DECISION - MAKING IN VIRTUAL SOFTWARE TEAMS USING CLOUD PLATFORMS

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Abstract

Software development projects are usually realized by traditional or virtual IT teams using computing clouds. Team collaboration requires decision - making regarding essential aspects of a project progress. The article concerns methods of decision – making process in the case of traditional and virtual teams' work. The research results conducted in a group of IT specialists are presented, and to analyze their preferences in decision-making methods, four possible cases were tested: hierarchical choice, team members' choice (consensus or voting) and external expert decision. The additional value of the research is the recognition of IT specialists' attitudes towards computing cloud usability in IT projects.

Keywords: software development, IT teams, virtual collaboration, cloud computing, decision-making

1. INTRODUCTION

A traditional team is a group of people linked in a common purpose, where its members have complementary skills. That allows them to maximize their strengths, and minimize their weaknesses, in order to improve their performance, and in consequence to solve their problems or to finalize successfully their tasks. In the case of IT teams, the main task is the software development of specified applications. A virtual team is also a group of individuals who work together, their tasks are interdependent, inseparable, and leading to a common goal, but they are geographically dispersed and their communication depends on ICT platforms (Dávideková, Hvorecký, 2017). However, it is not easy to evaluate how virtual a team is. In general, there are three predominant factors that contribute to virtuality. The first one is the possibility of IT technology, as was mentioned above. The second one is how big is the distance between team members, in geographical dispersion and in consequence in time zones. The third one is organizational and cultural diversity which affects team members' relationships and team output.

Traditional or so-called face to face teams (ftf), and virtual ones, are still under research and examination. It is a known fact that virtual teams generate more ideas compared to traditional ones. However, virtual teams require a longer time to reach a decision. When comparing performance of ftf and virtual teams the opinions about them are mixed. Some empirical research shows that real teams are better (Schmidt, 2001), others that virtual teams, and other research confirms that they are on the same level. Progress in communication media (e.g. 3D virtual environments) brings closer these two kinds of teams (Bourgault, Dronin, Homel, 2008). We will concentrate only on decision-making processes accompanying work of such teams. We consider the same decisions, taken in both kinds of teams, and compare them to distinguish differences. We cannot analyze why some of them make correct decisions, while other teams reach a wrong decision. There are many causes of these, such as: quality and experience of teams, their leader skills type, conditions of working environment, social and surrounding context and current circumstances, existing relations among members or working atmosphere and also organizational and technical support. During the last decades researchers have found many conditions under which groups make better decisions than individuals. However, in the case of decision – making in virtual teams many problems are open and need more research.

In the paper we limit our consideration to some aspects of ftf and virtual IT teams, as is shown in Fig.1. Some elements of computing environments, development platforms, structures of organization

and management strategies can be analyzed. More than 50 IT teams have been tested by a specially prepared questionnaire, and different methods of making decisions in the above context are analyzed.

