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PERSONALITY IN PROJECT MANAGEMENT METHODS

Abstract

High work efficiency is required by today's organizations. Besides of other factors it depends on the right allocation of employed workers to their duties. Assigning employees to the right activities isn't an easy task, because the job efficiency and differences in human nature have to be considered simultaneously. Usually, the decision undertaken by the human resource (HR) manager is based on his subjective experience. In several cases, such solution results in negative reactions of employees, and may lead to conflicts occurrence. In order to avoid them the problem of allocation of the properly selected team (taking into account workers' personality) to the project's activity is of crucial importance. Its right solution can decrease risk of activity execution delay. So, it is assumed the project's completion time depends both on physical and psychological features of employed workers. Experimental results presented illustrate this approach.

1. INTRODUCTION

Project management methods such as PERT, CPM, etc., allow to manage the scheduling of the project [7]. Estimation of the duration of each task (activity), and consequently project time duration is the main goal of the project evaluation. Generally, the goal of these methods is to increase the chances of project's completion, e.g. reducing the risk of its delay.

However, project management methods don't consider some features of the engaged resources. Especially skills and psychological features of workers are ignored. It is obvious that some employees are not able to do the some jobs. For instance, very nervous John shouldn't be a surgeon because he may harm his patients instead helping them. So, the personality influence on workers achievements seems to be obvious.

Usually project's activities are executed by teams of workers possessing different skills. Thus, for instance Bill, who is a calm person – does he is able to do surgery and/or what kind of personality of co-workers may support him. Either calm people? Teamwork can be seen as a cooperative effort of its members aimed at a common goal achievement. So, well coordinated project teams can guarantee project due time completion. In opposite, bad coordination may lead to project failures [11].

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What can be understood by “goodly coordinated” or “badly coordinated” project team? Someone may say that each worker have to have required skills, such as hole digging for a gravedigger, or throw the javelin for athlete. In other hand, however a good team is in the case when workers like to play and speak to each other. In other words, a good team can be characterized by good relations between its members [1].

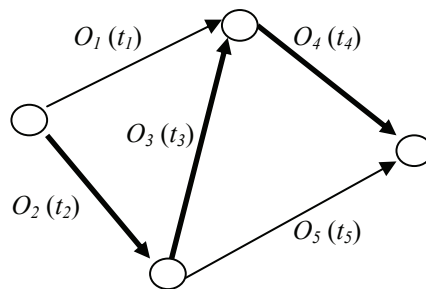
So, it seems that the communication plays a most important role in a project team. Differences in personality features lead up to misunderstanding, consequently in project team can be a source of work failure [2, 9]. So, the associated **job assignment problem** involving capturing of a unique set of workers personality features (influencing on a team behavior, communication among its members, and so on) is very important, however not easy issue.

Therefore, an attempt to connect the human capital evaluation methods (personality measurement methods) with project management methods is the main contribution of this paper. In that context the paper provides a formal statement of a job assignment problem both in **forward** and **backward reasoning** variants. Its solution aimed at implementation to the Decision Support Systems (DSS) designing is discussed.

The paper is organized as follows. The job assignment problem, and definition of personality, is described in section 2. The personality model is presented in detail in section 3. Illustrative example of **forward reasoning** version of job assignment problem is shown in section 4, as well as the **backward reasoning** one. Section 5 discusses two alternatives to proposed approaches. Finally, conclusions and an outlook for future work are presented in section 6.

2. JOB ASSIGNMENT PROBLEM AND PERSONALITY

Consider the project specified by activity on-arc network, see Fig. 1. Activities nominal time durations are in brackets.



Legend:

$O_z(t_z)$ - the z -th activity in the project

○ - node specify an event, e.g. activity ending/beginning

Fig. 1: Activity network

Bolded arrows state a critical path determining a project deadline. Eight workers are employed Problem is stated as follows: what pairs (teams) assigned to particular activities

won't exceed given deadline? To simplify our considerations, let us assume that each employee has required skills. Assume that between some persons are conflicts and misunderstanding. In other words, personality of team members may influence efficiency of assigned activity execution.

