

Selection of the Target Group based on Social Network

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ABSTRACT: Nowadays, there is a great need to find appropriate individuals or groups of people who would be able to perform specific tasks or could become a target group either for marketing or advertising purposes. Results of the new research presented in the paper has been made in order to improve the process of target group selection by adding the social elements of peoples' behaviors. The target group should fulfill a set of prerequisites. Simultaneously, the selection process ought to respect specific social aspects provided by the social network. The entire selection process, called human filtering, includes one of two separate scenarios: selection *by single member* or selection *by social group*. Both these novel approaches are considered in the paper.

KEYWORDS: social network, human filtering, social position, network processing, social subgroups

INTRODUCTION

Social networks have recently become one of the research areas where scientists from different fields look for inspiration. The social network analysis supported by computer science gives opportunity to develop other branches of knowledge. This cooperation of researchers from sociology and computer science helps to develop and improve both new scientific ideas and commercial solutions [7], [8], [12]. Nevertheless, before the social network analysis can be applied, some basic concepts related to social networks ought to be explained.

The main idea of social network can be easily presented as the finite set of actors who are the nodes of the network, and ties that link the nodes by one or more relations [4], [5], [11]. Wasserman and Faust defined an actor as individual, corporate, or collective social unit and a tie as a linkage between a pair of actors [11]. The range and type of the relational tie can be extensive [5], [11] and different depending on the type and character of analyzed actors.

In this paper, an actor is defined as a discrete individual (a single person) while ties reflect the behavioural interactions between actors. For example, a couple of people who send email messages to each other, who talk to each other or who comment the same internet blogs are in mutual relation. This definition of the social network that includes only individuals as actors is an important assumption for the selection of target group considered in the paper.

These days, there is a great need to find appropriate individuals or groups of people who would meet the specified requirements and be suitable for the defined tasks. The selection of the target groups is a common activity in almost all of the companies, where the managers pick people to the project teams or try to find new employees. On the other hand, the target groups are the sufficient and basic component for target marketing as well as for advertising campaigns. Identifying the cohesive subgroups is applicable in targeted advertising [12]. In another domain, i.e. in the recommendation method called collaborative filtering, people can be clustered into classes and based on user preferences within these groups the appropriate services or goods are suggested to an individual [1], [9].

However, now people are usually selected based on their individual abilities that match task requirements as in case of hiring new members for the project team or based on the mutual profile similarity between people as well as their past behaviors as in the case of collaborative filtering.

The aim of the solution presented in this paper is to select the set of network representatives not only based on their demographic characteristics and interests, but also based on the position of a person within the community. To reach this goal we should take into account that people who are in relations influence one another, so their behaviors should be analyzed in the context of their relationships [11]. This main goal of social network analysis that can be defined as follows: "a methodology for examining the structure among actors, groups, and organizations and aides in explaining variations in beliefs, behaviors, and outcomes" [6]. Social network analysis focuses on understanding the connections among people and the implications of these connections [11].

PROBLEM DESCRIPTION

Group selection is applicable to many domains, e.g. to choose people for project teams, find new potential employees, search the consumers' group for advertising campaigns, or use it for target marketing.

The information available in the social network can improve the process of finding the appropriate employees for specific tasks. On the one hand, the headhunters can find new employees who will suit their expectations by social network analysis. On the other hand, the analyses of individuals' characteristics and their acquaintances within social network support the development of target marketing by searching the appropriate target group. For example, some specific products or services can be offered to the single and relatively small clique that has been identified in the community. Moreover, these goods may be suggested only to the carefully selected members of the group, who are the most important in the population as well as have the greatest influence on others. In all of these cases, the main goal is the same – to find the group that will fulfill fixed requirements with respect to social features of network members.

The new solution proposed below combines the traditional way of people selection with some new elements of social network analysis.

THE CONCEPT OF TARGET GROUP SELECTION BASED ON SOCIAL NETWORK

The main concept of human group selection from social network is quite simple. The general aim is to pick the group of community representatives that fulfill established requirements. Simultaneously, the social aspects of peoples' behaviors should be taken into consideration during the selection. The entire process, which is further precisely described, is called human filtering (Figure 1).

