PROJECT MANAGEMENT

Shmatko A.V., Holubnychyi D. Y., Korolyuk N. A., Makarenko B. R.

THE USE OF COMPETENCY-BASED APPROACH IN THE PROJECT TEAM FORMATION MODEL

Shmatko Alexander Vitalievich, Ukraine, National Technical University "Kharkov Polytechic Institute", ass.prof.
Holubnychyi Dmytro Yurievich, Ivan Kozhedub Kharkiv National Air Force University, PhD, ass. prof.
Korolyuk Natalia Alexandrovna Ivan Kozhedub Kharkiv National Air Force University, PhD, ass. prof.
Makarenko Bogdan Romanovich, Ukraine, National Technical University "Kharkov Polytechic Institute", postgraduate

Abstract

In this article, we consider the problem of organizing the process of selecting the optimal system for protecting information from data leakage. The existing methods of assessing the information risks of an enterprise are analyzed. Information security systems from data leakage represent a complex technical system and have a number of features that complicate the selection process. A promising direction in the development of decision-making methods with expert source information is a linguistic approach based on the theory of fuzzy sets and a linguistic variable.

Keywords: information system, information security system, security audit, risk of information leakage, expert evaluation.

Introduction

The major factor of any project team competiveness is the level of professionalism and creativity of its employees. Successful project team cooperation depends on interaction of a set of factors: resources, information, materials, people and organizations, main among which is human potential.

Currently, scientific and technological progress in the sphere of information technologies has reached greater heights. The need for teams of software developers increases with the growth of the development projects. But at the modern pace of life, it's not always possible to allocate enough time to search and select a project team.

The list of competencies is one of the major factors of candidates selection. It is related to the fact that competency can be complementary and, in a sense, interchangeable. That is why it is very important to implement the process of forming a virtual project team based on a competency approach.

Automation of virtual project team formation and selection of candidates for it is one of the solutions to given problem. But at first it is necessary to decide which model will be responsible for the main logic of this process. This is exactly the goal of our research.

Because of the team "virtuality", members may not know each other. Therefore, the decision to engage a candidate will be based on few factors like expertise, knowledge and cost. After the identification of the factors, the problem of forming the team can be solved by calculating first the outcome of each candidate related to these factors, then selecting the candidates with the highest score.

Analysis of Recent Research and Publications

Virtual team, like any team, goes through the phases forming, storming, norming, performing and adjourning (Lipnack and Stamps, 2000; Tuckman, 1965; Tuckman and Jensen, 1977) to get performed while producing results. During the first step, "forming", members are brought together for the first time. Focusing on this, the question "how the team emerges to enter the forming stage" is justified. The step anterior to the "forming" stage is what we call team formation. It consists in the identification and the selection of candidates for each activity of the project in question.

The process of team formation is subdivided into the steps (Deborah and Nancy, 1999) summarized as follows:

Requirements definition.

Candidate identification.

Candidate analysis.

Contact establishment.

The dimensions of candidate analysis are measurable criteria that affect the team work. Since the focus is on the formation phase, factors essential to start the "forming" stage of team development are those that really matter. In the literature, some factors have been empirically evaluated or applied to other teams (Anderson, 1996; Deborah and Nancy, 1999; Lipnack and Stamps, 2000; Tuckman and Jensen, 1977; Schutz, 1955).