The Job Assignment Problem (JAP) is NP-hard one. It has been considered from half of the past century, and there exists in many industrial issues like product manufacturing and workflow organization – scheduling tasks. Since, some works take into account indispensable skills to perform activities, hence employees selection with required skills has to be considered [3]. Solution relies on workforce minimization by determining appropriate number of employees to the tasks.

Other example of job assignment problem is considered in [12]. The paper describes parallel and distributed machine learning to a basic variant of the job-assignment problem. However there is no model of personality influence on work time duration, especially in the team work (project team work). Gacovski [4] proposes an automated tool supporting project assignment process. Neuro-fuzzy interface system which can learn to make human-like decisions and uses fuzzy membership functions for the soft constraints is considered. However there is still no model where personality features are included in a job assignment problem.

The literature define personality as individual differences, characteristic of each person [14]. Many of them have been developed (**Norman 1967; Angleitner et al. 1990**). Characteristics that fall into many of the categories do not fit common definitions of personality. Descriptors of physical characteristics (e.g., short, muscular) lack sufficient reference to psychological (behavioral, affective, cognitive) features. Descriptors invoking social roles (e.g., motherly, professional) and social effects (e.g., famous, neglected) involve social-contextualization and relativization too heavily to give inferences about an individual's personality attributes. Descriptors of emotions (e.g., elated, afraid) and many motivational and intentional states (e.g., hungry, reluctant, inspired) are too prone to reference relatively transient characteristics. And some descriptors (e.g., awful, impressive) are so purely evaluative that they provide insufficient specificity with respect to psychological features [14].

Among descriptors more internal and enduring psychological attributes, three categories stand out. Abilities or talents (e.g., skillful, creative) refer to typical levels of performance on tasks. Beliefs and attitudes (e.g., religious) concern affectively tinged habits of mind pertaining to specific objects and concepts.

Although personality models have frequently contained some ability, and attitude, related content, at their core are traits (e.g., daring, patient) that are more directly related to typical behavioral patterns. Because they are expressed behaviorally, enduring motivational patterns (e.g., need for achievement) might also be easily fit within definitions of personality that emphasize typical behavior patterns. "Temperament" usually denotes the more clearly inborn and genetically derived aspects of personality, whereas "character" is often used to denote acquired moral qualities. But these terms are otherwise synonymous with personality, which can be defined as consistencies in patterns of behavior where behavior is defined broadly to include affect, cognition, and motivation on which individuals differ. Overall, personality is a lay concept of sufficient importance and usefulness to have been taken up and refined by scientists [15].

Usually someone can be recognized as optimistic or pessimistic. In other cases can be seen as an extravertic, or introvertic. These specifications (or criteria of human being personality evaluation) can be seen as decision variables and consequently their measures and measurement method should be declared. From existing personality measurement methods the most popular is **MBTI** (Myers-Briggs Type Indicator) [1]. The indicator is frequently used in

the areas of pedagogy, career counseling, **team building, group dynamics**, professional development, marketing, leadership training, executive coaching, life coaching, personal development, marriage counseling, and **workers' compensation claims** [14]. Moreover, the method is called the best-known and most trusted personality assessment tool available today [16]. About other measurement methods you can find in [13].

The MBTI sorts some of psychological preferences into four opposite pairs. These four dichotomies are [16]:

- Extraversion (E) and Introversion (I): differentiating people who direct their energy primarily outward toward other people and events from people who direct their energy primarily inward toward their inner environment, thoughts, and experiences,
- Sensing (S) and Intuition (N): differentiating people who take in information primarily through the five senses and immediate experience from people who take in information primarily through hunches and impressions and are more interested in future possibilities,
- Thinking (T) and Feeling (F): differentiating people who make decisions primarily based on logic and objectivity from people who make decisions primarily based on personal values and the effects their decisions will have on others,
- Judging (J) and Perceiving (P): differentiating people who prefer structure, plans, and achieving closure quickly from those who prefer flexibility, spontaneity, and keeping their options open.

