / ρ_i partition respectively, are built by people with the same education level or instruction level.

By intersecting the relation ρ with the relations ρ_i and ρ_e we are obtaining the equivalence relations $\rho \cap \rho_i$ and $\rho \cap \rho_e$. Knowing that $\rho \cap \rho_i \subseteq \rho$ and $\rho \cap \rho_e \subseteq \rho$ it results that $\rho \cap \rho_i \subseteq \rho < a >$ and $\rho \cap \rho_e \subseteq \rho < a >$ for every $a \in M$, which means that every class of the M / ρ partition is a reunion of classes from the $M / \rho \cap \rho_e$ partition and a reunion of classes from the $M / \rho \cap \rho_i$ partition.

Building an efficient agile teamwork depends on the temperament, the education and the instruction level, expressed by the relations between the partitions $M / \rho \cap \rho_e$ and $M / \rho \cap \rho_i$. In the definition of these relations one could also consider the rules enounced in section III.

In an agile teamwork, the reflexivity is the relations between a person and himself. The symmetry between the members means they there are accepting each other. The transitivity indicates that if a person X is connected to Y and Y is connected to Z then Z can develop a relation with Z. In our vision, optimising these relations consists in elaborating a set of collaboration rules like the one defined in this paper.

Consequently, the role of the mathematical model developed by us is to provide an example of organization of relations necessary for the proper function of an agile tem work.

CONCLUSIONS

In our conception, when building an agile teamwork one have to take into account the temperament/personality and the rules stated in this paper, according to the specialty literature (Goldman *et al*., 2009; Oliveira da Silva *et al*., 2009; Purdea *et al.*, 2003). This idea has been mathematically demonstrated and was partially checked by a survey that returned the expected results.

By the mathematical model described in the paper, we intended to present and to demonstrate the correctness of the people organization based on temperament/personality, education and instruction in an agile teamwork, in order to reach an optimal working environment for the members.

As a conclusion of the entire study, whose accuracy was mathematically demonstrated, is that an individual who is working well in an agile teamwork usually has the following profile: sociable, kindly, strong ego, opened, resistant to stress, ability to deal with conflict, low degree of nervousness.

In the process of organising the people in an agile teamwork according to the mathematical model, one can determine an optimal structure of the working relationships. The mathematical model can also be used to analyses the structure of the existing teamwork.

We intend to continue this research including concepts from the game theory, especially from the positive sum games.

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