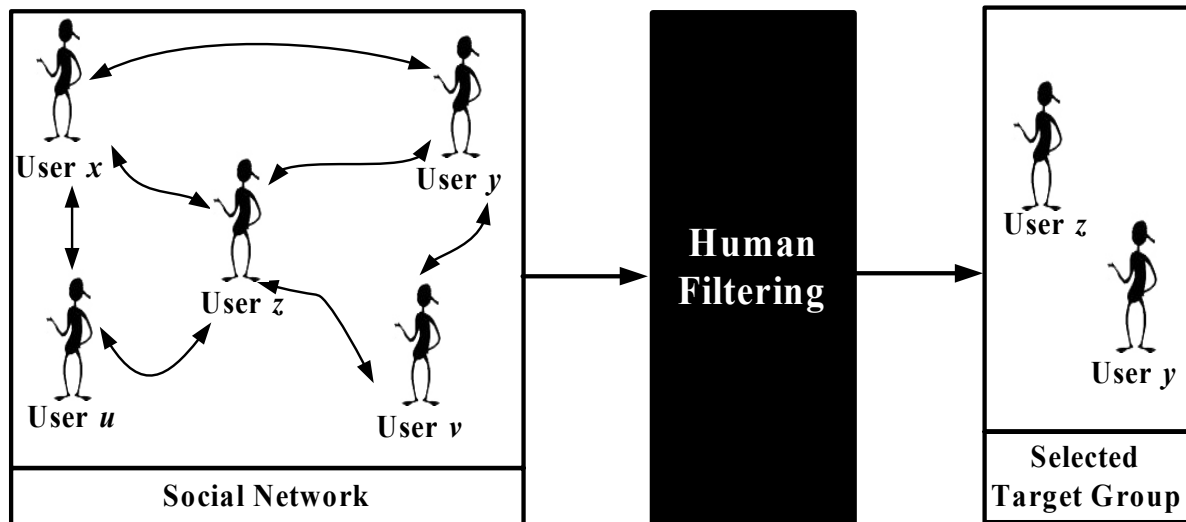


Figure 1: The process of selecting people for specific tasks

The human filtering process includes one of two separate scenarios: selection *by single member* and *by social group*. Both of them are presented below.

SELECTION BY SINGLE MEMBER

The *single member* approach is composed of three main stages: simple matching, social position assignment and ranking creation (Figure 2). As a result of the human filtering, the ranking list of all network members is created and top N persons form the target group. The simple matching consists of testing members of the social network against the set of requirements, which should be fulfilled, such as gender, education level, age, etc. Two groups of requirements: mandatory and optional can be identified. The former have to be fulfilled, whereas the latter not necessarily.

The more prerequisites the user meets the higher position in the final ranking list one obtains. First, every user is tested against the mandatory requirements. If even one of these requirements is not fulfilled then such person is rejected from the further calculations. If none of the community members meets all of the mandatory requirements then these requirements should be weakened and all the calculation repeated. Then, each user is checked against optional

requirements. After the simple matching process, the social position value should be assigned to every member of the network and based on its value the ranking is created. Top N members from the ranking form the final target group.