Generally it is 16 possible psychological types. In each case it is four-letter acronym, which denotes relevant personality type e.g. ESTJ, INFP, etc. This method evaluates psychological preferences in how people are communicating, interacting with environment. In other words, do people like to collaborate with other people. Most important is that everyone has, in some rate, particular personality “attributes”. For instance Smith is **Extravertic**. However it doesn't mean that he isn't **Introvertic** in some rate. From MBTI measurement might be that Smith is 50% extravertic, and 50% introvertic. Special situation is maximum result (100%) for extraversion or introversion.

Let us consider the following situation:

- Smith is introvertic in 80%, and 20% extravertic.
- Moor is introvertic in 40%, and 60% extravertic

Question is: does, and if yes in what grade, Smith can collaborate with Moor in collective work? Psychologists claims that differences in personality features don't exclude capability of collaboration. Extravertics need introvertics to be more concentrated on relationships. Introvertics need opposite personality to be more communicative and open for the environment [1]. Nonetheless, does Smith, 80% introvertic is able to work with Moor, only 40% introvertic? Answer is: yes, he does. However work time duration can be shorter, or longer. It depends on adjustment between their personality features. Thus model which will include useful values from personality measurement (from MBTI method) is developed (see section 3).

3. PERSONALITY MODEL

In order to show the way we would like to use as to cope with problem from section 2, let us consider the following model:

- **Activity decision variables:**

The j -th operation of the i -th project is mini project which consist of the z -th activities don't consecutive shared. Activity is described by pair:

$$O_{i,j,z} = (x_{i,j,z}, t_{i,j,z}),$$

where:

$x_{i,j,z}$ – starting time of the z -th activity of the j -th operation in the i -th project,
 $i = 1, \dots, lpro; j = 1, \dots, lop$

$t_{i,j,z}$ – time duration of the z -th activity of the j -th operation in the i -th project, $i = 1, \dots, lpro;$
 $j = 1, \dots, lop$

- **Operation constraint:**

– operation deadline $H \subset N$.

- **Enterprise decision variables:**

Given is set of employees Z_k ($k = 1, \dots, lprac$). Each employee is described by:

$$Z_k = (Os_k),$$

where:

Os_k – personality of the k -th employee, which is quadruple (from MBTI method):

$$Os_k = (IE_k, SN_k, TF_k, JP_k),$$

where:

IE_k – prompting source (introversion or extraversion),

SN_k – gathering information functions (sensing or intuition),

TF_k – decision making functions (thinking or feeling),

JP_k – relation with world (judging or perceiving).

From above assumptions the personality model has been built. Firstly, employee's personality features needs to be measured. Therefore MBTI method is proposed [1, 10]. Measurement result gives score in 0-100% scale for each feature (IE_k, SN_k, TF_k, JP_k - to simplify the illustration, only introversion (one of four personality features) is considered). Thus, membership function can be assumed [9]. Generally this function could take different shapes (Fig 2) according to the following formula:

$$\mu = \begin{cases} 0 & k \leq 0 \\ \left(\frac{k}{100}\right)^x & k \in (0,100), x \in N \\ 1 & k \geq 100 \end{cases} \quad (1)$$

For instance let us assume a triangle membership function as it is on Fig 3 (in formula: $x = 1$).

In general case the membership function can be of different shapes. Righteous shape should be discussed by psychologists (or considered as a result of an identification experiment) and it isn't issue to consider in the paper.