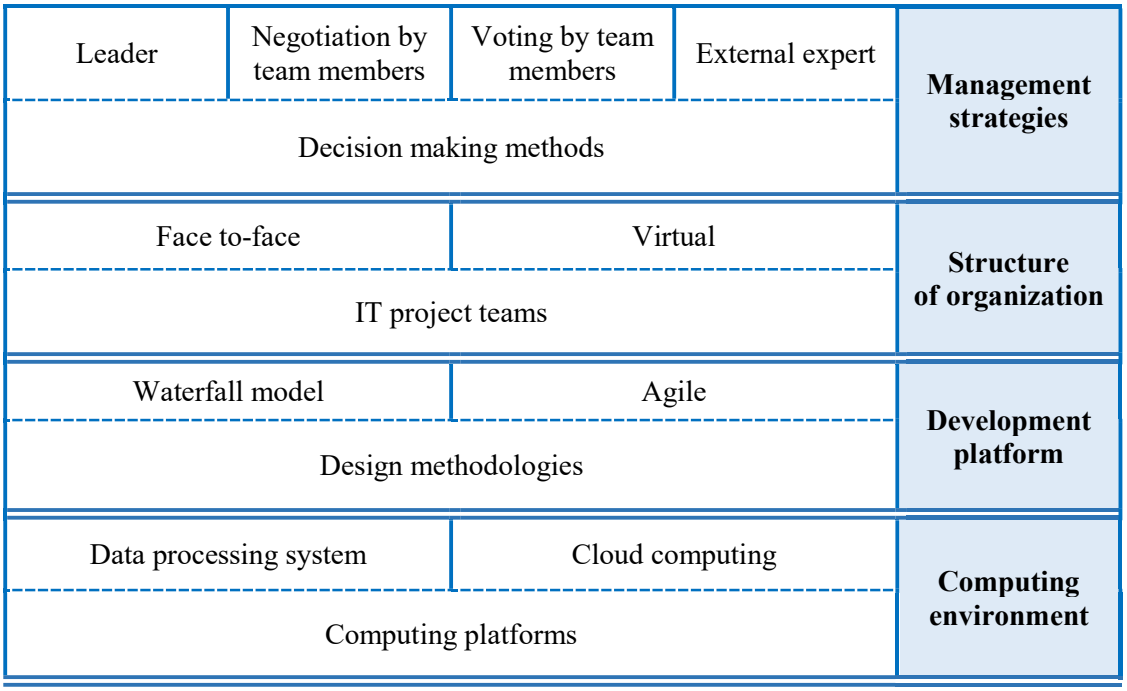

Figure 1 – The main aspects analyzed in the paper.

2. PROJECT PLANNING, DEVELOPMENT AND MANAGEMENT

The aim of project management is to achieve all of the assumed project goals with the specified constraints. We can distinguish two basic strategies of project development. One concentrates on the planning and design stage, where the project is defined clearly, and the required resources (including human, financial and technical ones) are strictly determined (see Fig.2i). The second one describes Execution & Improvements, where the project is consequently realized, and in the case of some problems, properly modified (see Fig.2ii).

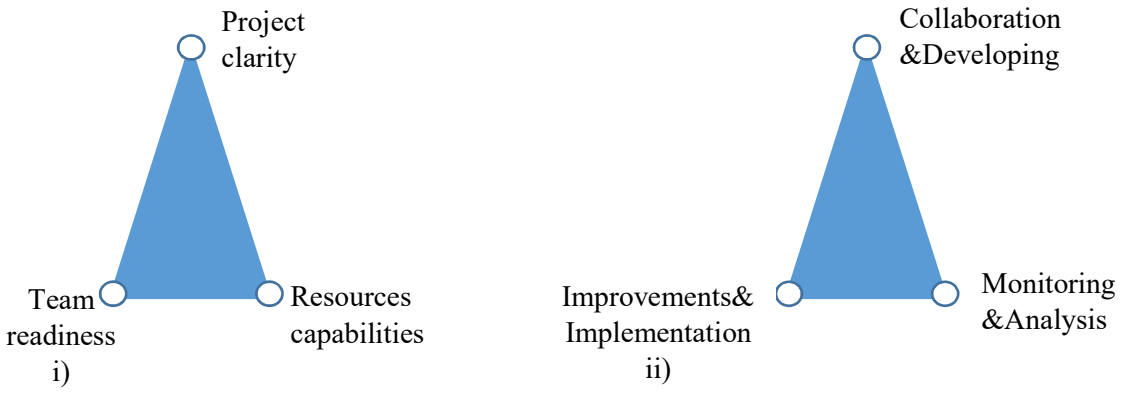

Figure 2 - The Project development stages: Planning&Design (i) and Execution&Improvements (ii)

Proper selection of the project team members and other resources in the first stage of project development significantly impacts on the efficient realization of the second stage. In the literature there are many propositions about how to organize the best conditions for project realization. There are many possibilities to choose suitable development platforms offering designing tools and the computing environments for software design, execution and testing (Philips, 2004).