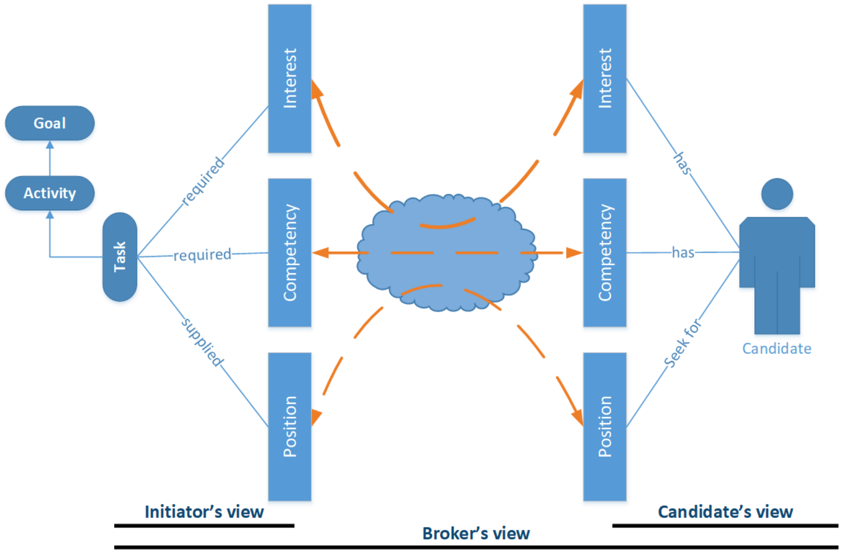

Figure 1 – A model for team formation

According to (Pynadath et al., 1999; Lipnack and Stamps, 2000; Petersen and Gruninger, 2000), a team is defined to execute activities which are grouped around a goal. In figure 1 (Achim P. Karduck and Amadou Sienou, 2006) have refined the model from (Petersen and Gruninger, 2000) by subdividing activities into single tasks able to be carried out by single experts.

The problem of assigning tasks is therefore simplified to single resource allocation which is more tractable than the allocation of multiple resources (Bar-Noy et al., 2001).

A task, in order to be performed, requires a position, a set of competencies and interests. Candidates are entities with interests and competencies who are looking for positions. Team brokerage consists of finding candidates for a task so that the positions, the competencies and the interests match (doted arrows). In this model, the team initiator defines tasks and requirements while experts provide information concerning their interests, their competencies and the positions in which they are interested.

Here, allocating a set of resources (experts) to the set of tasks defined in the context of a project is viewed as a Resource Allocation Problem (RAP).

Methods

Based on the (Achim P. Karduck and Amadou Sienou, 2006) research, the model for virtual project team formation and selection of candidates using competency-based approach was defined.

A skill is a tuple (A, B, C) where *A* is the area of competence, *B* the knowledge, *C* the knowledge item.

A competency owned by an expert is the tuple (A, B, C, l, e) where *l* is the level of skill and *e* the experience expressed in number of months.

A competency required for a task is a tuple $(A, B, C, l^{min}, e_{min}, w_l, w_e)$ where $l^{min}, e_{min}, w_l, w_e$ are the minimum level of skill, the minimum experience required, the weight of the level of skill and the weight of the experience respectively.

The competency (A, B, C, l, e) of an expert is valid regarding to a given requirement $(A', B', C', l^{min}, e_{min}, w_l, w_e)$ if the skills (A, B, C) and (A', B', C') match and the constraints $l \geq l^{min}$ and $e \geq e_{min}$ hold. Since interests are also competencies, we have adopted similar representations for them, i.e an interest is a tuple (A, B, C, l) where *l* is the level of interest.

Team formation is the problem (*Z, D, C*) specified as follows:

$Z = \{z_1, \dots, z_n\}$ – is the set of variables, each standing for the task to which experts should be allocated.

$D = \{d_1, \dots, d_n\}$ – is the set of domains of values to which variables z_i can be instantiated. Let us call elements of d_i instances indexed *I*, which are conceptualized as follows:

<u>Budget.</u> Amount of money planned for the task to be assigned; indexed $B(I)$.

<u>Cost.</u> A value representing the cost of assigning a task to an expert; indexed $C(I)$. We define the cost as follows:

$$C(I) = h_w(I) \times d(I) \times h_d(I) \tag{1}$$

where $h_w(I)$ - is the hourly wage;
d(*I*) - the duration in days;
$h_d(I)$ - the number of work hours per day.

<u>Performance.</u> A value, indexed $P_{instance}$, that expresses the performance value of the instance.

C – is a set of constraints in Z and D. They were categorized into availability constraint, position constraint, instance constraints and team constraints.

