

How to Compose your Dream Team?

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Abstract

Distributed and widespread companies already use extensively groupware to support their work processes. However, prior to actually working together, according teams must be composed. Future team members have often never met in reality, and the team manager faces new challenges in finding matching team personal. Unfortunately, the capabilities of groupware for such composing processes are still very limited, mostly due to a lack of information on potential team members. As a result, effective teams cannot be chosen. In order to address this problem, a groupware tool was developed to support effective composure for virtual teams. A team configurator offers functions to specify the wanted optimal values for a certain team. Using these values, the tool finds the best suitable members for the team using accordingly matchmaking strategies. This first version of the tool faces only social skills; they do not take professional skills and time restrictions into account. The team configurator has been initially tested and the results are shown in this paper.

1. Introduction

The rapid developments in internationalization and globalization arouse new demands on the organization of project teams. Rigid organizational structures have to be replaced by flexible ones so that projects will become more flexible and autonomous. The globalization forces companies to consider cultural differences in their products, and this implies that these cultural influences should also be considered in a project team. Project teams formed within one organizational unit are often not flexible enough to deal with these demands. The integration of freelancers into a project team will become more important. Virtual projects scattered all over the world could be one consequence of these demands. As the importance and popularity of virtual teams increase, it is imperative that we ensure their maximum effectiveness.

A project manager who has to establish an effective virtual project and an effectively working team cannot be successful, if skills, knowledge and experience in teamwork of the team members are not

taken into account. The conventional procedure of composing a team always includes certain steps of finding the appropriate team members. Team managers interview candidates, hold assessment centers or let their peers make suggestions. Adapting this procedure for virtually-working teams, we observed that these steps are often ignored. Moreover, only inconsistent indicators are available. Current groupware only provides the team manager e.g. with contact data about the people registered in the system. Many organizations have built extensive directories. Some of them are international employee listings including skills, backgrounds and previous assignments of the employees. Expertise Recommendation systems [7] support the user of a groupware in identifying people registered at a groupware who have the expertise necessary to solve a given problem. The Answer Garden [1] is a comparable approach. This system supports its users by making people with special knowledge accessible. If we configure a team with any of these systems we will receive a list of potential team members. Each potential team member will bring a required expertise and each of the team members will have a sufficient reputation. But these systems cannot ensure that these persons can really work efficiently together in a team. A lot of soccer teams have collected the best players for each position in their team from all over the world. But the coach is not always able to form a team out of these best players because the players must be effective when playing together in a team.

We have realized a groupware tool, which supports the team manager during the selection process. The team manager does not have to find each individual team member. The tool examines a set of people (for instance the employees of a company and potential freelancers) and generates a list of candidates that are best suitable for a desired team. The tool does not only support the initial composition of the team. Also the substitution of team members during the project work or the extension of the project team by additional team members is supported by this module.

2. Test and Measuring Instruments

We wanted to represent every person by a consistent profile. As we focused only universal

competencies and social skills, we needed to create a unique structure for such a personal profile that holds the necessary data. This data had to be gathered from according sources. We decided to use psychometrically examined tests that have already been used in organizational psychology. The main reason for this decision was that we could choose tests that have already been approved and that put the main emphasis on team effectiveness. We have examined six kinds of measuring instruments that could be useful for analyzing teams and individuals in order to compose more effective teams: Personality tests [2], Tests on the (working) style [6], Team role tests [6], Behavioral tests [6], Conventional employee assessments [5], 360° feedbacks [6].

We needed to choose a measuring instrument that provides data that can be used to compose effective teams. Furthermore, this instrument had to be applicable in groupware, psychometrically tested, reasonable and legally inoffensive. Regarding the automatic composition of a dream team and the extensive decision support we wanted the system to offer, the chosen measuring instrument needed to consist of a structure that can be interpreted and analyzed completely computer based and automatically. None of the examined tests fulfilled all criteria, but the 360° feedback method is of the widest scope. Especially, since all team members and the moderator can rate each others, it is ensured that reliable and useful evaluation results on people's competencies are produced. We developed the measuring parts of the team configuration tool using the 360° feedback method of Edwards & Ewen [3]. Concerning users that are new to the groupware application, we needed to choose a measuring instrument that provides data for the first round, as no results from the 360° feedback will be available for such users. Our idea was to use a suitable personality test for creating an initial personal profile for every new user. For that reason, new users will be tested using the Business Focused Inventory of Personality [4], a personality test that is especially designed for measuring business competencies.