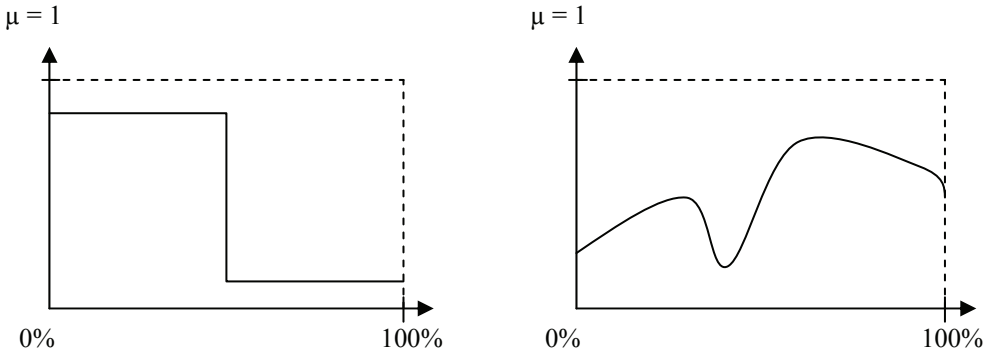


Fig. 2: Possible shapes of membership function

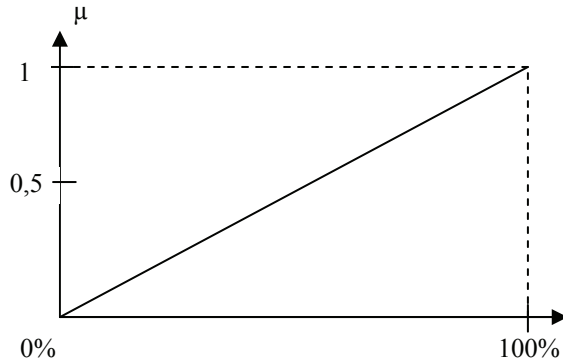


Fig. 3: Triangle shape of membership function

Thus, for instance, let take Smiths' result for $IE = 80\%$. For triangle shape he has result $\mu = 0,8$. Second employee, Moor has result $\mu = 0,4$. Both cases are shown in the Figure 4.

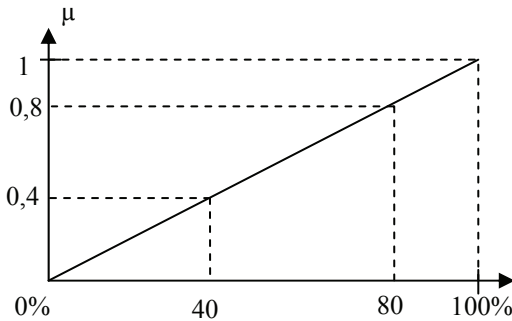


Fig. 4: Results for Smith and Moor

Now, their results should be compared. In other words we have to answer the following question: What influence on the work time duration has their personality? To do this, we need some assumptions for adjustment between results above. Thus illustration of our approach 3D Figure 5 is proposed.