Currently, the most popular technology has become cloud computing (Vasan, 2011). It offers various kinds of services assigned to three layers IaaS (Infrastructure as a Service), PaaS (Platform as a Service) and SaaS (Software as a Service). We can arrange, in comparison to traditional data processing platforms, more flexible and much cheaper developing possibilities on the PaaS level (Cohen, 2013).

The Execution and Improvement stage of software development is much more difficult to implement. The best practice and/or well-known principles must be kept in mind during this stage. Moreover, a team (during the work) should be aligned to the business goals, and should consider all changes in real time. One of the well-known development methods is the PRINCE 2 approach, which provides a method for managing projects with a clearly defined waterfall framework (Pollice, Augustine, Lowe, Madhur, 2004). Each activity is defined as a process with key inputs and outputs and with goals to be carried out to deliver a project's outcomes. Besides, it provides a platform for the cooperation of all participants of the project, and defines their roles and responsibilities. Also, there are some other international standards (e.g. ISO/IEC/IEEE) that present guidance on project development and management. One of the main purposes of development methods is to accelerate product delivery and reduce production costs. These requirements stimulate a new kind of software development called agile principles. Most agile development methods break development work into small parts called increments, that are planned and implemented in short time frames (e.g.1-4 weeks). Each product of such an iteration is evaluated and improved and after acceptation it is integrated with earlier accepted parts. The most popular of such methodology includes such frameworks as Kanban and Scrum (Shalloway, Beaver, Trott, 2009). Such methods, in contrast to waterfall models, focus more on producing working software, and less on documentation. Evaluation reports are saying that agile software development helps teams to deliver software faster, improves their ability to manage changes suggested by customers and leads to an increase of team productivity. It seems to be a preferable approach for virtual project teams.

3. DECISION MAKING MODEL

A team, to do its work professionally should be well organized, truly engaged in doing the work, and effectively managed. Teamwork process involves a series of interactions, information exchanges, questioning, answering, creating solutions and solving problems. There are two kinds of such problems: task - oriented, that corresponds to actions directly related to project purposes, and another, called team - oriented, referring to personal conflicts, unproductive communication, low members' motivation, etc. In both situations, the proper decisions should be made, which will eliminate or reduce negative influences on team output. In the paper we focus on task – oriented problems, but the well - known obstacles related to team relations and team climate must not be forgotten. The most important ones are, for example:

- Lack of team identity
- Low participation in a team
- Poor communication
- Ineffective team leadership
- Obstructive conflict
- Group thinking
- Absence of creativity
- Ineffective decision-making.

The above obstacles are typical for traditional teams but can also affect virtual team collaboration. In the case of virtual teams, some other challenges appear like: potential misunderstandings and misinterpretation caused by non-verbal communication gaps, lower team cohesion and trust, cultural diversity problems, social isolation or difficulties with brain-storming processes (Zofi, 2012).

It is possible to define some pattern actions to eliminate the above obstacles. One of them is to complete all the stages of the decision-making process that lead to the best problem solutions. It refers also to task – oriented problems, that in software teams can be oriented on:

- Choosing the platforms adequate to the project needs,
- Pointing out design methodology that is well-known and satisfactory for the team,
- Finding the research results to solve met difficulties.

They are often supplemented by the problems related to cloud computing usage in software development teams.

There are some decision-making models known, like Tuckman' s model composed of five stages: forming, storming, norming, performing and adjourning, or the Fisher model containing steps like: orientation, conflict, emergence and reinforcement (Turban, Liang, Wu, 2011). The new suggested model, matching software team decisions, is shown in Fig.3. It is assumed that decision-making consists of four main steps called: problem, knowledge, alternatives and solution.