Both chosen measuring instruments had to be shortened, mainly because some items were not essentially useful for team effectiveness, and we had to keep the time expenses in mind. The 360° feedback system by Edwards & Ewen [3] offers 166 items to choose. Wanting to constrain the required time for one team member to rate another one to five minutes at the most, we extracted 17 competency items that were most useful for team effectiveness. These items are arranged in four categories: administrative and organizational abilities, ability to communicate, effective teamwork and leadership. The Business Focused Inventory of Personality [4] consists of 210 items and 14 scales. We only extracted whole scales in order to maintain the

consistency of this test. Consequently, our adapted version enfolds 98 items arranged in 7 scales: motivation to design, motivation to lead, conscientiousness, flexibility, orientation to act, sociability and team orientation. As a result from the theoretical background, the tool itself had to consist of three different parts: First, we had to provide functions to fill out an initial questionnaire for new groupware users. This questionnaire consists of the items of the Business Focused Inventory of Personality [8]. Second, we needed to develop proper ways for team members to rate each other. Therefore, we decided to build an evaluation tool that follows the structure of the 360° feedback method of Edwards & Ewen [7]. Third and last, we needed the matchmaking tool itself, our team configurator. This tool would allow the future team manager to specify optimal values for the desired team. The tool would use proper matchmaking mechanisms to find the best suitable team members. The decision itself is done by comparing the optimal values with the whole set of personal profiles, finding the team composition with the fewest deviation from the optimal values.

3. The Team Configurator

3.1. General Structure

Our tool consists of three essential parts: The personal profiles, team templates and the team configurator. The personal profiles hold data on the competencies of each user and get their values from the two measuring instruments. Further, a moderator has to have the possibility to specify which competencies are necessary and desirable in a team to be composed. This was achieved by working with so called team templates. They represent the optimal values on the composition of a team with certain tasks. For every different kind of team an appropriate template can be created that specifies which composition of members is required in order to make this team most effective. Having information on people's competencies and the desired composition of a team, ways of creating the dream team can be developed. The team configurator automatically searches for the most suitable people for a team, using the values from a team template as source. The resulting dream team consists of the members that match the best with the optimal values of the chosen team template.

3.2. Personal Profiles

In order to represent ones competencies, every user has his or her personal profile. There are basically two different kinds of personal profiles: Profiles for users that have already participated in a team and profiles for completely new users. For new users, values from the adapted Business Focused

Inventory of Personality [4] are referenced. Therefore, all new users have to fill out the according questionnaire, when entering the system for the first time. The results of this test constitute the content for the personal profile of new users. As soon as a person has accomplished his or her first team project, a new personal profile will be built, following the competencies mentioned in the 360° feedback system [3]. The values for this are collected when all team members and the moderator rate each other. The structure of a personal profile will not change once a person has been rated by other members. After a person has completed the next team project, the competency values will be updated, adding the new ratings of all involved people.

Besides founding on a different measuring instrument, the personal profile of an already evaluated user varies from the profile for a new member in one more point: it also holds statistical information. These details can be used to identify how valid a certain profile is. For that reason, several indicators are available, ranging from information about how often this person has been evaluated by other people to how much the several ratings differed from each other. For instance, if eight people rate a focus person regarding one competency (e.g. creativity) and they all state the same value, this evaluation is more valid than if all rating results deviate from another. Moreover, the personal profile of a user who has already been rated in 50 teams is more differentiated than the profile of a user who has just been rated for the first time. A moderator can use these values to decide how much he or she should believe in the values of a personal profile. When all team members and the moderator have rated each other, the tool processes this data. First, the closeness of agreement is being calculated for each competency, using the standard deviation. The higher this value is the more all involved raters agreed regarding a competency of a person. Then, the respectively highest and lowest rating value for one competency is deleted, in order to eliminate mavericks. The same method is being used in Olympic rounding to obtain a stable median [3].

As the new values are calculated, the personal profiles are being updated. The tool distinguishes between new users and users that have been rated before using the 360° feedback. For users that have not been rated before, the tool deletes the values from the questionnaire they have filled out when entering the system first. Then, the new personal profile is built by storing the results retrieved from the evaluation. For people that already have a personal profile basing on competencies from the 360° feedback, the system updates the stored information by adding the new values from the evaluation. These values are added weightily, considering the closeness of agreement. If a competency had been evaluated with a high agreement level, the results of the

evaluation weigh more than if the rating people did not agree regarding this competency.

