University of Zurich
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Impact of Collaborative Information Technology

An explorative Analysis in Projects of Swiss Financial Institutions

Master Thesis

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Abstract

Collaborative information technology (CIT) such as instant messaging and video conferencing supports collaborative work. A recent international study has shown that utilization of CIT in organizations is still low. This thesis examines impacts of CIT to better understand these circumstances. For this purpose a research framework was constructed to gather information about CIT use and its impacts in an explorative field study. Interviews in 10 Swiss financial institutions were conducted, with users and providers of CIT. The results show support that CIT leads to impacts like higher effectiveness, quality, time savings, but also higher transparency and team cohesiveness. Significant differences in weighting of impacts between users and providers were found. Implications are drawn for further research.

Acknowledgments

Thanks to everyone who supported this thesis.

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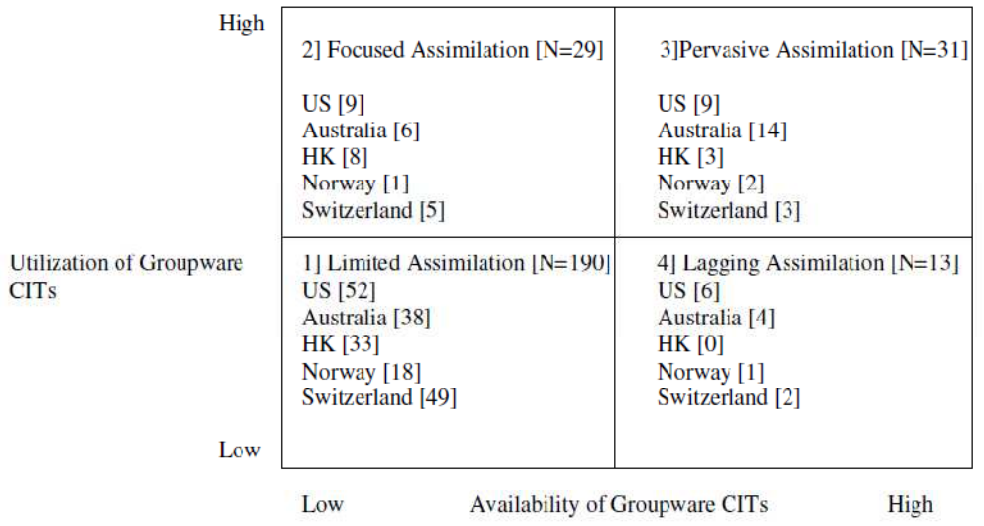
Introduction

Cooperative work, as a form of work organization, is not an idea whose time has just come. The notion of how people collaborate in getting work done, has been around since early humans coordinated their tasks in hunting, fishing, gathering and rudimentary agriculture.[…] The use of technology to support cooperation among work tasks is as old as the tales anthropologists can tell us about the tools that humans have used. What is new, however, is that the current focus on 'computer-supported cooperative work' gives us the chance to revisit our analysis of what forms cooperation now takes in the workplace, and to ask questions that can lead to envisioning computer support for working practices that encourage cooperation rather than isolation at work. (Greenbaum 1988)

Since the 1980s the world has become more globalized. Besides other factors, collaborative information technology (CIT) has facilitated this development. CIT is information technology which supports face-to-face or enables virtual collaboration across geographically dispersed work environments irrespective of temporal boundaries. The need for this technology increases in an ever more globalized world. This can be seen on the huge success of the evolving Internet, especially of Web 2.0. Phenomenons like collaborative creation, ordering and sharing of information can be seen in communities like Wikipedia, Facebook, Flickr or youtube (Surowiecki 2004)(Mathes 2004)(Anderson 2006)(Höltschi, Aschoff and Schwabe 2008). What happens in the Internet could happen as well in similar form in organizations.

Despite the benefits of this technology, a recent study about their assimilation in more than 500 organizations spread over the US, Australia, Hong Kong, Norway, and Switzerland unveils that assimilation is still little (Bajwa, Graham, et al. 2007). Assimilation is measured as availability of CIT for employees of an organization (which includes access to those systems) and its utilization. Figure 1 shows the results of this study with regard to groupware systems (which provide functionalities like e-mail, chat, group calendar, etc.) and conferencing systems (for audio or video conferences).



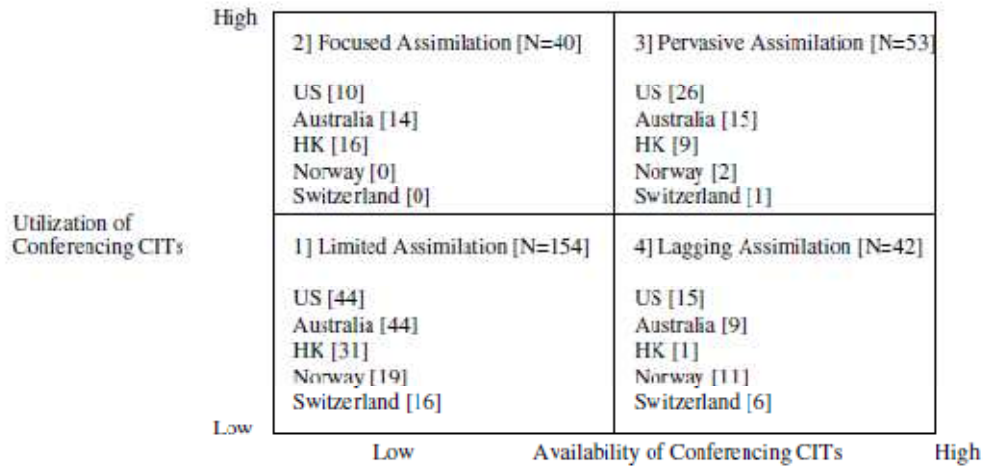


Figure 1: Assimilation of Groupware and Conferencing CITs (Bajwa, Graham, et al. 2007)

It is astonishing that assimilation is that low, especially for tools made for an organizational context resp. for teams, isn't it?

In total 263 organizations reported at least one count in availability of groupware systems. Only those are present in this statistic. By far the majority of the companies reported limited assimilation, thus availability and utilization of groupware are low (72% of the organizations) with the US leading the statistic followed by Switzerland. Pervasive assimilation, which is high availability and high utilization, was only reported for 12% of those organizations. The results for conferencing systems provide a similar picture. It differs in that a higher number of organizations especially in the United States exhibit pervasive assimilation. Switzerland is

still very weak. What leaps to the eye is the amount of lagging assimilation. Investments are taken into conferencing systems, but they aren't used intensively. Further, the study investigated in variables like size of organization, functional integration and promotion of collaboration.

So, what are the reasons for weak assimilation of CIT in organizations?

Researchers have long explored to find answers to this question to better understand the nature of CIT use. For example psychological research explores virtual teams[1], to understand distance collaboration. Distance collaboration refers to the participation of individuals in a group activity without physically being in the same location. Studies about virtual teams explore factors like interpersonal attraction, collective efficacy and trust.[2]

Further, virtual team research conducted, that *cultural differences* among team members can lead to coordination difficulties (Maznevski and Chudoba 2000) and create obstacles to effective communication (Sarker, Lau and Sundeep 2000). *Technical expertise* in CIT and team *training* can lead to higher team performance if it is consistent among all team members (Kaiser, Tullar and McKowen 2000)(Van Ryssen and Godar 2000).

Task processes for collaborative work and media choice hold additional factors for successful distance collaboration. The? former are forms of social interaction that occur while members of a team work together to accomplish a task or goal. Communication, coordination and collaboration are the tree major processes[3]. Media choice[4] means that a team can work productively with a media (CIT), if latter fits to a given context (task, process, etc.).

All above introduced factors are preconditions for a successful distant collaboration or even face-to-face collaboration. They are already deeply explored and research continues.

[1] Groups of geographically, organizationally and/or time dispersed workers brought together by information and telecommunication technologies to accomplish one or more organizational tasks (Powell 2004, p. 7)

[2] Interpersonal attraction is meant as having satisfactory relationships and friendships with other members of the group (Lott and Lott 1965). *Collective efficacy* is defined as the shared belief among group members that the group possesses the ability to successfully perform a task (Gonzalez, et al. 2003) (Bandura 2000). *Trust* as part of virtual teams was seen as challenging because it is difficult to assess teammates' trustworthiness without ever having met them (McDonough III, Kahn and Barczak 2001).

[3] See 2.1.2

[4] See 2.2.3

Some research efforts were also taken to investigate in post conditions of face-to-face and virtual teams using CIT i.e. on impacts. Major focus lies on benchmarking CIT-supported teams with traditional teams and measures impact differences in effectiveness (e.g. higher quality or creativity in terms of an increased number of ideas generated) or efficiency (e.g. time savings or better work practices)[5]. Even negative examples like interruption of work are regarded. Studies about such impacts often embed CIT into a task-oriented context. But (as of our knowledge) no scientific work exists, which provides a big picture of impacts of CIT mapped to a systematical approach of tasks.

Thus, research in impacts of CIT usage is assumed to gain further insight into the lack of assimilation of this promising kind of information technology in organizations to support collaborative work.

1.1 Aim and Approach

The aim of this thesis is to provide a holistic view of impacts of CIT used in intra-organizational face-to-face and virtual teams. Details about the following approach are provided in chapter 3 and 4. Since this research area is not heavily explored, an explorative empirical study is being conducted. At first literature regarding impacts will be reviewed. Only field and laboratory studies shall be taken to underpin these impacts. As described above task processes for collaborative work or simply collaborative tasks describe on a certain level of granularity the social interaction of teams while collaborating. It is assumed that impacts of CIT arise differently between collaborative tasks. Because CIT is used in such collaborative tasks, a systematical approach to classify them and one to classify CIT functionalities needs to be found. Together, this helps to build the following relation:

TASK > CIT > IMPACT

Now, which collaborative task uses which CIT tools and which impacts result out of the usage? An empirical study conducting interviews will help to provide initial statistical data to answer this question. These interviews will take place in Swiss financial institutions[6]. In order to gain insights into possible pattern and conflicts of CIT use in organizations, the level of

[5] See 0
[6] See 4.1.1 for underlying considerations

service users (represented by project managers) and the level of service providers of CIT are examined[7]. Because service users may not use CIT as service providers may expect, which could lead to a differentiated perception of impacts. The unit of analysis of the user side is the team, especially the project team, because the nature of projects requires its stakeholders to more or less intensively collaborate, nationally and internationally and the structure and organization of projects is quite similar between organizations. Thus, the user representative will be the head of a project team. The conducted data will subsequently be analyzed and discussed.

1.2 Research Question

The following questions mark the focus of this research:

- Which impacts arise from CIT usage in projects of financial institutions?
- Which CIT functionalities are used in which team task?
- Which CIT functionalities used in a team tasks yield to which impacts?
- Which differences in weighting of impacts result between users and providers of CIT?

1.3 Contribution

For science this thesis provides a research framework underpinned with literature and a research design to conduct an explorative field study. The outcome of this study, gathered in 10 large Swiss financial institutions, is a holistic view of CIT functionalities and its impacts differentiated by team task. Resulting details, like pattern or conflicts of CIT use between service providers and service users, are discussed. Finally, with regard to further research implications to improve the research framework as well as the research design are provided.