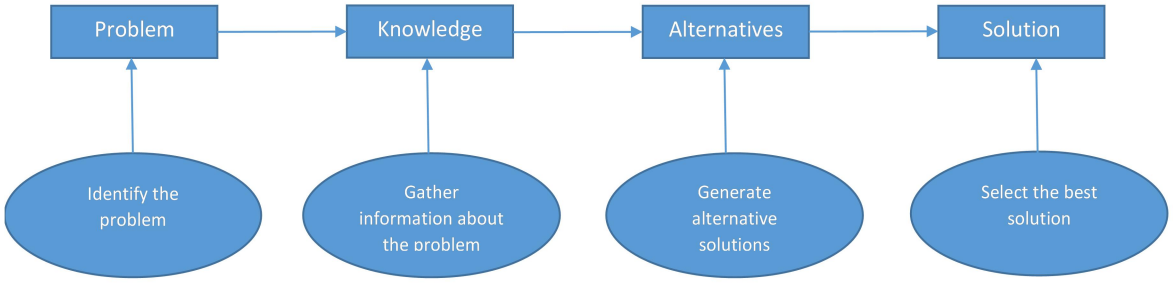

Figure 3 - Four step sequence of decision making

First of all, we should identify the problem and recognize the reasons for its occurrence. It is required to evaluate how the team is achieving its results, and to understand what kind of problem it is: task – or team – oriented. Next, the information explaining the problem context, essence and possible elimination methods. To find the best solution, several alternative solutions should be defined, analyzed and compared by the assumed criteria. The last step is to select the best resolution which next can be implemented. Going effectively through all the stages can be time-consuming and sometimes needs to be triggered by a team leader or a coordinator. Such a person can be also especially useful at the last stage when the final decision is made. There are four ways of decision – making used at that phase:

1. By the leader of the team, who gather information from members, and uses it to make decisions
2. By consensus, where every member of the team must agree to adopt a proposed decision. If it is not possible, new alternatives are formulated and presented for evaluation.
3. By voting, where members of the team discuss the decision and then vote, the team accept the choice if more than 50 % of members accepted it.
4. By extra expert, where nobody from the team is responsible to recognize how useful the solution is, and to solve it professionally.

It was discovered in previous research that the decision paths are influenced by two main factors: task characteristics and group internal structures that define work relationships in the team (Wei, Heckmann, Crowston, Li, 2011). Because of virtual team specificity, it seems probable that the way of making a final decision also differs in ftf and virtual teams. Collaboration technology used by a virtual team can encourage users to categorize information, to judge its importance, and leads to better quality decisions (McNamara, 2008). When asynchronous communication ICT is used, team members have much more independence in developing and testing their own solutions, before sharing them with the other members. At the same time they are less tended to discuss all of their ideas of problem solutions (Wei, Heckmann, Crowston, Li, 2011). Virtual collaboration process structure supported by a communication channel leads to equal information voicing in the team, which stimulates the negotiation process and focus on analyzed alternatives, not on personal preferences (Cordes, 2016). Because virtual team members commitment and team cohesion are the important challenges, the consensus decision model is fully recommended (Falkowski, Troutman, 2005).

Does it mean the decision – making methods are different in virtual and ftf teams? Answering the above question was the main goal of the research presented in the next part of the paper. Another aim was to test IT specialists' attitudes towards cloud computing. In other words, we concentrate on recognition of how project virtual teams are making decisions working in cloud computing environments, and what kind of design methodologies are more preferable.

4. RESEARCH RESULTS

In order to illustrate how decisions are made in traditional and virtual teams, a questionnaire was distributed in a group of IT specialists. More than 50 of them decided to answer the request. Most of them are men: 48/54 persons, and 55% of respondents have experiences in virtual collaboration. Their age structure is presented in Table 1.

Table 1 – Age of respondents

age	
18-24	17%
25-34	74%
35-44	9%

Respondents were asked to point out the kind of methods they use while working in software projects and about 65% of these IT specialists matched agile solutions (traditional waterfall method was pointed out by 24%). The answers to question about which computing and development platforms are more favorable were much more diverse, and opinions about them are presented in Figure 4.