When measuring competencies and rating people, many concerns regarding privacy and data storage come up. We face these problems by assuring that the name and the identifying data of a person can never be related to the competency information of the personal profile. Consequently, a personal profile can only be viewed by the person it belongs to. All other people can view this profile exclusively anonymous, hiding the real identity of the person behind it. A team moderator, when composing a team for instance can see a personal profile, since it is necessary for him or her to see if a person is suitable for a team. Nevertheless, all shown profile data is held anonymously, and the team moderator will never know which personal profile belongs to what person.

3.3. Team Templates

A team template specifies how the optimal composition for a team is. As teams with different tasks require different team members, every kind of team needs its own template. Our idea is to use these templates in order to cluster several kinds of teams. When multiple teams have a similar task it is desirable that they are composed similarly. This similarity refers to many different factors of composition, such as team size, heterogeneity and competencies. Therefore, a team template is being used to determine how the perfect team to solve a certain problem would be composed. A team that has to organize a conference, for instance, will need team members with different characteristics than a team that is ought to brainstorm on a new innovative product. Since team templates describe the interface between the individual and the team, we decided to follow the structure of the personal profiles and adapt it from the individual level to the team level. When creating a new template, a moderator can name the template, give a description and define the optimal team size. In addition, he or she can specify values for every competency mentioned in both measuring instruments. These values refer to the team as a whole, so that a team template consists of desired competency values for all team members. For every competency, three values have to be stated: the importance, the desired value and the desired heterogeneity. The importance is being used to indicate how relevant or necessary the according competency is for the team composition. Competencies with a lower importance will be considered less essential than competencies that have been defined as extremely important. The desired value states how a certain competency should be represented in the team. A high value implies that the team members should have good qualifications regarding this competency while low values represent that poor values are more desired. For

example, an organizationally working team will need high values concerning the competency planning and organizing. In contrast, an autonomously functioning team will need low values regarding the competency leadership. The last value to be stated is the desired heterogeneity of each competency. It is being used to indicate how different the team members should be from another in respect of this competency. A low value points out that the team should be homogenous for this competency in such way as the team members should all have the same competency value. A high value points out that the team should be composed diversely focusing this competency, and the competency values of all team members should differ from each other. For example, when needing a single laterally thinking person in a team, the moderator will have to state a high heterogeneity value for the competency creativity and innovative abilities.

3.4. The Team Configurator

A team is composed following a four-step process. First, the moderator has to fill in general data about the team, such as name and description. This information is used to identify the team later on and to present the overall goal to the team members. Second, a team template must be chosen that matches the desired team composition. The moderator must know what size the team should have and how the competencies of the members should be allocated. If no useful template exists, the moderator can create a new one. In the third step, the actual team is composed. The team configurator automatically suggests a dream team, while the moderator has the possibility to add, remove or exchange members. During this step the moderator constantly gets feedback on the current assumable effectiveness. The team configurator graphically presents how the current team composition deviates from the chosen template. The last step finished the team composing process. Since the team is identified and all members are chosen, the team is actually ready for operation. But the anonymity of all users is being kept throughout the whole composition process. The moderator still cannot see the identity of the team members until they have not confirmed their membership. A team member has the possibility to decide whether he or she wants to participate in this team or not. Only after all members have confirmed their participation, the team is finished and ready to start working. In contrast to systems that only allow holding and managing people and their personal profiles, our developed tool founds on sophisticated automatisms that extensively support team composition processes. Configuring a team or updating personal profiles are no longer tasks that have to be done by the user, but are accomplished automatically through according algorithms.

Besides smaller automatisms like managing a team evaluation or adding values to a personal profile, the most essential automatism developed describes the composition of a dream team. The basic idea of this function is to automatically find the people fitting best for a certain team. The optimal values that were defined in a team template in advance tell our system how the combination of all member competencies would be in a perfectly composed team. The algorithm adds the most suitable people available to the team, whereas the competency differences of the template values and the real member profiles should be minimized. When actually adding suitable members to a team, our system bases its decisions on performing a pair comparison between the optimal values of the template and the concrete team competencies.