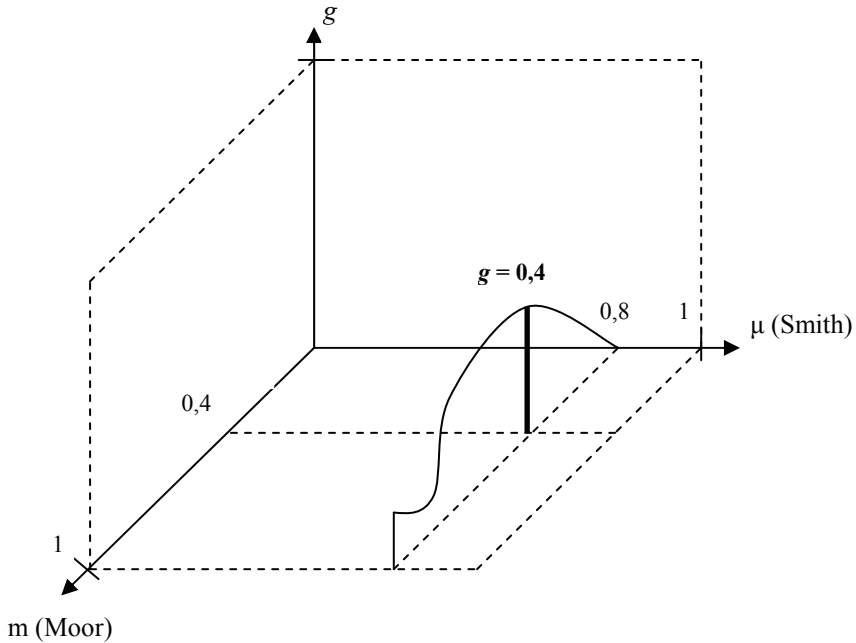


Fig. 5: Exemplary relation between two personality features

As you can see the results from membership shape are on axes μ (Fig 5). Third axis is represented by rate g [0; 1] which can be named as adjustment between personalities of Smith and Moor. The point where membership functions are crossed, rate $g = 0,4$. Shape of adjustment is of course arbitrary assumed. Obviously this shape can be different. Similar to membership functions this issue (shape of adjustment) should be discussed by psychologists. What for is rate g ? Our approach proposes to use this rate for estimation of the activity duration to which Smith and Moor are involved. Therefore the following formula is proposed:

$$t_j = t_N + \Delta \cdot (1 - 2g) \tag{2}$$

where:

t_N - nominal time,

Δ - difference between t_N and minimum/maximum activity time duration.

For instance, given are $t_N = 3$ u.t. (units of time) and $\Delta = 2$ u.t. (Fig 6). In this case, the possible time duration can be:

- 1 u.t. (when $g = 1$),
- 5 u.t. (when $g = 0$),
- and so on.

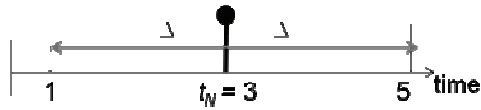


Fig. 6: Illustration of time gaps

According to rate g , different activity time durations are in output. To illustrate idea of our approach let us show an example of project.

4. ILLUSTRATIVE EXAMPLE

Consider activity on-arc network from Fig 1 (t_N are in brackets). Given are: $t_1 = 3$ u.t., $t_2 = 3$ u.t., $t_3 = 1$ u.t., $t_4 = 2$ u.t., $t_5 = 2$ u.t.

a) Forward reasoning example

- 1) Bolded arrows are on critical path. Thus project deadline is stated as $H = 6$ u.t.
- 2) Given is set of employees ($z_1, z_2, z_3, z_4, z_5, z_6, z_7, z_8$).
- 3) Consider the following pairs of employees:

- $O_2 - z_1$ and z_4 or z_1 and z_6
- $O_3 - z_2$ and z_3 or z_3 and z_7
- $O_4 - z_3$ and z_8 or z_4 and z_5

Let us concentrate on activities placed along critical path - because the project's deadline depends just on these activities.

Question is: do these pairs won't exceed given deadline?

In order to simplify our considerations let us focus only on the activity O_2 . Thus, given are $t_N = 3$ u.t., and $\Delta = 1$ u.t. Following personality measurement results are given: $z_1 = 70\%$, $z_4 = 42\%$, $z_6 = 80\%$. Due to proposed approach, two comparisons (like on the Fig 5) have to be done.

For pair z_1 and z_4 (Fig 7) and let us name this pair as **first pair**, for pair z_1 and z_6 (Fig 8) and let us name this pair as **second pair**.

It is easy to see (Fig 7 and Fig 8) the values of rate g for these pairs. Let now use formula (1). The result for first pair is presented below:

$$t_2 = 3 + 1 \cdot (1 - 2 \cdot 0,6) = 3 - 0,2 = 2,8 \text{ u.t.}$$

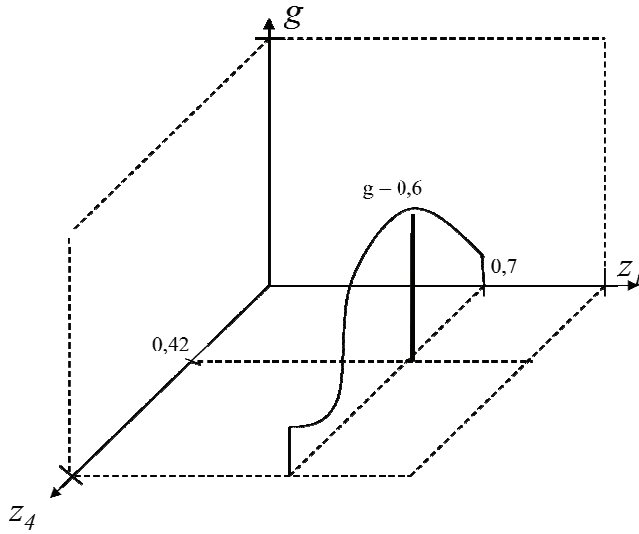


Fig. 7: Personality comparison for **first pair**

The result for second pair is presented below:

$$t_2 = 3 + 1 \cdot (1 - 2 \cdot 0,1) = 3 + 0,8 = 3,8 \text{ u.t.}$$

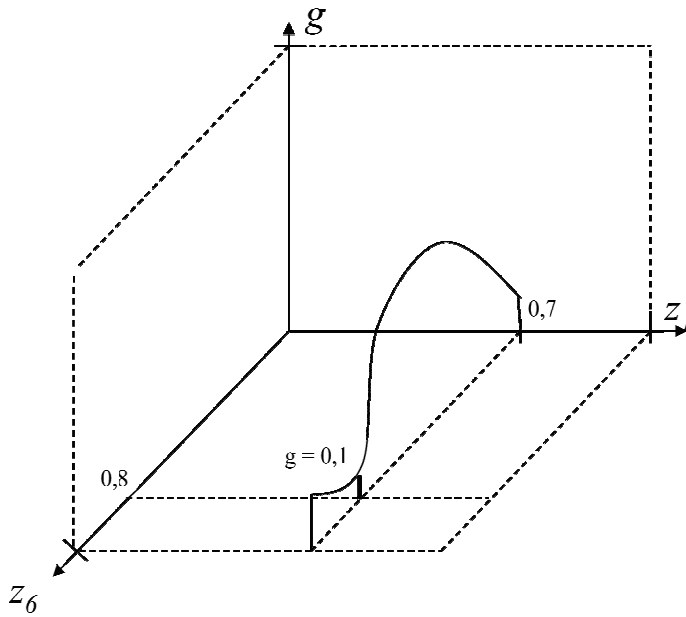


Fig. 8: Personality comparison for **second pair**

We see that first pair will do activity O_2 in shorter time, and this time is better than t_N . For the rest of activities on critical path (O_3 and O_4) the same calculations have to be done. The results are presented in the Table 1.

Tab. 1: Results for activities O_3 and O_4

O_3		O_4	
z_2 and $z_3 = 2,3$ u.t.	z_3 and $z_7 = 2,5$ u.t.	z_3 and $z_8 = 1,08$ u.t.	z_4 and $z_5 = 1,2$ u.t.

Cumulatively (critical path activities) all shortest possible time = 6,18 u.t. Thus, given deadline is exceeded. Our pair of employees doesn't satisfy. Example shows that sometimes it's not possible to answer the question. We need to change the character of our problem.

b) Backward reasoning example

1) Bolded arrows are on critical path. Thus project deadline is stated as $H = 6$ u.t.

2) Given is set of employees ($z_1, z_2, z_3, z_4, z_5, z_6, z_7, z_8$).

Problem follows from the question: **Do exist employees' job assignment to the project activities that will end in given deadline?**

First step to response to this question is to prepare a list of possible employees with required skills. Let us assume:

- O_2 can be prepared by z_1, z_2, z_3, z_4, z_6 .
- O_3 can be prepared by z_2, z_3, z_7, z_8 .
- O_4 can be prepared by z_1, z_3, z_4, z_5, z_8 .

Thus, each permutation should be checked, regarded by employees' personality. Some of the pairs we know from previous example (forward reasoning). However we don't know results for rest of possible pairs (in O_2 8 permutations, in O_3 4 permutations, in O_4 8 permutations).