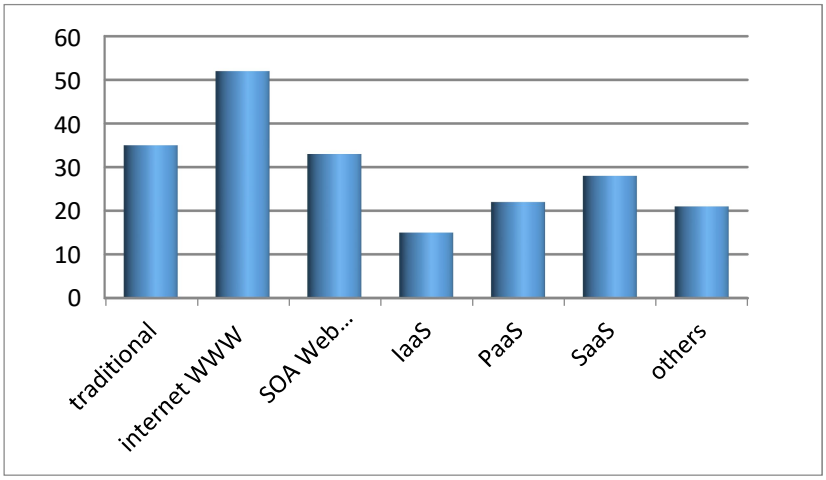

Figure 4 – Computing platforms used by IT specialists (% of respondents)

More than 43% of the tested IT specialists use clouds in their professional tasks, and 77% of them would use cloud computing in realized projects if possible. Figure 5 shows respondents' preferences towards cloud computing usage, depending on their previous experiences.

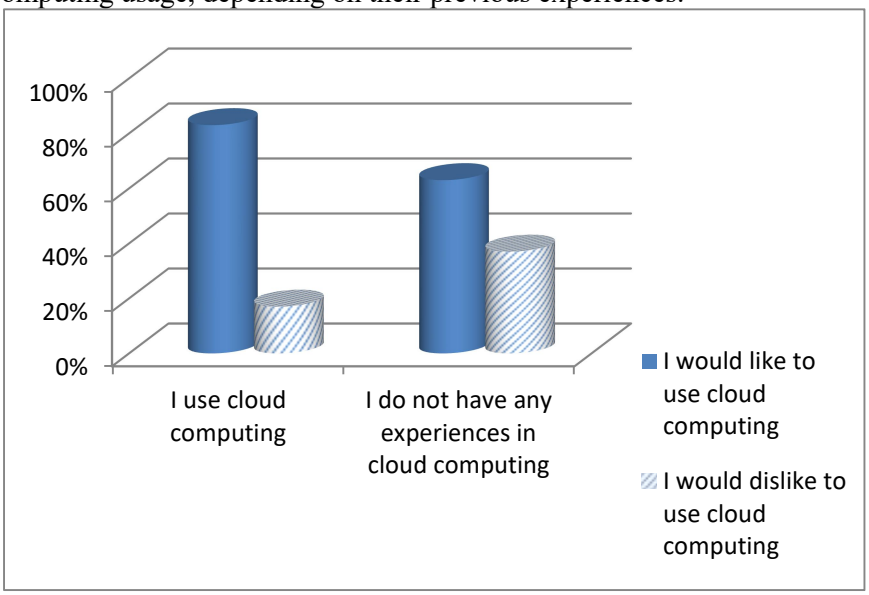

Figure 5 – Cloud computing experiences and preferences

It can be assumed that IT specialists' attitudes towards cloud computing are positive, most of them would like to use it if possible. Previous experiences in cloud computing raise the preference to use it in future projects. Respondents were also asked about the reasons for their acceptance or rejection of cloud computing solutions. Pros and cons were categorized into a few groups that are presented in Table 2.

pros	cons
Calculation speed	No need to use
Scalability	Security issues
Software expense elimination	Loss of control
Security	Knowledge gap
Convenience	

Table 2 – pros and cons of cloud computing

The most often-mentioned arguments against cloud computing were the lack of need and security issues. IT specialists (who are against) do not trust clouds, and were also afraid to lose control over programming code. An interesting argument was the knowledge gap – respondents said they do not have enough information to choose or access cloud computing solutions. The pros part was dominated by time and scalability arguments. There were also some reasons based on clouds' accessibility, and comfort connected with cloud computing solutions from the programmers' point of view.