1.4 Structure

Chapter 2 provides a literature review of areas required to explore above research question. In chapter 3, a research framework is developed. Next, chapter 4 shows the research design including the examined companies and information about the data collection. Chapter 0 and 6 provide the results and discuss them. Finally, chapter 7 concludes this thesis and chapter 8 provides implications for further research. The appendix and references succeed.

[7] See 3

2 Literature Review

This chapter builds the fundament of the research framework in the next chapter. It consists of two main sections: 2.1 Collaborative Work and 2.2 Computer Supported Collaborative Work (CSCW). In the first main section concepts of collaborative work i.e. social entities (i.e. formations of people who collaborate) and social interaction (i.e. group tasks) are defined and explained. For the purpose of this thesis the focus is on groups or teams working in projects. In the second main section CSCW and collaborative information technology (CIT), a category of information systems which support or (depending on the setup) enable social interaction, so called socio-technological systems, are introduced. Special focus lies on the classification of such systems. Then laws behind the optimal usage of CIT in different situations, called media choice, are presented. Finally impacts of CIT found in literature are presented and underpinned with laboratory or field studies.

2.1 Collaborative Work

In an organizational context, collaborative work occurs primarily within or between the three main stakeholders of a company, the (end) customers, the partners and the employees. In the next few sections the basic building blocks and the interaction between them required for the theory development in the next chapter are going to be introduced. The focus of this section is on collaborative work within organizations and especially in groups or teams.

2.1.1 Social Entities

People working together in an organization to achieve an objective form so called *social entities*. Groups, teams, dyads and also social networks and communities are such social entities. An organization itself is a social entity too. Social entities differ in a number of characteristics e.g. size, cohesion, dependency and aim.

Groups are social entities which consist of a majority of people, who relatively outlasting stand in direct interaction, have role differentiation and common norms and who are connected by a "we feeling"(Rosenstiel 1978, p. 263). The number of people is limited upwards and downwards. According to von Rosenstiel a minimum of three people are

required to detect some important social psychological phenomenon like coalition and decision by a majority. The upper limit is determined by the possibility for direct interaction between the group members and is therefore dependent on the duration a group is built for a certain aim. Direct interaction means that each member of a team can get in contact with each other, either verbal or nonverbal. Von Rosenstiel learned that the upper limit is a number between 15 - 30 people.

Teams are a specialization of groups. In Table 1, some definitions of this term are opposed. Additionally one definition of a virtual team is given.

Definition	Differences
Teams are specified as small groups of interdependent individuals who share responsibility for outcomes for their organizations (Sundstrom, De Meuse und Futrell 1990, p. 120).	• responsibility for outcomes
A team is a workgroup, whose members are willing to achieve a common goal. A workgroup is a group with a common task (Teufel, Muelherr and Bauknecht 1995, p. 10).	• willingness to achieve goal
A Team is a small group of people with complementary skills who are committed to a common purpose for which they hold themselves mutually accountable (Katzenbach and Smith 1993, p. 69).	• common purpose mutually accountable • complementary skills
Virtual teams are groups of geographically, organizationally and/or time dispersed workers brought together by information and telecommunication technologies to accomplish one or more organizational tasks (Powell 2004, p. 7)	• geographically and time dispersed • information technologies to accomplish task

Table 1: Definitions of Teams and Virtual Teams

The terms in Table 1 differ from the definition of groups in that they point especially on some sort of goal commitment. The first definition speaks of responsibility, the second of

willingness and the third of accountability. According to Mills (1993) there is an important difference between the terms responsibility and accountability: If someone has to do a job, he can get someone else to do it, but he is still accountable to produce the results. If the job isn't done right the only person to blame is him, because even though he has delegated the responsibility, he is still accountable. An additional part in the third definition is "complementary skills", which describes a quality of the members of a team. Gross und Koch (2007, p. 25) argue further that team members have to know each other and must have a common understanding of the joint work. Additionally they must have a shared definition of objectives and sub objectives and they must commit themselves to the goal attainment.

A virtual team differs mainly in that the members are distributed in either a geographically or a timely manner or both. As shortly described in the introduction, virtual teams are challenging because things like cultural differences, (technical) communication issues and inconsistent training among group members hamper effective collaboration. Powell (2004) provides a good overview of late research in this area.

To complete, dyades are social entities which consist of exactly two members (Gross and Koch 2007, p. 25). Such a formation can occur for instance if two persons having a meeting to decide something or do some work together.

Literature often does not distinguish the terms "group" and "team" exactly according to the above definitions. Within this thesis they are maintained as originally proposed by the authors but understood as synonyms with emphasis on the achievement of a common goal.

In addition to those social entities social networks and communities gain more and more popularity since real time interaction and user friendly interfaces on web platforms are possible (keyword Web 2.0). A social network consists of a finite set or sets of actors and the relation or relations defined on them (Wassermann and Faust 1994, p. 20). An example for a social network platform is Facebook (www.facebook.com). *Communities* are conceptually similar to social networks. A community consists of a certain amount of people, who voluntarily share a topic for a period of time. Based on social interaction with face-to-face meetings they develop a corporate feeling. (Back, Gronau and Tochtermann 2008, p. 64)

2.1.2 Social Interaction

Social interaction describes interaction within or between social entities. In general, three basic types can be distinguished: communication, coordination and collaboration.

Teufel, Muelherr and Bauknecht (1995, p. 12) define briefly, *communication* as comprehension of several persons among themselves. Gross and Koch (2007, p. 53) suggest quite similar that communication is the mutual understanding of people through the exchange of information. Research divides it primarily in verbal and non-verbal communication. Non-verbal communication can be further divided into vocal and non-vocal. Non-verbal communication refers to actions as distinct from speech, thus it includes according to Mehrabian (1972, p. 1) facial expressions, hand and arm gestures, postures, positions, and various movements of the body or the legs and feeds. Non-verbal communication enriches, but also enhances the complexity of communication, which may lead to misunderstandings between communicating parties. Schulz von Thun (1981) approached this area of conflict in his famous four ears model. If through mediating technology non-verbal communication is not transmitted or only limited transmitted, communication i.e. understanding between parties may be restricted.

As depicted in **Fehler! Verweisquelle konnte nicht gefunden werden.** communication is part of coordination and concerns the combination of parts to achieve the most effective or harmonious results (Thompson 1967). Gross and Koch (2007, p. 53) confirm this by saying coordination aims to find the best way for the arrangement of task-oriented activities and for the allocation of resources. Coordination thus focuses especially on the dimensions time and space (place).

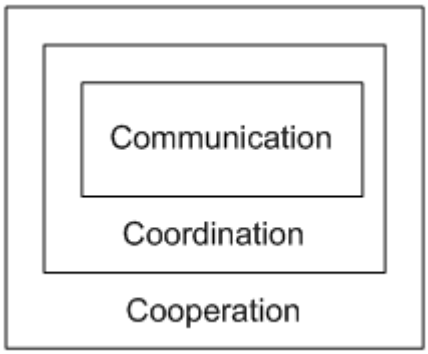


Figure 2: Relationship between communication, coordination and cooperation (Teufel, Muelherr and Bauknecht 1995, p. 11)

A third form of communication is *collaboration or cooperation*. Both terms appear in literature and are used here as synonyms. Collaboration[8] is composed of the Latin terms "co-" meaning "with or together" and "laborare" meaning "to work", thus working together or cooperating. As seen in Figure 2 collaboration includes communication and coordination. Collaboration describes the communication, which is required to coordinate and to agree on common goals (Teufel, Muelherr and Bauknecht 1995, p. 12) or as suggested by Gross and Koch (2007, p. 53), collaboration incorporates a common goal and the work on a common artifact. Especially the emphasis on "the work on common artifacts" distinguishes collaboration from coordination and makes it the supreme discipline and a great challenge of teams who socially interact. Greenbaum (1988) has called it an intrinsic value of human being, as cited at the beginning of the introduction of this thesis.

Collaboration can be distinguished in co-acting, interacting, contra-acting (Scharmann 1972). Collaboration is co-acting if each individual independent of the others can work on piece of a task. The results depend only on the motivation and the capabilities of the person itself. The success or performance on a social entity is the sum of its parts. Interacting collaboration means collaboration between individuals is required in order to successfully perform a task. A mistake of a member affects the overall performance. Finally, contra-acting is if diverging goals need to be harmonized or if consensus is required of contradictory opinions. In this thesis only the later two forms of collaboration are regarded, because intensive social interaction is required to reach a goal.

[8] This term is negatively coined in human history. In this thesis its meaning is restricted to the cooperation between individuals of organizations as part of our economy.

Collaboration in teams or groups, so called *collaborative work* or *group work* has been deeply explored. Teufel et al. (1995, p. 11) define that "group work is the sum of all task-related activities, which are executed by group members in order to fulfill goal-oriented tasks and so goals of a group". Tasks are thus central to collaborative work. The next section looks at tasks occurring in collaborative work situations. At first the term "task" is defined. Then several approaches to classify group or team tasks are presented and opposed.

2.1.3 Classification of Team Tasks

The term *task* can be stated as the actions carried out by individuals in turning inputs into outputs (Goodhue and Thompson 1995, p. 216). As stated in the end of the previous section, tasks occurring in collaborative work are called team tasks. *Team tasks* are characterized as a portion of interaction that involves informally assumed goals as well as assigned jobs (to team members) (McGrath 1984, p. 14).

Classification schemas describing systematically team or group tasks are rare. Still, many trials were made to bring real world team or group actions in order. Daft and Lengel (1984, p. 357) distinguish in their research of media choice two characteristics of tasks: uncertainty and equivocally. Uncertainty means the difference between the amount of information required to perform a task and the amount of information already possessed by an organization (Galbraith 1973). Here, a member of a group can ask questions to get the missing information. Equivocally or also called ambiguity on the other hand, is the existence of multiple and conflicting interpretations about an organizational situation (Daft and Norman 1981, p. 208). A member of a group may not even ask questions, because he does not know what to ask to solve a problem.

Dennis and Valacich (1999, p. 3-4) complement these task characteristics of Daft and Lengel and speak of task independent communication processes: conveyance and convergence. To resolve a problem of equivocally conveyance of information is required. Conveyance aims to distribute or disseminate information and obtain as much relevant information as possible to aid in understanding the problem. Once this has happend, the collected information needs to be interpreted by each group member in order to get a shared understanding. This communication process is called convergence. In Figure 9 conveyance is described as a task of idea generation and convergence as idea assessment and selection.

Goodhue and Thompson (1995, p. 221-222) differentiate between three characteristics of tasks within an organization: non-routineness, interdependence and job title. Non-routineness is a measure for the lack of analyzable behavioral patterns when observing people at work. Interdependence is the degree to which collaboration with other individuals (e.g. team members or employees of other organizational units) is required in order to fulfill a task. Tasks are also characterized by job titles. People on different hierarchy levels may perform differend kinds of tasks. To compare with above task characteristics, non-routineness tasks contain a certain amount of uncertainty and equivocally, because you cannot draw on experience. Conveyance and convergence of information may be necessary to achieve the goal of such a task.