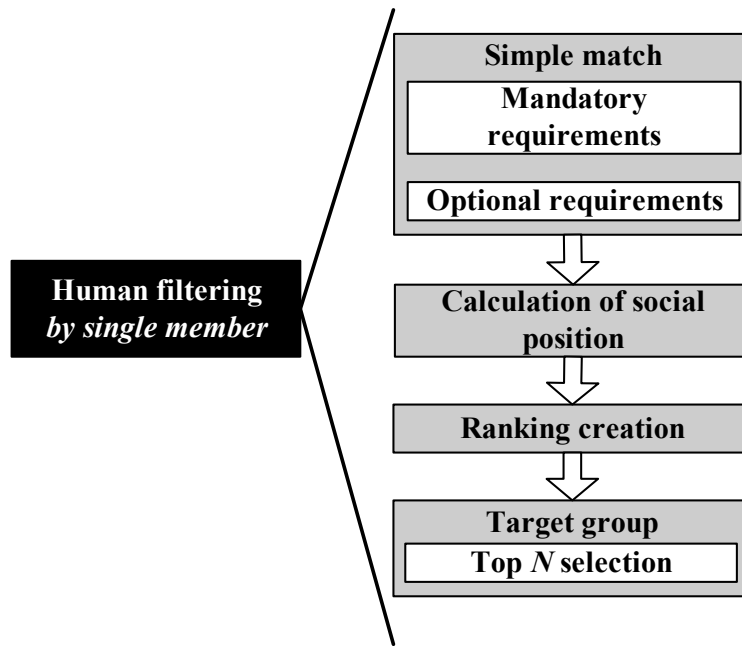


Figure 2: Elements of human filtering process *by single member*

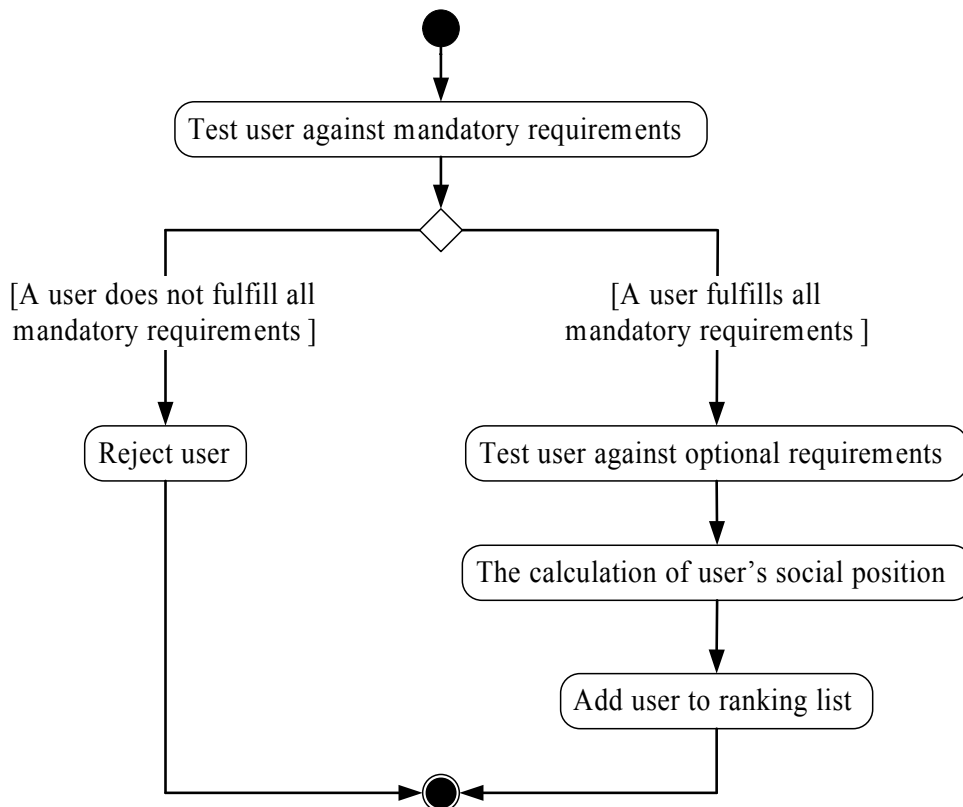


Figure 3: Human filtering process for an individual

The whole process of human filtering for an individual is presented in Figure 3. This ranking list is created based on the value of the match function $M(x)$, as follows:

$$M(x) = \alpha \cdot OR(x) + \beta \cdot \frac{SP(x)}{SP_{max}} \quad (1)$$

where:

$OR(x)$ – the optional requirements' function that pinpoints to what extend the user matches the optional requirements. The range of the function is $[0,1]$;

$SP(x)$ – the social position of user x within the community, the range is from $[0,C]$; C – the number of members within the community;

SP_{max} – the maximum value of social position within the given network;

α, β – the coefficient that indicates the importance of the functions $OR(x)$ and $SP(x)$ respectively.

OPTIONAL REQUIREMENTS

The optional requirements indicate the conditions that person does not have to fulfil. Nevertheless, the more optional prerequisites the user meets the higher position in the final ranking list one obtains.

The value of the optional requirements' function $OR(x)$ reflects to what extend user x matches optional requirements. It is calculated by using:

$$OR(x) = \frac{\sum_{i=1}^K w_i OR_i(x)}{\sum_{i=1}^K w_i} \quad (2)$$

where:

K – the number of optional requirements;

$OR_i(x)$ – the function that pinpoints whether the i -th optional requirement is fulfilled or not. If so then $OR_i(x)=1$, otherwise $OR_i(x)=0$;

w_i – the weights assigned to every single optimal requirement.

Note that the weights, which are assigned to optional requirement, enable to adjust the importance of particular optional requirements. For example, if the weight for *age* is greater than for *gender* than the user had better be of the proper age rather than of proper gender.

After calculation of $OR(x)$ for all members, their social position is computed.