The next two figures show in what way decisions are taken in the case of task-oriented problems in case of software development projects. Fig 6. presents differences in decision-making in the case of cloud computing chosen as a computing environment. Respondents were asked to choose typical ways of making decisions while they were working as traditional (ftf) and virtual teams (v).

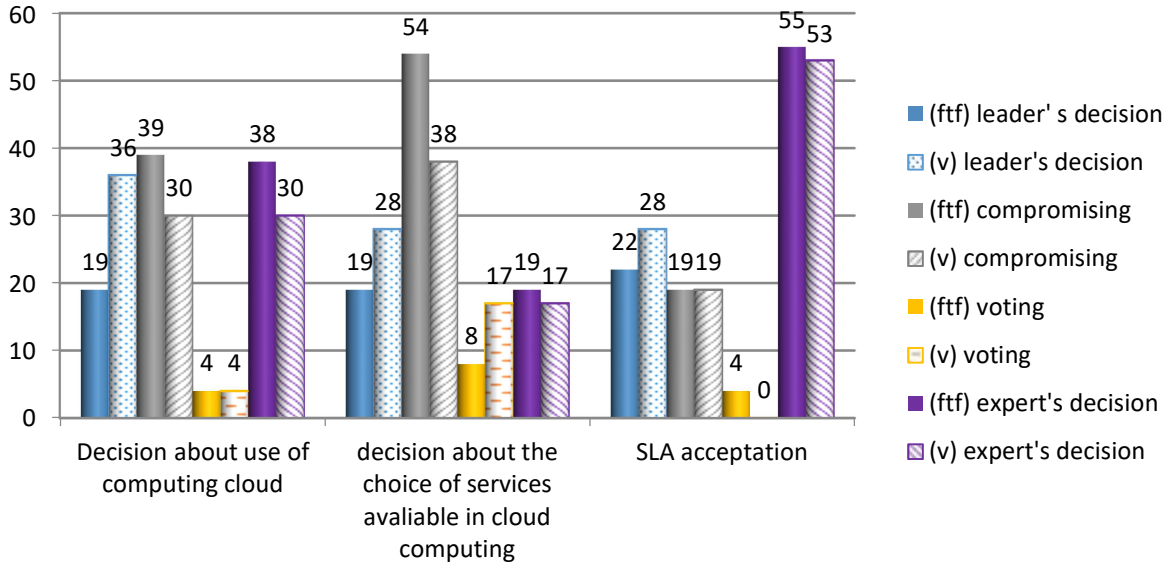

Figure 6 – The way of decision – making in the case of choosing cloud computing as the development platform (% of respondents)

There were three types of decision assessed: about use of a cloud, services choice and SLA acceptation. Respondents could point to one, of four, ways of decision – making. The most important results are:

- In the case of the decision referring to cloud computing usage, and services choice, the most popular in ftf teams was compromising; in virtual teams, the leader was usually responsible for the decision of cloud computing usage and members were rather empowered to make the decision about the services choice,
- SLA acceptation was typically decided by the expert in traditional and virtual teams,
- Expert's decision is also required in some cases of answering the question as to if the cloud computing should be used,
- Leader's decisions were much more popular in the virtual team case for each kind of decision,
- The least popular team decision method was voting, but it was a bit more often in virtual teams in the case of services choice.

Fig 7. shows differences in decision-making in the case of cloud computing chosen as development platforms. There are also results presented for both: face – to face teams, and virtual teams.