Wood (1986) explores another distinguishing aspect of tasks – its complexities. He states in a theoretical model that tasks can be distinguished by their complexities. The means for differentiating these complexities are three essential components: (Required) Acts, information cues and products. Acts are patterns which form the basic unit of behavioral requirements. Required acts represent basic task components which are required for task completion. Stimuli that are used to make discriminations during task performance are called cues. Information cues are pieces of information about the attributes of stimulus objects upon which task performers can base the judgments required for task completion. Acts and information cues are task inputs. Products are the measurable results of task related acts (task outputs) which can be used to identify and differentiate tasks. Wood derives three types of complexities: component complexity, coordinative complexity and dynamic complexity. *Component complexity* is the number of distinct required acts and information cues. The larger the number of these components and the lower the component redundancy (degree of overlap) the more complex is a task. *Coordinative complexity* is defined as the relationships between information cues, acts and products and depends upon the intensity of interactions between and the height of the component complexity. Finally *dynamic complexity* means the changes in the relationships between task inputs and products and is measured as the stability of the task input-product relationship. Such changes may influence the required skills and knowledge needed for completing a task.

Wood's follows a systematical approach which is quite impressive. Hiscomplexities and the task characteristics of Goodhue and Thompson are to some extend related. Wood's component complexity could be used to analyze and measure task complexity of job titles within a team or a unit and vertically along the different levels of authority. His coordinative complexity would suit to describe the interdependence between collaborating partners like teams or departments, measured by the required acts, information cues or products. Finally, Wood's dynamic complexity could be used to analyze and measure the changing relationships of non-routines of the components of a task.

The described task characteristics focus on different important aspects of tasks, but they do not exclusively point on collaborative work i.e. they do not cover the range of collaborative social interaction happening in this kind of social entity while heading to reach an objective. The following classification schemas focus on such a perspective and are suitable for experimental team research.

Hackman (1968, p. 164) concentrated in a large study to explore the nature and differences of task types. He distinguishes three types of group tasks. The first task is called *production*. It is related to tasks asking groups to be creative i.e. generate ideas, which is conveyance in the words of Dennis and Valacich. The second task type is called discussion. It focuses on discussions of values or issues, usually with a requirement of group consensus. The third task type is called problem-solving. It refers to tasks asking the group to describe how to carry out some plan of action. Discussions as well as problem-solving could be related with convergence of Dennis and Valacich. Hackman had 108 three-man groups generating products by fulfilling such tasks. Results indicate that problem-solving tasks were characterized by high action orientation (a certain course of action which has to be followed to be successful or interpreted by Wood an orientation on acts and relationships), production tasks by high originality (degree to which ideas are fresh and unusual as opposed to obvious and mundane) and discussion tasks by high issue involvement (degree to which a product implies a particular point of view regarding some issues). Hackman used this and further results of this study to develop a general framework for the description and analysis of group tasks, which he published one year later (Hackman 1969).

Hackman provides with his task classification and the empirical study an important basis toward a classification of group tasks. It regards most of the task characteristics described previously and it takes into account the relation to real world collaborative work situations. But it is still quite coarse in that Hackman does not distinguish which kinds of discussions are made or which problems are solved.

The classification schema of Joseph McGrath (McGrath 1984, p. 53 - 66) builds on Hackman (1968), Shaw (1973), Laughlin & Komorita (1976) and more and fulfills above requirements. It is used by a large community of scientific authors. McGrath calls his classification schema the Group Task Circumplex (see Figure 3).

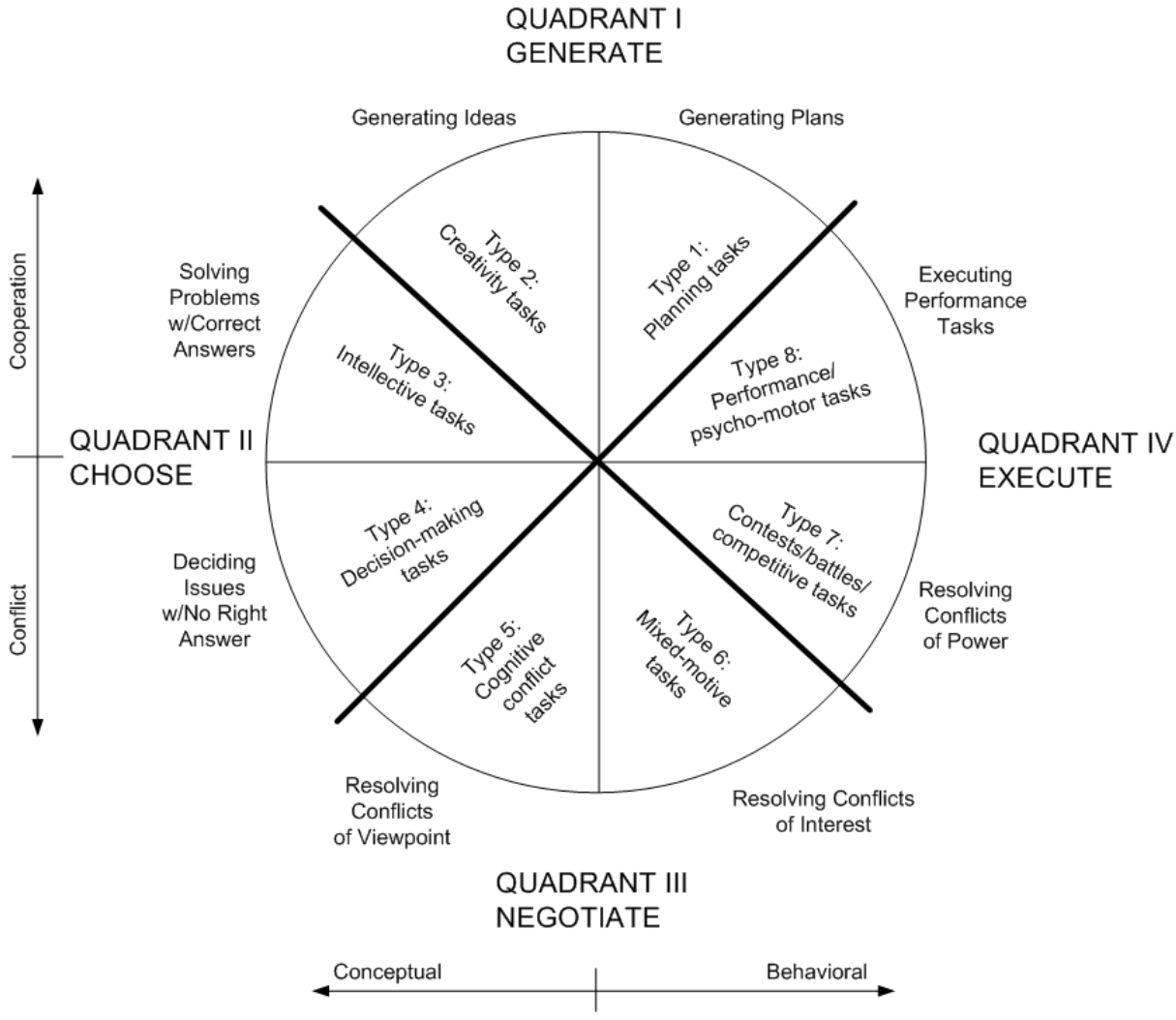


Figure 3: The Group Task Circumplex (McGrath 1984, p. 61)

This is an integrated system which describes systematically the different types of tasks under the focus of group performance. This means McGrathsees groups as task performance systems and explores the different task types under this view point. The circumplex is divided into two dimensions: the horizontal axis divides tasks into the conceptual and behavioral dimension while the vertical axis divides it into conflict and cooperation. Conceptual means a task entails conceptual or cognitive performance requirements (e.g. choosing from a bunch of alternatives). Behavioral on the other hand means that performance requirements are based in the behavior of the group or an individual (e.g. perform a task in a given time frame). The vertical axis reflects the degree to which the task is cooperative (e.g. by generating ideas) or conflictual (e.g. by discussing about open issues).

The following is a summary of the chapters dealing with group tasks. Example studies or theoretical concepts and practical examples are given to underpin the descriptions of the task types. The practical examples are taken from a team at the University of Zurich working on a project which is about the development of a tool to support bank advisory. First of all the project manager develops together with his team a project plan for the development of a bank advisory tool on a brand new multi-touch table called Surface. Because this tool is pioneer work, uncertainty and ambiguity are present. While the team is working on the design of the user interface, the generation of ideas is required. Several alternatives of the user interface results. The group needs to decide which design suits best. The team members discuss this issue and bring different viewpoints into the discussion. After the design phase the tool will be implemented. The work requires much team interdependency to be efficient. At some points in the development phase discussions between experts are required to find software bugs. The aim of a project manager is to steer a project to meet the milestones. Imagine a member of the project team e.g. a software engineer was bought in. He is paid by effort (person days). Discussions about different interests between the internal team members and the external could occur. Additionally, the project team as a whole needs to defend its project from external influences, like getting the budged from a central steering comity to continue with a next phase of the project.

The classification schema is divided into four group processes: generate, choose, negotiate and execute.

Group Process Generate

This process consists of two types of tasks: planning tasks and creativity tasks.

Planning tasks

A *planning task* (McGrath 1984, p. 126 - 130) requires the group to lay out a course of action which is the generation of alternative paths to reach an already chosen objective. McGraths planning task is comparable with Hackman's problem-solving tasks. Some paths may be more effective or efficient and some are less. This type of task neighbors on performance tasks (type 8) in that they both focus on implementation. But this task requires that a solution to a specific problem is worked out in form of a plan of action, usually within a set of constraints. For example, how could you safely change a tire on a busy expressway at night?

Practical example: each team member provides planning information (deadlines, required resources and milestones) about how to go on with the components of the bank advisory tool. After some coordination work between the different stakeholders an (initial) project plan results. It is continually refined in collaboration with the team members to optimally achieve the required objectives.

Creativity tasks

Creativity tasks (McGrath 1984, p. 130 - 136) neighbor on intellective tasks in that they point on cognitive aspects. By performing this task the group generates ideas. This task type is comparable with Hackman's production task.

The Osborn's Group Brainstorming Paradigm (Dunnette, Campell and Jaastad 1963) introduces the brainstorming methodology, which can help a group to generate ideas by minimizing barriers of expression of ideas. As part of the methodology, group members are not allowed to evaluate or be critical of their own or others' expressed ideas, although they may offer ideas that build upon an idea previously expressed (by one self or others).

Practical example: The project team meets for brainstorming on some parts of the user interface. The result is a set of ideas which need to be assessed and refined. Decision-making (idea selection) is not part of this task.

Group Process Choose

The group process choose consists of intellective and decision-making tasks.

Intellective tasks

Intellective tasks (McGrath 1984, p. 67 - 78) have “correct answers” as seen in the mind of experts. Therefore expert consensus defines answers. Logic problems and other problem-solving tasks with correct but not compelling answers belong to this sort of tasks. There is a gradient rather than a sharp difference between tasks with a demonstrable right answer (intellective tasks) and those where the choice of alternative is to be based upon a consensus of preferences (decision-making tasks). The link between is what is regarded as “established fact”. McGrath provides the example: “Once all knew the world was flat. Now the state of knowledge has changed”.

The Twenty Question Task (Taylor and Faust 1952) is an example for an intellective task. Subjects can be individuals or groups. Their task is to determine a target object by asking a series of questions that can be answered “yes” or “no”, with each “no” counting as one question against their score. The aim is to determine the target object with as few “no’s” as possible with the group allowed a maximum of twenty. Group members must agree on each question asked in order to continue.

Practical example: During the realization phase (development) of the bank advisory tool a software bug was detected. Architects and software engineers have to discuss the bug to find a solution.