<u>Availability constraint</u>. An expert is eligible for a team if he/she is available during the executing time of the tasks for which he/she is applying.

Position constraint. An expert applying for a task will be considered only if the position posted in the context of this task is the one that he/she is looking for.

Instance constraints. These constraints are restrictions to the level of interest, level of skill and experience. An expert is considered having an interest, skill or experience only if his/her levels of skills or experience are at least equal to the level defined in the constraints.

Team constraints. In contrast to instance constraints where only single experts are taken into consideration, team constraints affect the whole team.

Let us introduce a binary variable $x_I \in \{0,1\}$ expressing whether an instance is activated; i.e. if the task z_i is assigned to a given expert and the resulting assignment is indexed *I*, the value $x_I = 1$, y otherwise $x_I = 0$.

Based on the properties of single resource allocation we have defined the following constraints:

C_1. The total budget planned for a project should not be exceeded:

$$\sum_i^n \sum_{I\in z_i} C(I) \times x_I \leq \sum_i^n \sum_{I\in z_i} B(I) \times x_I \tag{2}$$

For convenience, let us define the quotient

$$\Delta_{budjet} = \frac{\sum_i^n \sum_{I\in z_i} C(I)\times x_I}{\sum_i^n \sum_{I\in z_i} B(I)\times x_I} \tag{3}$$

And specify this constraint as follows:

$$\Delta_{budjet} \leq 1 \tag{4}$$

C_2. All tasks must be assigned and each only once:

$$\forall_{z_i} \in Z, \sum_{I\in z_i} x_I = 1 \tag{5}$$

Like any constraint satisfaction problems, this one will also have one, none or multiple solutions $X = \langle I_1, \dots, I_n \rangle$. Solution is valid if both constraints C_1 and C_2 hold. Therefore, we need to support the selection of a team by introducing the concept of team performance value *P,* which maps each solution *X* to a value $P(X)$.

The value $P(X)$ depends on single performance values of the experts involved in the team *X*.

Selecting an expert for a given task is a decision problem depending on multiple criteria. The decision is based on the performance of an instance which is an aggregate value of the factors cost, synergy, skills, experiences, commitment and risk.

In order to transform these factors, we have eliminated interdependencies and have obtained the following criteria:

Δ_{cost}. There are many candidates for a given task. The cost of assigning this task to an expert indexed *i* is $C(i)$. Let $C(max)$ be the cost of assigning the task to the most expensive expert Δ_{cost} is the standardized value of the deviation of $C(i)$ from $C(max)$.

$$\Delta_{cost} = 1 - \frac{C(I)}{C(max)} \tag{6}$$

Level of commitment. Value is indexed as $(I) \in [0,1]$.

Synergy. We have defined the value of synergy as the similarity V_s of candidate interests to the interests required for the task in question.

Let

$$S^{task} = \{(A_i B_i C_i l_i^{min}), i = 1 \ldots n\},$$

be the set of interests required for a given task,

where l_i^{min} - be the minimum level required for each interest;

$$\omega = \backslash\{w_i, w_i \in [0, 1], \sum_{i=1}^{n} w_i = 1, i = 1 \ldots \mathrm{n} \backslash\}$$

be a set of weighting factors representing the relative importance of interests;

$$S = \{(A_i B_i C_i l_i), i = 1 \ldots n\},$$

be a set of weighting factors representing the relative importance of interests;

The vector X^{expert} representing the computed values of an expert's interest is defined as follows:

$$X^{expert} = \langle \ldots, l_i \times w_i \times \tau_i, \ldots \rangle \tag{7}$$

$$\tau_i = \begin{cases} 1 l_i \geq l_i^{min} \\ 0 l_i \leq l_i^{min} \end{cases}, i = 1 \ldots n \tag{8}$$

where l_i – expert's level of i^{th} interest.