SOCIAL POSITION

The social position refers to the standing and potential social capital of the user in the network [8]. The concept of social capital has been studied by many sociologists [2], [3], [10]. In general, the greater social position one possesses the more valuable this member for the others is. It often happens that we need to extract only highly important persons, i.e. with the greatest social position. Such people surely have the biggest influence on others. As a result, we can focus our activities like advertising or marketing only on them and expect that they would entail their acquaintances. The value of social position depends on both the strength of the relationships the person maintains in the network as well as the social positions of their acquaintances. In other words, the social position of a person is inherited from others but the level of inheritance depends on the activities of the acquaintances directed to this person. Thus, the social position depends also on the number and quality of relationships. The same social position can be achieved by member x if x would have many relationships with people who have medium social position or if x would have only few relationships but with participants with high social position.

Social position function $SP(x)$ of user x respects both the value of social positions of user's x acquaintances as well as their activities in relation to x :

$$SP(x) = (1 - \varepsilon) + \varepsilon \cdot (SP(y_1) \cdot C(y_1 \rightarrow x) + \dots + SP(y_m) \cdot C(y_m \rightarrow x)) \quad (3)$$

where:

ε – the constant coefficient from the range $[0,1]$;

y_1, \dots, y_m – acquaintances of x , i.e. members who are in the direct relation to x ;

m – the number of acquaintances of user x ;

$C(y_1 \rightarrow x), \dots, C(y_m \rightarrow x)$ – the function that denotes the contribution in activity of y_1, \dots, y_m directed to x .

To calculate the social position of the person within the social network the convergent, iterative algorithm is used. It means that there have to be fixed appropriate stop condition. Firstly, people who do not have any relationship within

network are rejected and their social position equals 0. Next, the contribution of activity of the members who are in some relationships but they are not active within these relationships at all is distributed equally among all their acquaintances. The reason is that the sum of all contributions of one person in their relationships ought to equal 1. The research shows that the initial value of social position does not influence its final value, but the number of iterations. Moreover, the sum of all users' social position within network is convergent to the number of network's members.

The example of calculation of the social position is presented below. Let us assume that we have a social network as in Figure 4. The arc values in Figure 4 indicate the contributions of activities between a pair of members. The sum of contributions separately for each member equals 1.

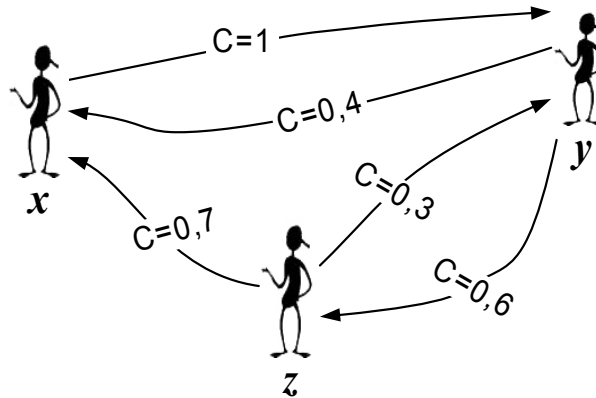


Figure 4: Example of social network

The initial social position is established as follows: $SP(x) = \frac{1}{3}$, $SP(y) = \frac{1}{3}$, $SP(z) = \frac{1}{3}$. The Table I presents the results of calculations. To reach the stop condition, no difference up to 5-th place after point between two following iterations, 59 iterations had to be performed.

Iteration No.	1	2	...	57	58	59
$SP(x)$	0,33333	0,47433	...	1,01963	1,01964	1,01964
$SP(y)$	0,33333	0,52966	...	1,20848	1,20848	1,20848
$SP(z)$	0,33333	0,33600	...	0,77182	0,77182	0,77182

Table I Social position calculation for the social network from Figure 4; $\epsilon = 0,83$; stop condition: no difference in SP values with precision of 5 digits after the decimal point for all the members in two following iterations

SELECTION BY SOCIAL GROUP

The second approach to human filtering is called selection *by social group* (Figure 5). First, a social clustering method that comes from social network analysis (SNA) is utilized to extract cohesive social subgroups, i.e. groups of people close one another.

After the cohesive subgroups are identified, the group matching is performed. The first step of this activity is to test each group against the set of additional group requirements that concerns the overall characteristic of a searched group. For example, we are interested only in groups that exceed the certain number of members and simultaneously, the cohesion of the group is at least of the given level.