Decision-making tasks

Deciding issues with no right answer (within the group) is the purpose of decision-making tasks (McGrath 1984, p. 79 - 87). The correctness of a decision is to be defined by the consensus of the group itself (e.g. a jury). But decision-making tasks still can have intellective components or facts. The preferred alternative depends on the way in which the facts are weighted and combined, and that in turn depends on values or points of view (see cognitive conflict tasks) about the subjects. Therefore not one single correct answer but the consensus of preferences is important here.

The Soner-Kogan-Wallack Risky Shift Paradigm (Cartwright 1973) describes a decision-making task. Subjects are asked to indicate what risk level they would need in order to adopt the riskier of two alternatives, for a series of choice dilemma items. The items involve advising someone about relatively desirable-but-not-certain courses of action, rather than less-desirable-but-certain courses, for life events such as job choices, decision about medical treatments, and the like. Subjects are then placed into groups and asked to discuss the issue, to provide a group decision, and to provide post-group individual responses.

Practical example: Several alternatives for the above mentioned user interface are now available. Team members have preferences for the alternatives, but there is no right or wrong user interface. In some points consensus exists. In the end the team needs to decide.

Group Process Negotiate

The tasks of this group process mainly differ in the motives of the outcomes. For cognitive conflict tasks group members cooperate to reach the same objective. In mixed-motive tasks group members cooperate to reach their own personal goal. In both cases negotiation is required. Hackman's discussion task type is comparable with this group process, but as mentioned above Hackman did not provide any specializations.

Cognitive conflict tasks

Cognitive conflict tasks (McGrath 1984, p. 88 - 94) resolve conflicts of viewpoint (within a group). They can be an integral part of decision-making tasks at the point where social judgment e.g. by a jury is required. Group members may differ in their underlying cognitive views of a problem and may disagree on the judgment pattern or judgment policy of its colleges. They disagree in the way to go, but not in the aim to reach. Thus, all want to reach the same goal, but think or judge differently.

The Hammond-Brehmer Social Judgment Theory paradigm (Brehmer 1976) describes a cognitive conflict task. Subjects are assigned to groups and are asked to make a series of decisions. For example, they may be deciding on the suitability of a set of job candidates, stock choices or budget allocation. The members of each group differ from each other in terms of how they view the specific judgement involved. These differences arise either because they have received differential training in an earlier stage of the study, or because

they were selected in terms of their different viewpoints. At first, the subjects are asked to make a set of judgements individually. The experimenter may then give each individual feedback on own and partner's "judgement policies". After this, participants work together in a group, discussing each case until they reach a joint decision on it. Finally, the experimenter provides the correct answer (according to an outside expert), and the group moves on to the next problem.

Practical example: The viewpoints under which the candidates for user interfaces were designed are fairly different. As part of the decision-making process, further discussions are required to understand the judgment pattern (the way how someone thinks) of the others and to reach a joint decision.

Mixed-motive tasks

Resolving conflicts of interest (among group members) is what mixed-motive tasks (McGrath 1984, p. 95 - 113) are. In the previous task types and an ideal world all parties share the same common interests, goals and motives and do not profit at one another's expense. A mixed-motive task is based on conflicts between member's interests and motives. Negotiation is required, but as opposed to cognitive conflict tasks, group members do not want the same outcome for the group as a whole. The best outcome for a member is not the best outcome for one or more other group members. Tasks are such that each member's behavior affects his or her own and other's outcomes (interdependency in outcomes). In order to get desirable results, collaboration between the group members is required.

The Prisoners Dilemma (Rapoport 1967) clarifies what mixed-motive tasks are. The prisoner's dilemma theory is imported for the study of social conflicts in groups. Two players, A and B, are asked to choose one of two alternatives, under conditions where the pay-off that each receives depends on the pair of alternatives chosen. Alternatives are often labeled C (for cooperate) and D (for defect). Pay-Offs are arranged so that if both choose C, each gets a favorable and equal pay-off; if one chooses D and the other chooses C, the player choosing D gets a highly favorable pay-off and the one choosing C gets a very negative pay-off; and if both choose D, both get equally negative pay-offs.

Practical example: The external software engineer might have mixed-motives. He could have the intention to work inefficient to be able to charge a lot. This could delay the project

progress and result in intensive negotiations. As a result and depending on the plan of further collaborations the software engineer defects or cooperates.

Group Process Execute

This group process contains two task types that refer to physical, as opposed to symbolic or intellectual or verbal tasks. The first task type deals with contests and the second type with performance of task execution.

Contests/battles/competitive tasks

This type of tasks (McGrath 1984, p. 114 - 120) focuses on the world outside the group. A group is trying to conquer the other. By performing contests/battles/competitive tasks, one group is trying to resolve conflicts of power with (an)other group(s). Contests are quite similar to mixed-motive tasks in that each party wants to reach their own goal. But they differ from tasks of the prior type in that they do not happen within a group, but between groups. The main objective is winning.

Sherif (1961) illustrates this task type in a study. A set of teenagers, selected to be homogeneous and unaware that they were participating in a research study, spent three weeks at an isolated summer camp. They were divided into two separate living and activity groups and were put into competition by means of a tournament of games (baseball, tug of war, etc.). Later, they were placed in a series of “crisis” (e.g. a breakdown in the camp water supply) in which the two groups had to work together to resolve the crisis.

Practical example: The project team could for example phase two situations in which it has to defend its project:

1. The project costs more than planned. For the next phase more budgets needs to be requested at the steering comity. A competition between other projects begins. The project team needs to fight in order to continue with their project by negotiating with the steering comity.

The project team develops its tool from scratch while an external partner offers a similar tool. Top management has to do a make or buy decision. The project team influences the top management to decide for “make”.

Performances/psycho-motor tasks

The purpose of executing performance/psycho-motor tasks (McGrath 1984, p. 120 -124) is excelling. This means that tasks execution is measured against objectives or absolute standards of excellence. The group carries out activities not in battle against another group but in fulfilling external standards of excellence (or sufficiency). Effectiveness and efficiency (time, cost, quality) are important aspects of this task type.

Friedler (1954) describes in a study a performance task in which only the results (e.g. number of units produced per time, sales per time, etc.) are observed. No data on the performance process is gathered and no observations of performance are made.

Practical example: A milestone consisting of some work packages needs to be fulfilled, e.g. the development of some software components. Discussions are not required any more. In order to be within time, cost and quality the team needs to work together and perform adequately effective and efficient.

That's the Group Task Circumplex. McGrath points out that a task classification should ideally fulfill the following requirements. It should be *mutually exclusive, that is* a task has to fit in one and only one category. But McGrath mentions e.g. that between the intellective tasks and the decision-making tasks there is a gradient dichotomy. This means in some cases it might be hard to distinguish. Then it should be *collectively exhaustive, which* means that all (real world group) tasks have to fit in some of McGrath's task categories. Last, it should be *useful,* therefore the classification schema should point up differences between and relations among the tasks that otherwise would not have been noticed.

2.1.3.1 Empirical Validation of the Group Task Circumplex

Straus (1999) empirically tested parts of the task classification by McGrath (1984). She used already collected data of McGrath to prove several hypotheses and focused on three types of communication acts: coordination, consensus and process communication. Consensus is divided into agreement, which is defined as approval or endorsement of another member's contribution, and disagreement, which is defined as disapproval or rejection of another member's contribution. Process communication addresses how to go about accomplishing a task. An intellective task for instance could be called "How about if I work on number one

while you work on number two?". Strauss makes three hypotheses. First of all the amount of agreement in group discussions will increase as tasks require greater interdependence. She states for instance that an idea generation task does not require consensus, which results in little agreement and disagreement, and minimal interdependence among group members. The second hypothesis only differs in that she thinks the amount of disagreement (instead of agreement) will increase. The third hypothesis is "The amount of process communication in group discussions will increase as tasks require greater interdependence among members".

In her study she tests an extended vertical dimension of McGrath's Circumplex. Instead of coordination and conflict, she used collaborate, coordinate and conflict resolution. The empirical study of face-to-face and computer mediated groups contained an idea generation, an intellective and a judgment task. Results confirmed all three hypotheses for both sort of groups with only slight differences. The vertical axis of McGrath's is therefore empirically validated. An interesting result is that in computer mediated groups the amount of agreement corresponded to the amount of coordination requirements of a task whereas in face-to-face groups the rates of agreement where constant across tasks. Strauss believes that although the requirements for member interdependence depend on the task in question, participants in FTF discussions need to share the floor regardless of task type.

Further literature about studies, which use McGrath's Circumplex can be found in Powell (2004).

2.2 Computer Supported Cooperative Work (CSCW)

The area in information systems research which is concerned with the intersection of collaborative work and CIT is called Computer Supported Cooperative Work (CSCW). CSCW examines the possibilities and effects of technological support for humans involved in collaborative group communication and work processes (Bowers and Benford 1991). The terms "cooperative" and "collaborative" are used in this context as synonyms. The aim is to analyze social interaction and make technology more effective, efficient and enhance the user experience for collaborative work (Gross and Koch 2007).

CSCW is a multidisciplinary research area. As seen in Figure 4, beside research areas like informatics resp. information systems (e.g. human computer interaction (HCI)) other sciences like sociology, psychology and parts of business administration are involved.

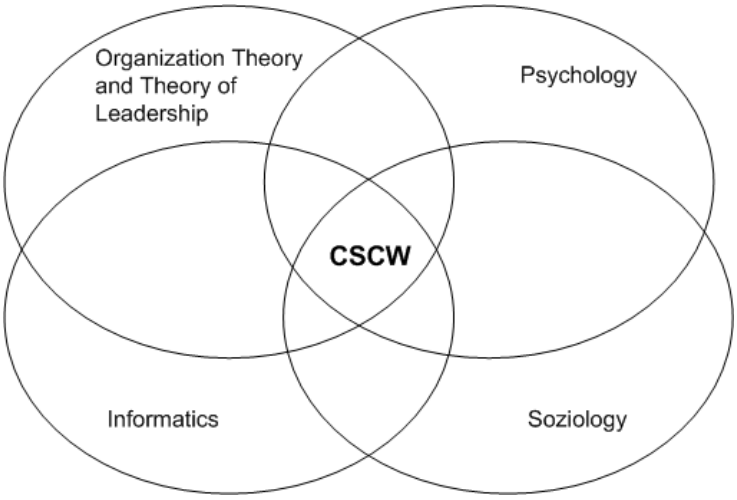


Figure 4: The interdisciplinarity of CSCW (Teufel, Muelherr and Bauknecht 1995, p. 19)

2.2.1 Collaborative Information Technology (CIT)

With the term collaborative information technology (CIT) a category of information systems is addressed which help teams to enable or facilitate collaborative work. Other terms in the literature describing the same category are seen (in this thesis) as synonyms. These are for example collaborative software, collaborative systems, group support systems or groupware. Ellis et al. define this category of software systems like:

Groupware are computer-based systems that support groups of people engaged in a common task (or goal) and that provide an interface to a shared environment (Ellis, Gibbs and Rein 1991, p. 40)

As such, a CIT is a socio-technical system, which is a combination of social systems (e.g. groups, teams and dyads) and technical systems to enable social interaction. Or as defined by Herrmann (2003, p. 60): “a combination of organizational, technical, educational, and cultural structures and interactions”. Gross and Koch (2007, p. 14-15) add to this definition that socio-technical systems are an organized amount of persons and technology, which are aligned and structured to the achievement of certain objectives. In the following section

classifications to this category of information systems are presented and opposed.