The value of synergy is finally defined as follows:

$$V_s = 1 - \frac{\sqrt{\sum_{i=1}^{n}\left(x_i^{ideal} - x_i^{expert}\right)^2}}{\sqrt{\sum_{i=1}^{n}\left(x_i^{ideal}\right)^2}} \quad (9)$$

where X^{ideal} represents the virtual ideal expert according to this factor:

$$X^{ideal} = \langle \dots, l^{max} \times w_i, \dots \rangle, i = 1 \dots n \quad (10)$$

Competency (skills and experience). The execution of a task requires a set of skills and experiences. Since experience depends on skills, we have introduced the concept of Competency to explain the aggregate value of both.

Let

$$S^{task} = \{(A_i B_i C_i l_i^{min}, expe_i^{min}), i = 1 \dots n\}$$

be the set of skills and experiences required for a task.,

$$\omega^s = \backslash\{w_i^s, w_i \in [0, 1], i = 1 \dots n\backslash\}$$

be the set of skills and experiences required for a task.,

$$\omega^e = \backslash\{w_i^e, w_i \in [0, 1], i = 1 \dots n\backslash\}$$

be a set of weights representing the relative importance of experiences.

The vector X^{expert} represents the computed values of the skills of an expert:

$$X^{expert} = \langle \dots, l_i \times w_i^s \times, \tau_i, \dots \rangle \quad (11)$$

$$\tau_i = \begin{cases} 1 l_i \geq l_i^{min} \\ 0 l_i \leq l_i^{min} \end{cases}, i = 1 \dots n \quad (12)$$

The vector Y^{expert} represents the computed values of the corresponding experience:

$$Y^{expert} = \langle \ldots, expe_i \times w_i^e \times, \tau_i, \ldots \rangle \tag{13}$$

$$\tau_i = \begin{cases} 1 expe_i \geq expe_i^{min} \\ 0 expe \leq expe_i^{min} \end{cases}, i = 1 \ldots n \tag{14}$$

The fused view of skills and experience is the matrix $C = \langle X_i, Y_i \rangle$. The aggregate value of expert's competencies is processed with the vector :

$$Z^{expert} = \langle \|C_1\|, \ldots, \|C_i\|, \ldots, \|C_n\| \rangle$$

Let Z^{ideal} – be the virtual expert with the highest possible values of competencies. The aggregate value of an expert's competencies is the similarity of his/her competencies to the ones of the ideal virtual expert:

$$V_c = 1 - \frac{\sqrt{\sum_{i=1}^{n} \left(z_i^{ideal} - z_i^{expert}\right)^2}}{\sqrt{\sum_{i=1}^{n} \left(z_i^{ideal}\right)^2}} \tag{15}$$

Also, we will put in place a value V_a for complementary competence and skills that are not obligatory, but the knowledge of which can give the candidate extra credits. It will be calculated in the same way as the core competencies, but its weighting factor cannot be greater than or equal to the weight coefficient for V_a.

Let $w_i, i = 1 \ldots 4$, be weighting factors representing the initiator's relative preferences for the criteria $\Delta_{cost}, V_s, V_c, V_a$ Since the factors are preferential independents and the values are standardized, the weighted sum aggregation procedure is applicable

to evaluate the performance $P_{instance}$ of an instance *I* as follows:

$$P_{instance}(I) = \sum_{i=1}^{4} w_i \times I_i^{value} \tag{16}$$

where $I_{i=1\ldots4}^{value} = \langle \Delta_{cost}, V_s, V_c, V_a. \rangle$

This value expresses "how well" the profile of an expert fulfills the requirement specification of a given task. For each task, the expert having the highest score is the best one.

Given that it was possible to order experts interested to tasks, it is now necessary to find the best constellation of experts. For this purpose, one will refer to the team performance value *P(X)* which is the weighted sum of the utility of assigning single tasks

to experts:

$$P(X) = \sum_{i=1}^{n} w_i \times \sum_{I \in z_i} P_{instance}(I) \times x_I \quad (17)$$

here $w_i \in [0,1]$ –is a weight representing the relative importance of the instance *I* and $\sum_{i=1}^{n} w_i = 1$.