The second step of group matching is the simple match known from the selection *by single member* approach. However, here we can either test all users from the group against the requirements or create a representative of each group and test this representative against the specified requirements. The group representation can be created based on the calculations of average characteristics of all the group's members. In another approach, the representation is the person who is the closest to the centre of the group. As the result of group matching only one group that best suits the specific needs is selected.

After that, the entire human filtering *by single member* is performed to the selected group (see the previous section). Note that the input for human filtering *by single member* is one group instead of the entire social network.

Finally, the ranking list of the selected members is created in order to identify the most valuable persons within the matched group.

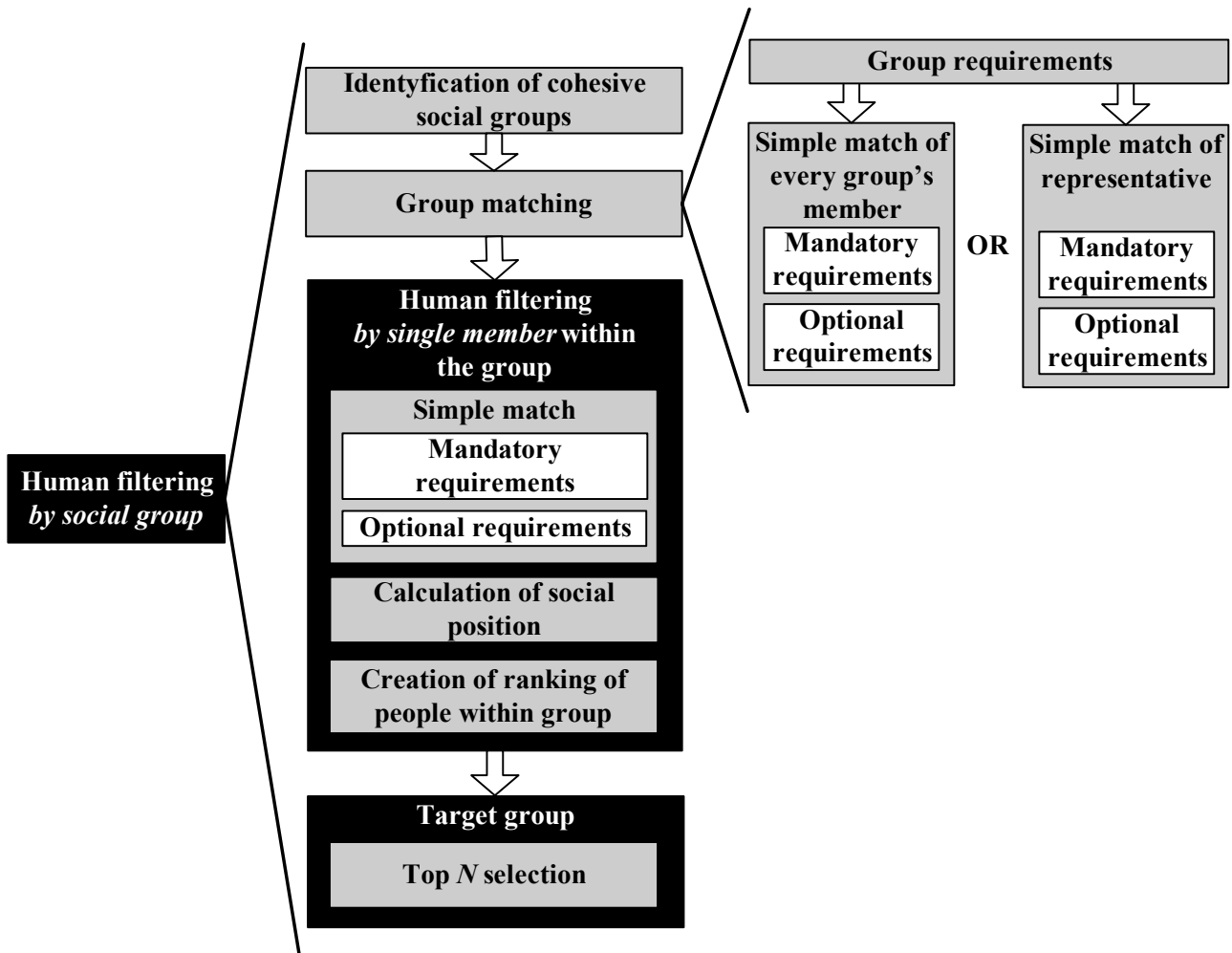


Figure 5: Elements of human filtering process by social group

COMPARISON OF BOTH APPROACHES

Two variants of human filtering were presented in the previous sections: *by single member* and *by social group*. In the *social group* approach we obtain the list of potentially most valuable members only from one, previously identified social group, i.e. those who are close one another (Figure 6a). We can also expect that they are in the direct relationship, have common acquaintances or at least the shortest paths between them are relatively short. On the other hand, the *single member* method provides the distributed group of people from the entire network who not necessarily are related or close to one another (Figure 6b).