2.2.2 Classification of CIT

In the past many researchers tried to classify CIT. The reviewed classification schemas or taxonomies explored different aspects related to this category of information systems. Some of them are theoretical frameworks and some emerged from the analysis of available software products and services. In the following the most famous or often quoted classification schemes are presented.

Time-Space-Matrix

One way to classify CIT is by looking at the dimensions geographical location and time. The Time-Space-Matrix (Johansen 1991) incorporates these dimensions (see Figure 5).

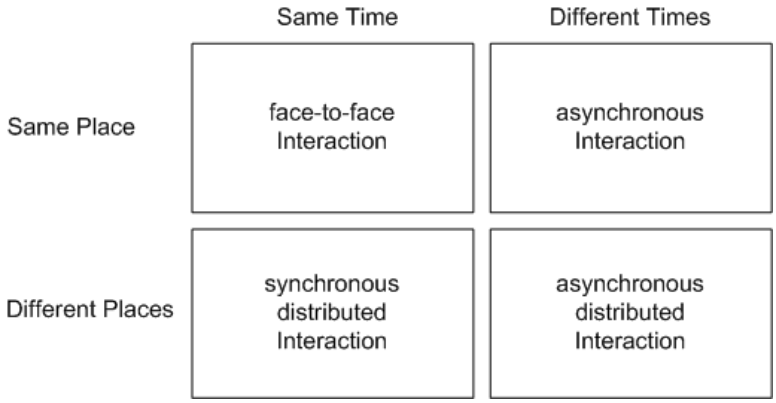


Figure 5: Time-Space-Matrix (Ellis, Gibbs and Rein 1991, after Johanson 1991)

The Time-Space-Matrix is one of the first classification schemas used to classify CIT. Tools supporting e.g. brainstorming or polling belong to the category face-to-face interaction. Asynchronous interaction can be supported through for example shared file drives. In situations of synchronous distributed interaction for example audio or video conferencing tools could be used. Then a famous tool for asynchronous distributed interaction is email. This coarse classification has been cited many times. It illustrates two important aspects especially in a globalized economic world where companies have offices all over the planet. But the underlying processes are not considered. For this, the following classification schema is introduced which looks at the very basic processes of interaction via CIT.

3C Model

The 3C model (Teufel, Muelherr and Bauknecht 1995) classifies CIT according to its degree of support for communication, coordination and collaboration. For this, CIT is arranged in the triangle seen in Figure 6.

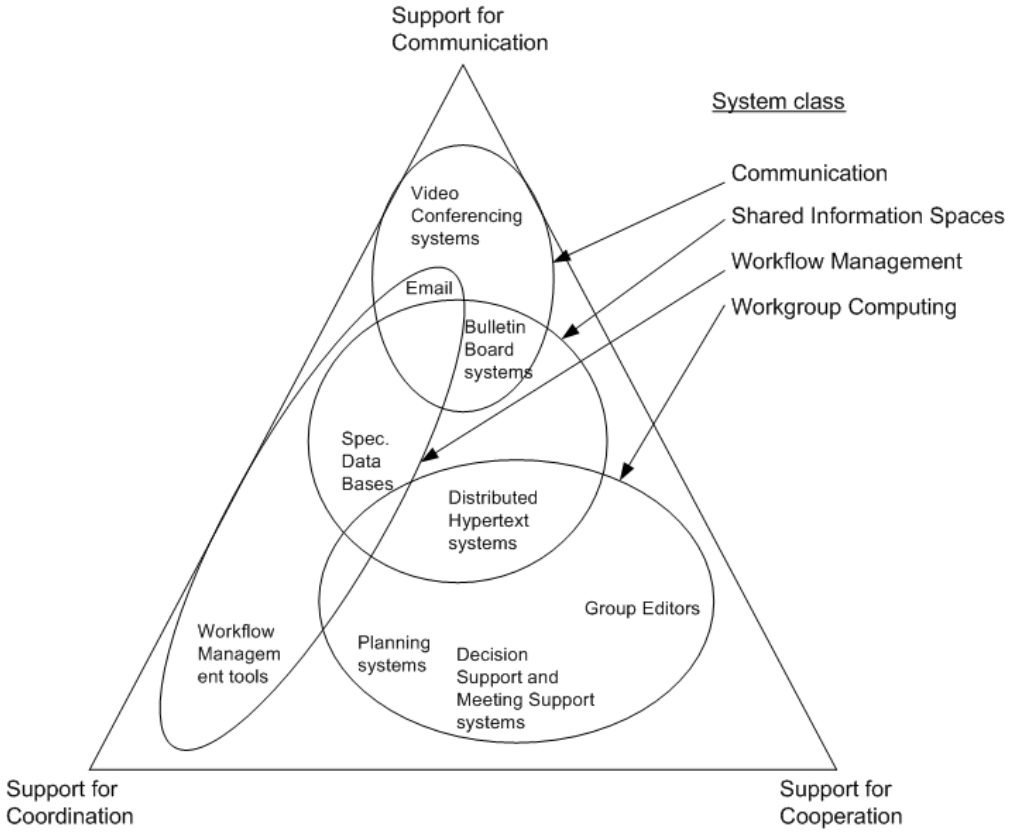


Figure 6: 3C Model (Teufel, Muelherr and Bauknecht 1995, p. 27)

The four described system classes communication, shared information spaces, workflow management and workgroup computing are distributed within this triangle. The system class communication enables explicitly communication partner the exchange of information. Primarily time and space differences are being bridged. The system class shared information spaces provides tools to store and retrieve information in appropriate form. Information exchange is implicitly. The next system class workflow management supports processes in an organization where many actors participate. And the last system class workgroup computing supports groups by fulfilling tasks without strong structures. These classes can overlap each other and the ones more in the center combine functionalities of communication, coordination and cooperation.

This model complements the time-space matrix such that CIT can be spread between the boundaries of three types of social interaction. The four system classes help to further distinguish. There is no obvious negative in this classification schema besides classes only describe CIT up to a quite coarse level. The upcoming classification schemas do not show up a new paradigm to classify CIT but more finely grain the classes. First a distinction on the level of application and second a distinction on the level of functionalities is going to be presented.

Application-level classification by Ellis, Gibbs and Rein 1991

Ellis, Gibbs and Rein (1991) suggested to classifying CIT by its application. But the authors state that because some categories overlap and because the classification is not comprehensive it should only give a general idea of the breath of the groupware domain. This classification schema divides CIT into 7 classes:

- *messaging systems*

  Support the asynchronous exchange of textual messages between groups of users e.g. email.

- *multiuser editors*

  Members of a group can jointly asynchronously or synchronously compose and edit a document.

- *group decision support systems and electronic meeting rooms*

  Provide computer-based facilities for the exploration of unstructured problems in a group setting. The goal is to improve the productivity of decision-making meetings, either by speeding up the decision-making process or by improving the quality of the resulting decisions.

- *computer conferencing*

  Real-time computer conferencing allows a group of users, who are either gathered in an electronic meeting room or physically dispersed, to interact synchronously through their workstations or terminals e.g. text or audio based or by sharing the desktop. Shared calendars belong also to this class.

- *intelligent agents*

  Intelligent agents are daemons running without user input and are responsible for a

specific set of tasks in group supporting systems e.g. providing information about current location and other presence information to all members of a team.

- *coordination systems*

  Allow individuals to view their actions, as well as the relevant actions of others, within the context of the overall goal and may trigger users actions by informing users of the states of their actions and their wait conditions, or by generating automatic reminders and alerts, e.g. a ticketing system.

Compared with the 3C model, this classification actually describes the items which are ordered inside the 3C model. A weakness of this classification is how the classes have been build and what the relations between them are. But as the authors stated, it is only intended as an inventory of what CIT applications were available at that time. The following classification schemas distinguish CIT by looking at its basic functionalities or technology attributes. Many recent studies take this approach to explore the nature of CIT.

Functional-level classification by Bafoutsou and Gregoris Mentzas

Bafoutsou and Mentzas (2002) analyzed software products to survey their common functionalities. For this they analyzed 47 CIT tool products. The following 28 basic functionalities or characteristics arose from their analysis:

- *Bulletin boards* (a message board, where a conversation can be carried on over time)
- *Discussions* (after having posted a subject, a discussion is ongoing either online or over time until the subject is closed)
- *E-Mail and E-Mail notifications* (exchange of text messages and notification about changed project information in the calendar, the to-do list, documents or new activities in the group)
- *Online paging / messaging* (instant alerts on the user's screen, serving as informal messages or notifications about scheduled meetings, etc.)
- *Chat* (real-time text talk, where messages appear on both users screens)
- *Whiteboards* (allow two or more people to view and draw on a shared drawing surface used for discussing or describing objects, which are difficult to verbalize)

- *Audio/video conferencing* (use of audio or video to enhance human presence in meetings to discuss visual information or providing a view of activities at a remote location)
- *Task list* (list of actions to be performed, pending activities, unresolved problems and scheduled meetings are kept and the user is notified for new items in the list)
- *Contact management* (an address book is provided, where contact information about meeting participants or project partners can be found)
- *Screen sharing* (both people have the same view of the screen and possibly the remote user can take control of the other user's system. Screen sharing can mean view of the screen is shared or applications too)
- *Surveys / Polling* (decisions are made online, and surveys on different topics are conducted. Occasionally voting results are graphed and disseminated)
- *Meeting minutes/records* (minutes are disseminated among participants, action items are posted, or the team's thoughts are gathered so as to constitute the starting point for subsequent meetings)
- *Meeting scheduling* (creating meeting agendas and lists of issues or using calendars for organizing meetings)
- *Presentation capability* (users can conduct presentations, i.e. show and annotate PowerPoint slides)
- *Project management* (projects and project milestones, meetings, memos and project interactions are tracked. Traditional project management with stand alone project charts (e.g. Gantt) is not considered)
- *File and document sharing tools* (documents and files are available to a group of people to view on a server or attached to an email)
- *Document management* (sharing of documents using functionalities like version control, search, electronic signing and access control)
- *Synchronous work on documents/slides* (files/documents can be edited simultaneously by a number of users, either on each other's screen, or on a whiteboard)

The analysis unveils a rich set of CIT functionalities (or features). Partly the functionalities are dedicated to special application (e.g. polling) and others are held more general purpose (e.g.

email, which could also be used for polling, votes, surveys, etc.). Compared to Ellis et al. it is known that this classification schema is derived from an analysis. But what is still missing are the relationships between these functionalities. Categories and sub categories would help to establish these relationships. For example email and chat could be categorized as messaging systems as in Ellis et al. Further, in above classification notification functionality is dedicated to email. But many other systems could also provide such functionality (e.g. the meeting scheduling functionality could notify a user when a meeting is going to start). The following classification schema incorporates a lot of above functionalities and it fulfills the mentioned requirements.

Functional-level classification by D. Mittleman, R. Briggs, J. Murphy and A. Davis

The classification scheme of Mittleman et al. (2008) is the latest available and only known classification scheme providing categories and subcategories for almost all today available CIT tools in a finer grained manner than the other schemes above. It is based on the analysis of 250 CIT products. According to the author this schema is intended to help users (including managers selecting a product and developers selecting a market niche for their software) to analyze and understand the sometimes complex bundles of capabilities found in CIT products. The classification scheme is divided into 4 categories and 11 subcategories according to their core capabilities and other attributes seen in Table 2.