Given are following results of personality measurement: $z_1 = 70\%$, $z_2 = 40\%$, $z_3 = 50\%$, $z_4 = 42\%$, $z_5 = 30\%$, $z_6 = 80\%$, $z_7 = 90\%$, $z_8 = 65\%$. Results given from proposed personality model are presented in Table 2.

Tab. 2: Results for operations O_2, O_3 and O_4

O_2	O_3	O_4
z_1 and z_2 ($g = 0,3$)	z_2 and z_7 ($g = 0,21$)	z_1 and z_3 ($g = 0,5$)
z_1 and z_3 ($g = 0,5$)		z_1 and z_4 ($g = 0,1$)
z_2 and z_3 ($g = 0,6$)	z_2 and z_8 ($g = 0,48$)	z_1 and z_5 ($g = 0,68$)
z_2 and z_4 ($g = 0,3$)		z_1 and z_8 ($g = 0,48$)

z_2 and z_6 ($g = 0,15$)	z_3 and z_8 ($g = 0,76$)	z_3 and z_4 ($g = 0,26$)
z_3 and z_4 ($g = 0,26$)		z_3 and z_5 ($g = 0,3$)
z_3 and z_6 ($g = 0,7$)	z_7 and z_8 ($g = 0,6$)	z_4 and z_8 ($g = 0,77$)
z_4 and z_6 ($g = 0,57$)		z_5 and z_8 ($g = 0,4$)

256 combinations are given. However, only few of combinations satisfy assumptions of deadline (e.g., pasted by grey – the best possible combination), and they are answer for given question.

Example shows that in some cases, forward reasoning is not sufficient to solve the stated problem, and backward reasoning should be considered as well. Note that large number of combinations eliminates brute force method as solution method. So, more effective, however heuristic methods should be proposed.

5. SIMILAR APPROACHES

Similar approaches are seen in the literature. Patalas-Maliszewska [5] consider intellectual capital defined as enterprise specific resources its employees. Presented approach shows added value for Small and Medium Enterprises determined as knowledge, skills and abilities of employees', etc. – stating for an enterprise Intellectual Capital (IC). The paper presents algorithm that enables to predict effects of investment involved in knowledge-workers on the enterprise competitiveness. Knowledge-worker is distinguished by: creativity, knowledge, qualifications, reliability, skills, involvement, and honesty. Real life example shows that the model proposed is useful in an area of investments evaluation devoted to IC increasing.

In turn, Małachowski et al. [6] propose a method of quantitative analysis of competence. Competence is defined as ability of knowledge use, and skills which are needed to do the job. In other words, similar to approach presented above, the employee is characterized by required features to be effective. Form of the competence description can be verbal or mathematical one. The authors are focused, however on the mathematical model development, which can be useful in competence management. Workers personality is not discussed.

In conclusion let us note that our approach being focused on the personality of the knowledge-workers, can be seen as extension of practically tested model of return of investment in knowledge presented in [5] and in mathematical model of competence management [6].

6. CONCLUSIONS

Personality has crucial role in teamwork. Psychologists have no doubts about that. Moreover, presented examples shows this influence when bad adjustment of employees personalities has effect on work time duration. However, this issue has been omitted so far in the project planning, and project management problems. Some considerations cover only the personal abilities (skills) in workgroups. Thus, issue which is considered in the paper practically hasn't been presented in other papers.

The discussion presented explains what kind of problem is considered. When people are working together in groups, and many tasks are included (some need energetic people, other one need slow, calm personality) Job Assignment Problem can be associated.

The disadvantage of presented approach is that adjustment for personalities has been discussed as potential, arbitrary assumed issues. To be sure, research based on benchmarking methods should be done. However, still many questions remain to be open, for instance: do the people change the behavior through lapse of time? Work of Mazur [8] can be example of well presented considerations about changing personality, behavior over human life.

Further works will focused on benchmarking research in existing enterprises.

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