The matchmaking algorithm first creates a list of all available people that are registered in the groupware. For each person, the competency values from the personal profile are gathered. Then, the tool takes the optimal values and the desired team size gathered from the chosen team template. In the matchmaking step itself, the tool calculates the differences between the current team chosen and the optimal values for each possible team composition. There are $\binom{n}{k}$ possibilities to build a team of k members out of a set of n people. The desired value for a competency is compared to the median of the actual values of all members. The desired heterogeneity regarding a certain competency is compared to the actual standard deviation of the according member values. The importance of a competency is taken into account when estimating the overall effectiveness. The composition with the smallest difference and therefore the highest assumable effectiveness is the dream team that the tool will suggest. Above and beyond, the team configurator automatically creates a list of available users that could be added to the team. This list is descendingly sorted by the contribution to the effectiveness. The user that would increase the assumable effectiveness the most is on top of the list while the least significant user has the last position. The moderator can use this list to find suitable team staff, if he or she wants to change members in the dream team composed by the team configurator. These activities are supported in addition by presenting the effects a person has on the assumable effectiveness of a team. Before adding, removing or exchanging users, the moderator can find out how the assumable effectiveness would change when performing the planned operation. The team configurator presents a nominal/actual value comparison for every factor stated in the chosen template. Hence, the team configurator offers many automatisms for supporting the team composing process, but also gives the moderator the possibility to intervene.

4. First Results

We analyzed the capability of our team composition tool in several university student projects. In the following we will document the results of the analysis of eight virtual project teams. In our study 29 participants worked part-time in projects. 19 participants were male and 10 were female. The age of the participants was between 21 and 27.

At the beginning of the test all participants were registered at the groupware more.groupware, and each participant filled in the forms of the initial questionnaire, founding on our adapted version of the Business Focused Inventory of Personality [4]. These inputs were the basis of the group composition process selecting the fitting team members. With the help of our tool we divided the 29 participants into five teams. Our aim was to compose teams with two different profiles. Two teams had a high rate in the characteristic creativity and two teams were configured as conscientious and well-organized. As we only had a total amount of 29 participants, the fifth team could not be composed considering a special profile. Therefore this team will not be incorporated in the following analysis. In the two creative teams the characteristic creativity was intended to be heterogeneous. This implies that only a few of the members of these teams were highly creative and the others differed in this characteristic. The two teams arranged to be conscientious and well-organized were configured homogeneously. This means that all members had these characteristics. As there were only 29 students being at our disposal, it was only possible to compose one team whose members were creative at a high rate and one conscientious team fitting into the profiles in the best possible way. By this, the two secondly composed teams were supposed to be less effective than the first composed teams concerning their respective profile. The members of the teams were not informed which team profiles were used to compose the teams.

These five teams had to work on special tasks for three weeks. The tasks required an effort of each participant of approximately four hours per week. The participants worked anonymously using pseudonyms so that existing social relations between the participants could not influence the results of our study. At the beginning of the project work, we used a virtual team game to build up a team spirit in the virtual team. This game makes the participants get to know each other without giving up their anonymity. During the team work two teams worked on the task to elaborate future cooperative computer games and two teams had the task to work out a concept for the computer support of the design process of computer games in distributed teams. Each of the two tasks was handled by a creative team and by a conscientious team. In order to generate their concept

the teams used some creativity tools (brainstorming, lotus flower and an idea manager) in a groupware. At the end of the project each team documented their project results in a position paper which was written using a group editor. This editor was provided by the groupware, too. Finally these position papers were submitted into a conference tool (openconf) and each paper was reviewed by thirteen reviewers. The main categories of this review were state of the art, worked out vision, originality, innovation and overall rating.

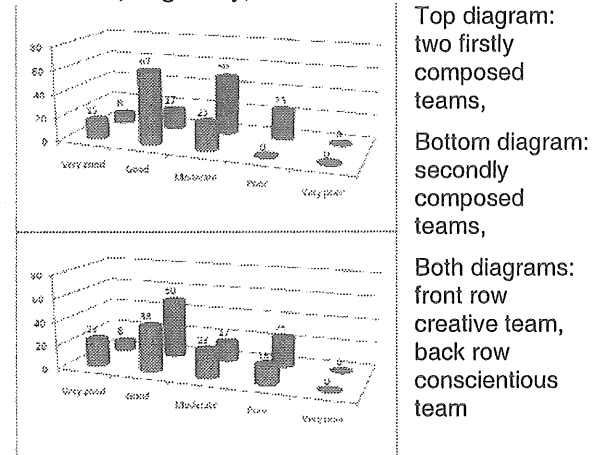


Figure 3: Innovation achieved by the teams (first projects)

We had chosen the tasks to work out concepts of future cooperative games and to work out a concept for the computer support of the design process of computer games because both tasks had a focus on working out innovations. We had assumed that the two creative teams would work out more innovative concepts than the two conscientious teams. Figure 1 indicates that we were right in the assumption the concepts of the two creative teams are more innovative than the concepts of the conscientious teams.