Capability	Affordances essential to the nature of the technology
Core Funktionality	Primary functionality provided by the tool. This maps to the tool's location within the classification scheme (see Table 2).
Content	Possible content for contributions to a collaboration system are: text, links, raster graphic, vector graphic, and data-stream.
Relationships	Users can establish these kinds of relationships among contributions: collection, list, tree, and network.
Supported Actions	Actions that users can take on structures or relations.
Add	Ability to create structures or relations.
Receive	Ability to receive, view, or read contributions to the system.
Edit	Ability to modify content or relationships.
Delete	Ability to eliminate content or relationships.
Action Parameters	Three key parameters that characterize or modify actions.

Synchronicity	Expected delay between the time one person executes an action and the time other users can perceive the effects of that action.
Identifiability	Degree to which users can determine who executed an action.
Access Controls	The granting or revoking of user ability to execute supported actions.
Session Persistence	The degree to which contributions are ephemeral or permanent.
Alert Mechanisms	The ways participants are notified that something or someone in the system requires their attention.

Table 2: Comparision Schema Attributes (Mittleman, et al. 2008, p. 309)

The classification schema shown in Table 3 is based on this set of technology related attributes. The attributes *core capability* and *content* have mostly characterized the classification schema.

Categories	**Subcategories**	**Descriptions**	**Example**
Jointly Authored Pages		Technologies that provide one or more windows that multiple users may view, and to which multiple users may contribute, usually simultaneously.	
	Conversation Tools	Optimized to support dialog among group members.	E-Mail, Chat
	Joint Document Authoring	Optimized for the joint production of deliverables like documents, spreadsheets, or graphics.	Wiki
	Group Dynamics Tools	Optimized for creating, sustaining, or changing patterns of collaboration among people making joint effort toward a goal (e.g. idea generation, idea clarification, idea evaluation, idea organization).	Idea Management Tool
	Polling Tools	Optimized for gathering, aggregating, and understanding judgments, opinions, and information from multiple people.	Doodle
Streaming Technologies		Technologies that provide a continuous feed of changing data.	
	Desktop/Application Sharing	Optimized for remote viewing and/or control of the computers of other group members.	Citrix
	Audio Conferencing	Optimized for transmission and receipt of sounds.	Skype
	Video Conferencing	Optimized for transmission and receipt of dynamic images.	Skype
Information Access Tools		Technologies that provide group members with ways to store, share, find, and classify data objects.	
	Shared File Repositories	Provide group members with ways to store and share digital files.	Windows Shares
	Social Tagging Systems	Provide means to affix keyword tags to digital objects so that users can find objects of interest, and so they can find others with similar interests.	Flickr

	Search Engines	Provide means to retrieve relevant digital objects from among vast stores of objects based on search criteria.	Google Search
	Syndication Tools	Provide notification of when new contributions of interest have been added to pages or repositories.	Feed Reader
Aggregated Systems		Technologies that combine of other technologies and tailor them to support a specific kind of task.	Skype

Table 3: Classification scheme for CIT (Mittleman, et al. 2008, p. 312)

The categories in Table 3 are similar to Ellis et al. but they to some extend systematically divided with regard to the underlying technology: The first category Jointly Authored Pages has a digital page and the second category has a continuous feed of changing data as its core capabilities. The third category focuses on some data store functionalities. The fourth category *Aggregated Systems* is a mix of tools of the first three categories optimized to support work practices that cannot be achieved with a single technology. An example is the product Skype. It includes a conversation tool (chat), audio and video conferencing. Additionally (with separate plugins) joint document authoring and more is possible. Additionally more modern tool categories like social tagging systems and syndication tools exist. The notification functionality described in Bafoutsou et al. is here listed separately as syndication tools.

2.2.3 Media Choice

This section is concerned with theories about how groups (should) choose CIT tools in daily situations in order to work effective and efficient. The key word is *media choice* which will be used later in the discussion of the results of this thesis.

Media Richness Theory

The *media richness theory* (Daft and Lengel 1986, p. 559 - 560) postulates that for any task there is a medium with the appropriate amount of media richness. Tasks are characterized by a certain amount of equivocally and uncertainty. The key factor in equivocally reduction is according to the authors the extent to which structural mechanisms facilitate the processing of rich information. Information richness is defined as the ability of information to change understanding within a time interval. Information richness of communication media is for example the capacity for immediate feedback, the number of cues and channels utilized, personalization, and language variety (Daft and Wiginton, Language & Organization 1979).

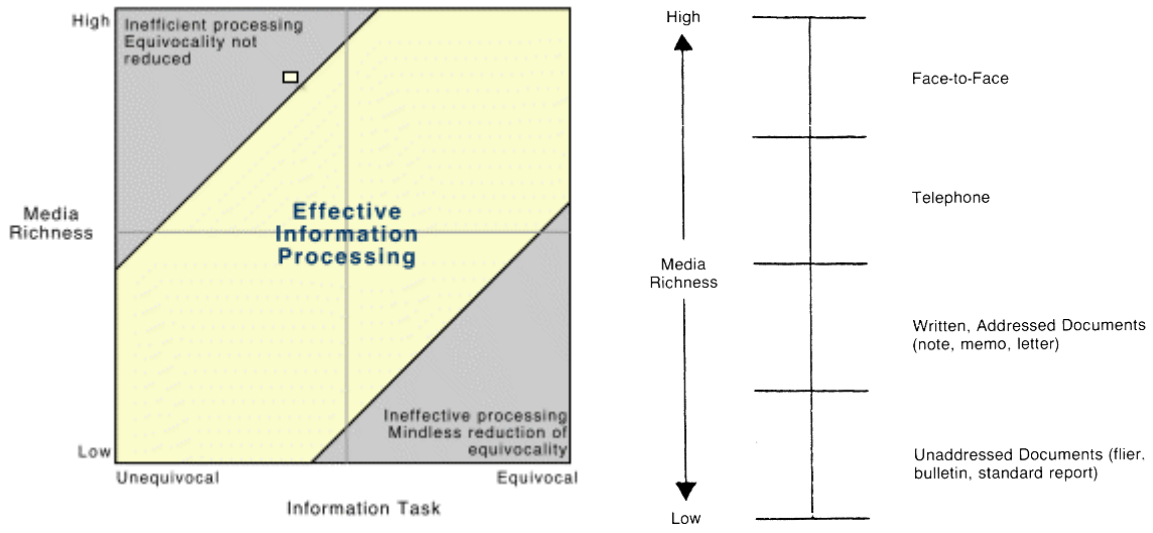


Figure 7: Media Richness (Daft and Lengel 1984) and Hierarchy of Media Richness (Daft et al. 1987)

Now the higher equivocally in a task, the richer the media should be. This law is illustrated in Figure 7. Face-to-Face communication is of high richness followed in decreasing order by video, audio and text communication. Meetings of high equivocally and uncertainty should therefore be hold face-to-face. But the coordination for a meeting could be arranged via email or a group calendar. If on the other hand a task consists of high uncertainty, Daft and Lengel suggest using media which provide a lot of information, like written reports. To conclude, Media richness theory argues that task performance will be improved when capabilities of the media (cues, feedback, personal focus, and language variety) are matched to task equivocality and uncertainty.

McGrath and Hollingshead (1993) combined the media richness theory with the task-technology fit model (Goodhue and Thompson 1995) containing the task types of the group task circumflex. The resulting model can be seen in Figure 8 and is called Task-Technology-Fitness (originally it was called Task-Media Fit on Information Richness). The Task-technology-fit model in a nutshell shows empirically that if there is high utilization of a technology and if a good fit between the technology and the task it supports exists, then this positively impacts individual performance.

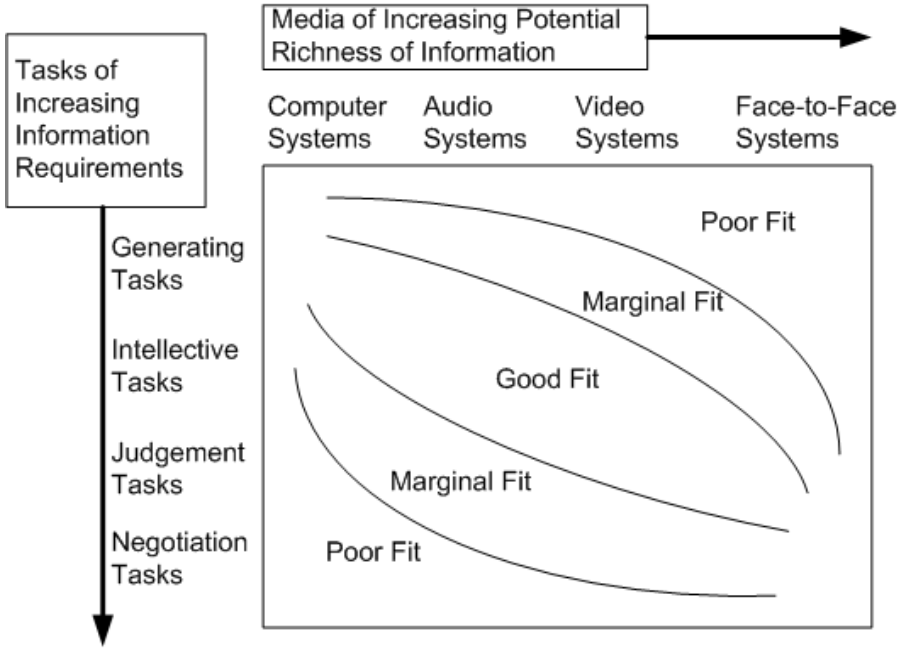


Figure 8: Task-Technology-Fitness (McGrath and Hollingshead 1994, p. 111)

On the y-axis the 4 group processes of McGrath's Group Task Circumplex are listed in increasing order of potential richness required for task success. CIT (including face-to-face) on the x-axis are assessed by its increasing ability to transmit rich information. Good fit results along the diagonal from top left to bottom right. Gupta et al. (2006) empirically tested this model. They conducted a survey in a large oil and gas company in Norway. Over 300 employees participated. The results are shown in Table 4.

Type of tasks	Media			
	SMS	E-Mail	Instant Messaging	Audio (phone call)
Generate: Generate ideas and planning tasks and /or allocate responsibility and deadlines for process.	Poor fit	Good fit	Poor fit	Medium fit
Choose: Make decisions which have clear evident solutions.	Poor fit	Good fit	Poor fit	Good fit
Choose: Make decisions which require consensus, discussion of "best practice" among several possible good answers.	Poor fit	Medium fit	Poor fit	Medium fit
Negotiate: Resolve and discuss different points of view.	Poor fit	Medium fit	Poor fit	Good fit

Execute: Create a dynamic and including atmosphere (dialog and flow in communication) between group members.	Poor fit	Medium fit	Poor fit	Medium fit
Execute: Co-ordinate tasks and work with each other.	Poor fit	Good fit	Poor fit	Medium fit

Table 4: Task-Technology-Fittness model empirically tested (Gupta, et al. 2006)

The Media in Table 4 are the ones used in the gas and oil company. Additionally the authors added McGraths group process "execute", because this setup better fits the task types supported by CIT in this company. The results indicate that participants do not think SMS and chat fit to any of the listed task types. The authors believe that SMS was ranked like this because the underlying technology (display size, storage capacity, etc.) is too weak and that chat has no tradition in this company and was not introduced as an official communication channel. On the other hand participants state that email and audio fit medium or good to all task types. The authors believe that the possibility of easily storing information is the reason why email is seen to have a good fit with generate, choose and execute tasks.