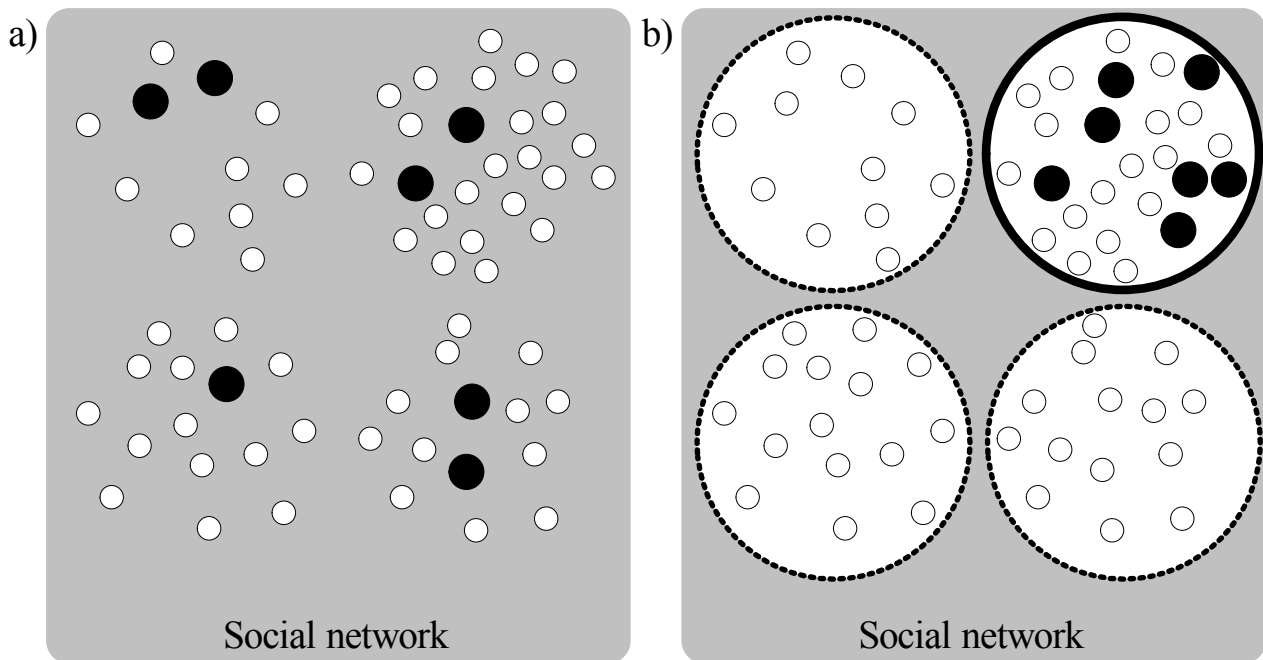


Figure 6: The outcome of human filtering process a) *by single member*; b) *by social group*. The black circles denote people who were selected in human filtering process

CONCLUSIONS AND FUTURE WORK

The human filtering process can differ depending on the goals of target group selection. Two variants were presented: on the one hand human filtering process *by single member* and on the other hand human filtering process *by social group*. In the *social group* approach we obtain the list of members only from one, previously identified social group i.e. those who are in relationships with one another. On the other hand, *single person* method provides the group of people not necessarily related to one another.

The presented solution gives the opportunity to improve the selection of groups regardless the goal of such selection. This framework can be a powerful tool, which can be used to choose people for project teams, find new potential employees, search the consumers' group for advertising campaigns, and finally use it for target marketing. The social position enables to analyze the social network with respect to social aspects of peoples' behaviors.

Future work will focus on the application of the presented concept in telecommunication domain, the adjustment of proper, static coefficients in (1), (2) and (3), as well as the development of the appropriate social clustering method for the *social group* approach.

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