At the end of the project work each team member evaluated each other member of his team using the adapted 360° feedback. The initial profiles were deleted and the profiles based on the 360° feedback were used to compose five new teams. We used the same team profile (two creative, two conscientious and one team without a special profile) to compose five new teams. Again the participants worked anonymously in the groupware using new pseudonyms. So the participants did not know that they were working together with some of the members of their former project. Again each team had three weeks to work on their projects and the estimated amount of time each participant had to invest in the team work was again four hours a week. Using the defined team profile we analyzed again only four teams. Two of the teams (a creative one and a conscientious one) had the task to work on future concepts of recommendation systems for spare time purposes. The two other teams were asked to

develop a concept of recommendation systems for business sectors. The teams used again creativity techniques (method 6-3-5, lotus flower, idea manager) to elaborate their concepts and they documented their team results with a group editor as they had done before.

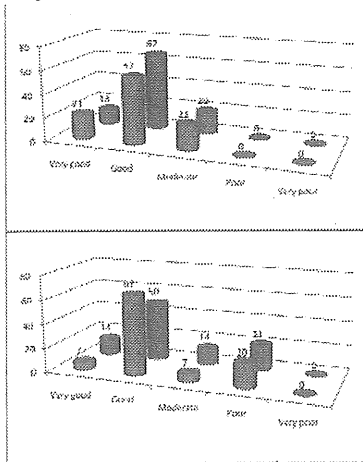


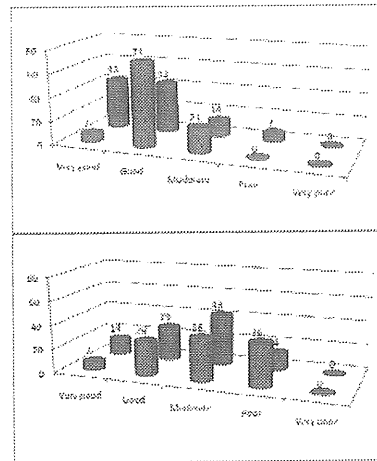
Figure 2: Review results concerning innovation in the analyzed application areas (second projects)

For the second series of projects, we had assumed that the two conscientious teams would work out their proposals for a concrete recommendation system in more detail than the creative teams. The two creative teams should again achieve better results concerning the worked out innovation which could be achieved by the use of recommendation systems in their analyzed application area. The left diagram in Figure 2 shows that the achieved innovation in the application area "spare time use of recommendation systems" was rated "very good" by 21% of the reviewers. Only 13% of the reviewers rated the results of the conscientious team as very good. In the right diagram the review results of the secondly composed teams are compared. The diagram shows that we have a higher spreading of results. But again there is a tendency that the creative team achieved more innovative results than the conscientious team. In Figure 3 the review results concerning the proposed system are shown. These results fit to our assumption that the conscientious teams with those participants who are well-organized should achieve better results than the creative teams whose members all had only low rates concerning the item conscientiousness. Our approach is a first step to show that a computer support of the team composition process is a worthy addition to current groupware. Despite the low number of test persons and composed teams our evaluation results make clear that team work gets more effective if teams are not chosen by accident but by regarding the profile of the team members. The more detailed such a profile is the better the configuration of a team will get.

Top diagram:
two firstly
composed
teams,

Bottom diagram:
secondly
composed
teams,

Both diagrams:
front row
creative team,
back row
conscientious
team



Top diagram:
two firstly
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Bottom diagram:
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Both diagrams:
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team

Figure 3: Review results of the proposed system (second projects)

5. Conclusion and future work

The management of projects operated by virtual teams will be the challenge of the next decade. Currently a project manager of a virtual team uses traditional project management tools to plan the project and to control the project progress. For the communication, the cooperation and the coordination of the team members the manager and his team make use of many collaborative tools such as chats, wikis or videoconference systems accompanying support for the accomplishment of tasks. In this paper we have shown that the computer support of the team manager must already facilitate the process of composing a team. A team manager who has to establish an effective virtual project and an effectively working team cannot be successful, if skills, knowledge and social relationships of the team members are not taken into account. The teams configured with the help of our team configuration module on the base of predefined profiles achieved results as we had assumed according to the initially specified team profiles. These first results must be verified in future tests that configure more teams and specify a larger variety of team profiles.

6. References

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