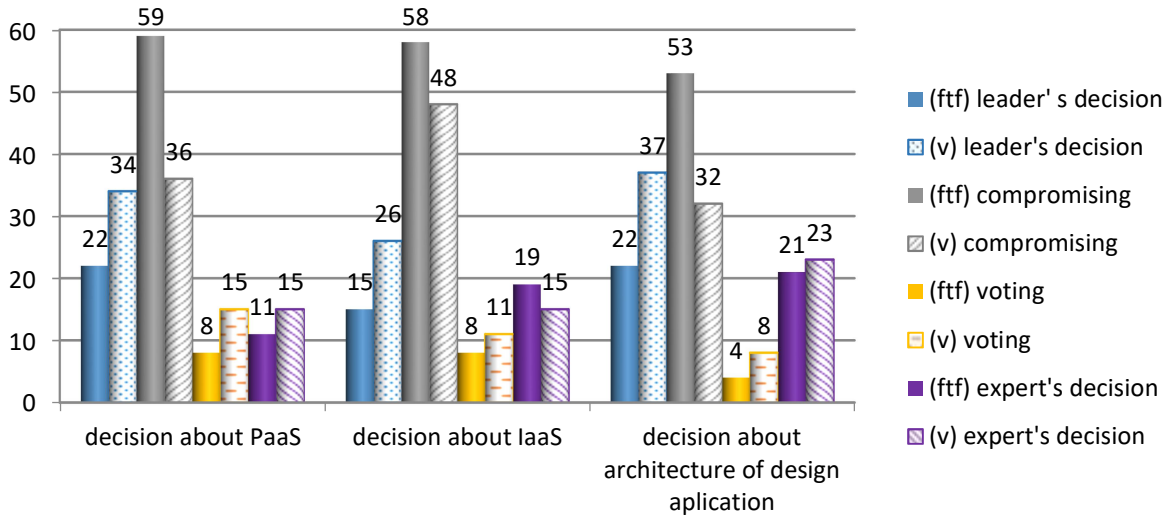

Figure 7 – The way of decision – making in the case of the choice of cloud computing as a development platform (% of respondents).

It is visible that the most important way of making decisions about cloud computing as the development platform, in traditional teams, was compromising. The leader's opinions were much more powerful in virtual teams, especially in the case of both the choice of PaaS platforms, and architecture of designed applications. Decisions about choice of IaaS by virtual teams as application running environments were more often taken as compromising, but the role of leader seems to be stronger in the case of virtual teams than in ftf teams. Moreover, voting was the least preferable way in each kind of decision making, but it is possible to notice that this method is more often pointed to in virtual collaboration cases.

5. FINAL REMARKS

It is well-known fact, that decision – making is a very important operation in strategic management. There are plenty of factors that have big influence on such process. In the paper some of them, related to modern computing environment (i.e. cloud computing) were discussed. Moreover, we considered two kinds of software teams: traditional and virtual ones to analyse the most popular ways of decision – making in each of them. The achieved results show as follows:

- The virtual environment, which is said to be a great chance for self-managed teams of experts, stimulates teams to rely on leaders' opinions more than on the discussion and compromise way. It can be the result of virtual teams' low trust and low cohesion (especially in Polish conditions). In consequence the different ways of building trust and commitment should be implemented in these kinds of teams, to promote team discussions and information sharing,
- The voting is fortunately perceived as the worst way of decision-making. It is important in the case of the development of different services supporting virtual team decisions. Disadvantages of this way of making decisions such as: possible team division, lack of satisfaction and commitment in the losers' group, should be better understood and eliminated,
- The influence of team virtualization on its results obtained in cloud computing environments need to be deeply analyzed. It should be confirmed that software teams make better decisions, and make their collaboration more effective thanks to cloud computing.

The obtained results are initial knowledge, and further research is necessary. Other aspects of software teams characteristic as well as the roles of leaders or available technologies can be taken into account. IT specialists' attitudes towards cloud computing were also widely analyzed, and based on the present research cloud computing seems to be widely accepted in many research groups. One of the reasons for negative attitudes can be the knowledge gap, which is astonishing in a group of IT specialists. That suggests the need for cloud computing pros and cons promotion in such groups, because the lists generated by respondents do not cover the ones given by cloud computing experts. It emphasizes that there is a need also for improving education in the area of cloud computing.

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