Results

Let us consider the example which illustrates how defined model could be used for solving team formation problem in real world. The following tables illustrating the levels of skills and experiences of 3 candidates requiring 3 skills to obtain the Front-End Developer position.

Table 1 - Example of candidates competencies

	Candidate₁		*Candidate₂*		*Candidate₃*	
	l	*exp*	*l*	*exp*	*l*	*exp*
Competency₁	3	42	3	40	2	42
Competency₂	3	32	4	36	2	25
Competency₃	2	28	2	26	2	24
Competency₄	3	20	2	18	2	20

Table 2 – Sample competencies for conventional position

Competency1	skill - *HTML5&CSS3*; min knowledge level – 3; min experience – 40, skill weight – 0.25, experience weight – 0.3
Competency2	skill – *JavaScript ES6*; min knowledge level – 3; min experience – 30, skill weight – 0.35, experience weight – 0.4
Competency3	skill – *Angular 2*; min knowledge level – 2; min experience – 24, skill weight – 0.3, experience weight – 0.2
Competency4	skill – *SASS*; min knowledge level – 2; min experience – 18, skill weight – 0.1, experience weight – 0.1

Here the *l* is the minimum level required for each competency, which could be *none = 0, 1 = low, 2 = medium, 3 = high* or *4 = expert.* And the *exp* – is the minimum level of experience defined in month.

Using defined model, and the given input values from above tables we obtained the following results after all needed calculations: $V_{C1} = 0.9093$, $V_{C2} = 0.9632$, $V_{C3} = 0$

That is the second candidate has the highest total level of competence and for this reason he is the best candidate for this position.

Conclusion

In this research project, we have conceptualized factors affecting the formation of teams by defining models and metrics able to evaluate experts and teams.

Based on this conceptualization of performance values and the formalization of constraints imposed by the project that a team must carry out, we have transformed the problem of forming teams into a resource allocation problem.

As stated in (Deborah and Nancy, 1999) there are different types of virtual teams. Since for project or product development teams' activities are clearly defined in the form of technical requirements with fixed duration and measurable results, this system aims to support the formation of this kinds of teams. It is necessary to note that the system can also support the formation or pre-formation of non-virtual product development teams when rational measurable competencies of members are more important than emotional aspects.

In the future we intend to use advanced techniques of knowledge representation and processing to handle high inter-related skills

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POLITICAL SCIENCE

Grishin O.E., Levashova O.V., Goricheva V.L., Tolochko A. V.

INSTITUTE OF THE PRESIDENCY IN THE THEORY OF SEPARATION OF POWERS: HISTORICAL AND POLITICAL DISCOURSE

Grishin Oleg Evgenievich, Candidate of Political Science, Associate Professor, Department of Political Analysis and Management, Peoples' Friendship University of Russia (RUDN University), Russia, Moscow

Levashova Olga Viktorovna, Candidate of Legal Sciences, Associate Professor of the Department of Criminal Law and Criminology, Head of the Department of Criminal Law and Criminology, Eletsky State University named after IA. Bunin (Bunin Yelets State University), Russia

Goricheva Vlasta Leonidovna, Candidate of Legal Sciences, Associate Professor of the Department of Criminal Law and Criminology, Yeletsky State University named after IA. Bunin (Bunin Yelets State University), Russia

Tolochko Alexander Vladimirovich, Ph.D. in Political Science, Associate Professor of the Department of Philosophy, Social Sciences and Journalism, Yelets State University. I.A. Bunin (Bunin Yelets State University), Russia

Abstract

The article discusses the theory of separation of powers in the interaction with the concept of the institution of the presidency in the history of political doctrines. In the theoretical constructions of ancient thinkers there are elements of the separation of powers, in which there is some optimal form, it is able to find its personification in the figure of the President on the development of the historical and political process. Theorists of the early middle Ages spoke about the emergence of the state in the course of natural evolution, with the position that these processes are due to the divine will. Since the end of XVIII