Whether or not those results are representative, the Task-Fitness model shows that the Media Richness theory is an important finding to assess media choice.

Media Synchronicity Theory

Media Synchronicity Theory (Dennis and Valacich 1999) builds on Media Richness Theory and has already been mentioned in section 2.1.3. Dennis and Valacich do not think that media choice is only determined by media richness. In their theory they focus on communication processes and on the media's information processing capacity. Media synchronicity is the extent to which individuals work together on the same activity at the same time. It consists of two generic communication processes which make the link between the two theories: conveyance and convergance (Dennis and Valacich 1999, p. 4-5).

Conveyance is the exchange of information, followed by deliberation on its meaning (e.g. brainstorming). Divergent processes lead to a reduction of uncertainty. Low media synchronicity is preferred for it. *Convergence* is the development of shared meaning for information, thus resulting problems or generated ideas are analyzed or assessed.

Convergent processes lead to a reduction of equivocally. High media synchronicity is required. Figure 9 depicts this situation.

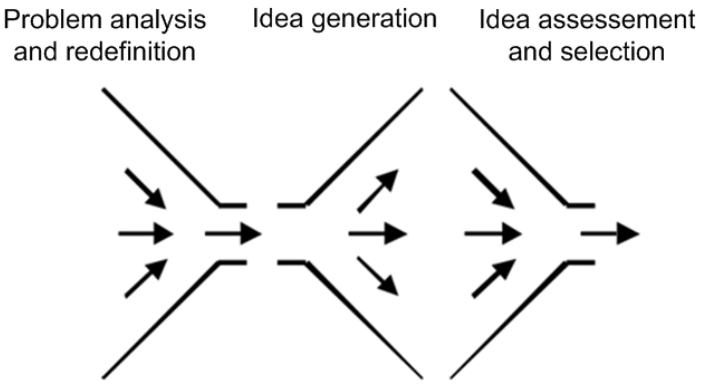


Figure 9: Communication Processes Conveyance and Convergance (Schwabe 2001)

Besides that the Media Synchronicity theory describes 5 media characteristics which can affect communication: immediacy of feedback, parallelism, symbol variety, rehearsability and reprocessability (Dennis and Valacich 1999, p. 6-7). *Immediacy of feedback* is the extent to which a medium enables users to give rapid feedback on the communications they receive. It is the ability of the medium to support rapid bidirectional communication. *Parallelism* describes on how many channels people can cooperate or communicate at the same time by doing different communication processes. *Symbol variety* describes on how many ways information can be transmitted. In other words, on how many channels can information about the same communication process be transmitted? For example chat has a lower symbol variety than face-to-face communication. In chat only text and icons are available. In face-to-face communication vote height, facial expression and more can influence a discussion. *Rehearsability/Revisability* enables the sender to compose a message with the exact meaning that he or she intends. It is probably unimportant for simple messages, but becomes more important as the complexity or equivocality of the message increases because increased rehearsability/revisability will lead to improved understanding. *Reprocessability/reusability* enables the receiver to repeatedly process the message to ensure that he or she accurately understands the message delivered. *Reprocessability/reusability* becomes more important as the volume, complexity, or equivocality of the message increases. Figure 10 illustrates these 5 media characteristics in a communication scenario of 3 sender and 3 recipients working together in parallel.

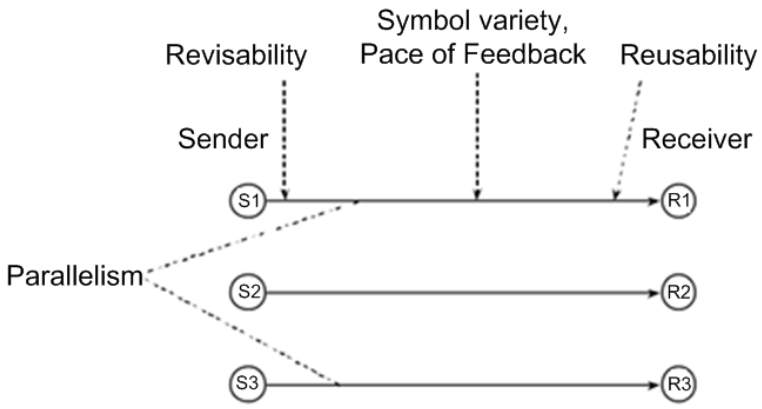


Figure 10: Media properties of the Media Synchronicity Theory (Schwabe 2001)

Based on the two introduced communication processes and the five media characteristics the authors conclude that face-to-face communication is not always the "richest" medium for communication. The "best" medium or set of media depends upon which of these five dimensions are most important for a given situation.

Symbolic Interactionist Perspective

Symbolic Interactionist Perspective (Trevino, Lengel and Daft 1987) enhances the Media Richness theory as follows. Symbolic interactionism is a theoretical approach to understand sociological as well as social psychological phenomena developed by Blumer in the end of the 1960. It means that society is interaction and interaction is symbolic in the sense that it is conducted in terms of the meanings people assign to things. When people interact with one another societiy's values, norms, and institutions are created within the symbolic meanings that have developed. Mapped to organizations this theoretical approach can be applied to communication behavior and it especially helps to understand media choice processes during managerial communication. Because managers working together (e.g. in negotiations) create symbols and new organizational meanings. In an exploratory study of Trevino, Lengel and Daft (1987) 65 managers from 11 organizations were interviewed and asked about the reasons for their media choice. A content analysis unveiled 3 factors which influenced managers' media choices:

- *Ambiguity of the message content and richness of the communication media* (Daft and Lengel 1986)
- *Symbolic cues provided by the medium*
  (According to symbolic interactionism, anything can be considered a symbol and a carrier of meaning. Media should therefore carry symbolic cues beyond the obvious content of the message)
- *Situational determinants*
  (Time and time pressure, distance, expediency, structure or role expectations; the availability of an appropriate CIT tool (e.g. email while traveling))

Thus, the higher the importance is, the higher is the richness, and the higher is the pressure the lower the richness. Further, the study showed that CIT was used only because of situational constraints. Whenever possible, face-to-face collaboration was selected.

The following theories about media choice are only described in brief summary, because they are quite easy to understand:

- *Social Influence Model* (Fulk, Schmitz and Steinfeld 1990)
  Media choice depends on social influence (e.g. own and others statements). Plus subjective considerations play a role too. The more useful media use is perceived, the rather a media is used.
- *Critical Mass Theory* (Markus 1990)
  A communication media is used if one is able to reach the counterparts. Thus, a certain amount of people (critical mass) is required using the same media. The more users possess a communication media, the higher is the value of this media.
- *Channel Expansion Theory* (Carlson and Zmud 1999)
  Experiences made with a communication media positively influences perceived richness of the communication channel established. For example in email and chat conversations smileys are used to substitute missing social signals.

2.2.4 Impacts of CIT

In this section the fundamental elements for this thesis are discussed – impacts of CIT. In total 10 impacts of CIT have been extracted from literature. Due to the limited availability of field or laboratory studies about impacts of CIT, studies focusing on impacts of IT tools in general are incorporated. Depending on the importance, the studies are explained in more or less depth.

Higher project effectiveness

Effectiveness is doing the right things (Drucker 2007, p. 2). Project effectiveness is doing the right things in projects which mean to work in a way to optimally reach project objectives. Hence it is believed that CIT support leads to higher project effectiveness. Qualified studies analyzing project effectiveness of CIT and suggesting this assumption have not been found. Especially not such, where similar projects where performed with different kinds of CITs or with a group using CIT and with a control group without CIT-support. In the literature studies often link effectiveness to other impacts presented in this section e.g. increased creativity of team members or higher quality of work. Such impacts describe effectiveness on a micro perspective e.g. the CIT tool group editor may lead to higher document quality. Project effectiveness contrary is meant to describe effectiveness on a macro perspective. The following studies point on project or team effectiveness, but they either do not unveil all necessary details or they do not focus enough on CIT. Latter means doing the right things in a team.

Pavlou, Dimoka and Housel (Pavlou, Dimoka and Housel 2008) looked at how effective teams are when fulfilling projects. 400 teams in a large multi-national corporation were analyzed. The key measurement in this survey is the construct of 'Collaborative IT Tools Leveraging Capability' (CITTLC). It is explained in detail in Pavlou and El Sawy (2006). CITTLC is the ability of work groups to effectively use the basic IT functionalities of collaborative IT tools to facilitate group work. It is proposed to enhance among other things "project effectiveness". Pavlou et al. argue that better project effectiveness comes from the effective use of email, chat, and conferencing functionality enables work groups to share project knowledge by viewing, discussing, and editing project documents. The results show that the impact of CITTLC on group effectiveness in projects was significant. Unfortunately the study did neither indicate which tasks or group activities the group managers were supposed to look

at nor how the questionnaire looked like. It was also not obvious whether or not the analyzed teams have been compared with face-to-face control groups doing the same tasks. Therefore how “project effectiveness” was conducted in depth is unknown.

In another field study (Lurey and Raisinhgani 2001), virtual teams are explored with regard to team effectiveness. Team effectiveness is understood in this study as team’s performance and satisfaction. Performance is measured among other things in time required to achieve a given task. 8 companies and in total 67 workers in 12 virtual teams were involved. The results indicate that CIT support was seen little important for the success of virtual teams. Factors of higher importance are that team leaders need to establish positive team processes, develop supportive team member relations, create team-based reward systems, and select only those team members who are qualified to do the work. Face-to-face meetings were seen as important to reach interpersonal relationships at the beginning of cooperation.

These studies provide weak evidence that CIT can lead to higher project or team effectiveness. Additionally some background information about the first study is missing. The following study provides more evidence toward project or team effectiveness although it is about operational work.

Lind and Zmud (1995) had the opportunity to conduct a study in a manufacturing firm which has just introduced voice mail to enhance asynchronous collaboration in a network of sales persons. Special about this company and situation is that only two of the five sales regions have migrated to voice mail at that time. This gave the researchers the opportunity to assess the impacts of CIT by comparing the results of a control group without voice mail support. The results indicate that the hypothesis “Sales regions having access to voice mail will outperform sales regions not having access to voice mail” is significant. Performance is measured in number of goods sold in a given time frame. Authors see reasons directly by the convenient and time-saving store and forward nature of voice mail and indirectly by improved relationships between the collaborating stakeholders enabled by the more effective use of written communication media like email.

Studies, conducted in a setup as described above but related to projects, are seen as necessary to gather evidence about whether or not CIT leads to higher project effectiveness.

Increased creativity of team members and higher quality of work

In the analyzed literature creativity is often described as the amount of ideas a team can generate with or without CIT support. More ideas can lead to more sophisticated solutions and higher quality. Therefore the impacts "increased creativity of team members" and "higher quality of work" are seen as interdependent.

Let's start with a laboratory study (Dennis 1996) about decision making in which groups of students received different (but not conflicting) information about the task, which they needed to combine to identify the optimal decision. In total 14 groups each of 10 students participated in this experiment and were assigned to groups using group support systems (GSS) and groups without GSS support. The results show that GSS use increased the amount of information exchanged (or ideas) by 50%, enabling members to exchange sufficient information to identify the optimal decision. But for the majority of groups this increase did not lead to better decisions. Dennis called it a lack of information processing through the use of GSS and argued that humans have a limited amount of cognitive resources and that participants are unable to integrate newly received information into the existing information base. To conclude there is an increase in creativity but not an increase in (decision) quality of the final product.

Löber, Schwabe and Grimm (2007) explored in a laboratory study with students the effect of changes in group size on productivity when using chat or audio conferencing to collaborate. The task context in which these tools were used was an already known design task called "the automatic post office of the future" (J. Olson, et al. 1993). This task consists of planning, creativity and cognitive conflict tasks mentioned in McGraths Task Circumplex (see 2.1.3). Participants were asked to design the post office of the future. This is a task with little uncertainty but a high degree of equivocally. Besides measuring the satisfaction of the participants with a questionnaire, the productivity was measured by a ratio of the time required to fulfill the task and the quality of the task. The quality of the post office design was rated by the number of distinct ideas captured. The results indicate that audio groups up to four members show a significantly higher productivity than chat groups. Chat groups

on the other hand achieve better results when group size is increased to seven. The process of creativity of the audio groups seems to be hindered when the group is large because they have to share the communication channel. According to Löber et al. audio groups behave similar to brainstorming face-to-face groups.

Both studies explore creativity and quality of groups fulfilling certain tasks. The first study only results in higher creativity by comparing CIT supported and non supported groups. The second study shows by comparing groups of different sizes and two different kinds of CIT that higher creativity and quality depends on media choice.

Higher time savings

Another promising impact of CIT is higher efficiency. Efficiency is doing the things right (Drucker 2007, p. 2). In other words, working efficient means consuming a minimum of scarce resources like time, money, goods or human resources. CIT promises to save time.

Lind and Zmud assume in their field study as already mentioned above that one reason for higher sales performance is the time-saving store and forward nature of voice mail. But other influences may have impacted this success.

In the introduced laboratory study of Löber et al. the productivity is calculated by dividing the rated result of the group work by the time needed to complete the task. The results show that a significant improvement of performance with the larger number of group members occurred in the chat groups. It was possible to communicate more ideas in the given time in groups of seven, compared to groups of four.

A similar result with regard to creativity and time savings was shown empirically in the study of Dennis. Decision time was measured by the number of minutes required for the group to reach a decision. Initially the authors made the hypothesis that it takes longer for the GSS groups to reach a decision. But this hypothesis was not supported by the experiment even though more information was available. The explanation for this is that the majority of the groups did not include all the information into their decision-making which saved time. But as mentioned above the decision quality did not increase and so further research is necessary to prove if decision time and decision quality both can be increased through CIT.

Another negative example was reported by Olson. Olsen (1992) examined groups with and without CIT support. They used a group editor which allows simultaneous multi-user document editing. 38 groups each consisting of MBA students had (once again) to design the automatic post office. The results indicate that the CIT supported group produced higher quality and longer documentation about their ideas with more background knowledge to make the ideas understandable to the group. The behavior of a CIT supported group was that after the joint brainstorming session, each of the three members of a group wrote one part of a document. One wrote the introduction while others wrote about costs and benefits of their particular design. But this didn't result in time savings with regard to the unsupported group. The unsupported group stopped earlier with brainstorming to have only one person writing down the ideas. Further the results show that about the same amount of time was spent for planning (e.g. managing the flow of meetings or planning the writing) (11% and 9% for supported and unsupported, respectively). The supported groups spent 7% of their time asking each other questions about the technology because they were unsure or confused. More training probably could have helped to gain better time performance.

Hence, the presented studies show diverse results and do not generalize that CIT leads to time savings. But dependent on the task and the tools used some evidence exits.

Higher cost savings

Studies presenting results regarding direct cost savings through CIT have not been found. But in a stable environment time savings lead to cost economies, because less work staff is required. Since time-savings of CIT are only reported in some situations (Dennis 1996)(Löber, Schwabe and Grimm 2007) (Lind and Zmud 1995), it is not clear if this statement holds.

On the other hand CIT enables virtual teams. If teams collaborate successfully in a virtual setup the need for traveling is reduced. This results in less expenditure for traveling (Pavlou, Dimoka and Housel 2008, p. 3).

Higher parallelization of work

Parallelization of work is assumed to be another important factor to gain efficiency in team collaboration. It means that work can be divided into several packages and be executed at the same time. An example for parallelization is when a team is working on a shared

document using a group editor. Another example is a group calendar or email which can help to coordinate resources to work in parallel.

The group editor scenario is illustrated in the already introduced study of Olsen et al. (1992). In a brainstorming session they spent 10 % of their time doing parallel work. Authors reported that group members supported with CIT used the technology to capture ideas that they never felt compelled to talk about, since everyone could see the ideas as they emerged and comment if they disagreed.

Parallelization is further described in Löber, Schwabe and Grimm (2007). Chat unlike audio enables groups to contribute to a certain topic at the same time. This reflects what Olsen reported. In an audio conference only one person at the time can speak. In a brainstorming session for the design of the automatic post office, students were able to express ideas in parallel. Because group performance in chat conferences is higher for larger number of group members, this enables them as just described to generate ideas and comment on them in parallel.

The issue that in audio conferences only one person at a time can speak called production blocking (Diehl and Stroebe 1987). It significantly reduces the exchange of information because participants are prevented from contributing information. Later in a discussion participants forget or suppress this information because it seems less relevant (Lamm and Trommsdorff 2006).

These laboratory studies indicate that at least for the analyzed CIT tools that parallelization may result from its use.

Higher interruption of work

The meaning of interruption of work in this context is the interruption from executing a primary task (current main task) on behalf of a secondary task (e.g. the arrival of an email or a chat message). The following two studies have explored the effects of such interruptions.

Jackson, Dawson and Wilson (2001) present a field study conducted in a company retailing office solutions about the interruption of work through email notifications called “The cost of email interruption”. It was of great interest to find a way to measure how much a primary task (e.g. writing a document) is interrupted when an email message arrives. For that a

special email client was installed which enabled the researchers to observe employees during daily work. With that tool it was possible to monitor the size of incoming messages, the time it takes to read their subjects and message bodies and the time it takes to reply. Software monitoring the desktop of an employee was installed too. During a period of 28 working days 15 employees were observed. The results show that employees allowed themselves to be interrupted by email as often as by telephone. The recovery time from an email interruption was found to be significantly less than the published recovery time for telephone calls (in average 64 seconds). But the way these employees handled their incoming messages lead to more interruption than with telephone. For example the email client was configured to check every 5 minutes for new emails. With an average reaction time of 6 seconds (which is comparable to a phone call) a high frequency of interruptions resulted.

A study of Microsoft Cooperation (Cutrell, Czerwinski und Horvitz 2000) explores the cost of interruptions through instant messaging. 9 advanced Microsoft Office users participated and were observed during the execution of the following task. Searching for a website in the internet and analyzing the graphic design quality of this website. While participants were performing the search task, they were sometimes interrupted with an instant message notification. Half of the messages were relevant to the current task and the rest was irrelevant. The results show that messages which are relevant to the current task are less disruptive than those that are irrelevant. The authors argue that determining message content prior to notifying the user may be useful. Further the study suggests that notifications received while a user is typing are problematic too. Notifications received while a user is in the evaluation stage and scanning a website for the graphic design quality is also problematic, because of the time required to re-orientate in the website after the interruption.

Both studies illustrate the impact of interruptions. Interruptions are suggested to negatively influence performance i.e. in the given cases more time is required to fulfill a task. Due to the small amount of participants both studies are only seen as explorative. To prove the findings further research is required. But nevertheless the studies suggest interesting issues of CIT functionalities which interrupt at work. To reduce the problem of interruption Horvitz

and Apacible (2003) have analyzed how to minimize the interruption triggered by email notifications.

Higher transparency of work

Functions of CIT enabling transparency of work are for instance a chat protocol, wiki or shared file access. A team member can use these functionalities for example to trace a decision path or to control the work process of a team colleague.

Studies rarely cover this issue with regard to CIT. In the introduced study of Olson (S. Olson, et al. 1992) participants using a group-editor were able to see the work progress of the other team members and use it for their own work.

Another example of transparency of work through CIT is the transformation of implicit knowledge to explicit knowledge, called externalization (Nonaka and Takeuchi 1995, p. 64). Nonaka and Takeuchi report on transparency advantages of customer relationship management System (CRM). CRM systems do not directly belong to any classes of CIT tools (see 2.2.2) but contain CIT functionalities. They enable the transformation of implicit knowledge to explicit knowledge, i.e. for instance discussions of a phone call with a customer can be written down in a database or document and then exchanged (Nonaka and Takeuchi 1995, p. 69). This leads to more documentation effort and the sharing of it in turn leads to more transparency of work. Knowledge as a result can be kept within organizational boundaries even when the knowledge carrier leaves the company.

Higher group cohesiveness

Cohesiveness is an important factor for group collaboration, especially in distributed teams. The term cohesiveness describes the extent to which members are attracted to the group and to each other (Chidambaram 1996). It is associated with greater satisfaction (Chidambaram 1996) and higher effectiveness (Lurey and Raisinhgani 2001). Some studies have found that cohesiveness is higher in teams collaborating face-to-face than using CIT to collaborate (Straus 1997).

Chidambaram (1996) assumed that if teams collaborate via CIT (virtual team), cohesiveness is low at the beginning, but with repeated use cohesiveness evolves over time and can become as strong as between face-to-face teams. This in turn can help geographically

distributed teams to better collaborate. Chidambaram bases his argumentation on two key propositions: 1. Computer-supported teams need longer time to develop close relations compared to face-to-face teams. 2. Over time, users of computer media will adapt the medium to meet their relational needs. With longer periods of interaction, computer-supported teams will adapt the mediated technology to their advantage and can exchange more social information in a given period of time, which will then help them develop relational ties. This means that teams will eventually develop ways of exchanging socio-emotional communication to collaborate successful (Walther 1996). Data for testing the model was obtained from a laboratory experiment with 28 five-member groups. Half of the groups had GSS support, and the other half didn't. The GSS they used allowed them to generate ideas, discuss alternatives and evaluate choices. The groups had to act as a board of directors of a multinational company meeting on regular basis to make decisions. The results supported his propositions.

Better work practices for collaboration

CIT is supposed to have the ability to optimize work processes in collaborative work situations and as such change work practices like organizing a meeting using a group calendar or writing a document using a group editor.

The laboratory study of Olsen (introduced above) about the usage of a group editor (S. Olson, et al. 1992) illustrates how a change in face-to-face work practices took place. An already mentioned side effect is that groups supported by a group editor wrote longer and more detailed documentation about their post office design in order to make their results understandable to the group members. The unsupported group on the other hand just produced a list of bullet points. Another change in work practice in the supported group is that because each group member writes down its ideas individually the others can read them, change or simply comment them or add new ones during or after the ideas are produced.

The psychological effects of the ability to comment or edit the content of others using a group editor is the subject of a laboratory study of Blau and Caspi (2009) about collaborative learning using Google Docs (a web 2.0 based group editor). 118 students attended this study. In the first phase they had to write a summary about a lecture they took. Then those

summaries were randomly assigned to be reviewed. Some students had to only comment and others had to edit the content. Findings indicate that participants in all groups believed that collaboration improves the document quality. But the author suggests that collaborative learning may be improved by encouraging collaboration mainly through suggesting and receiving improvements and less by editing each others' writing.

For the sake of completeness Orlikowski (1992, p.369) mentions in a field study which was conducted in large service firm which just had introduced a new groupware system, that no changes in work practices took place, given the constraint that the study was conducted during an early stage after the initial implementation of this tool.

3 Research Framework

In order to approach the research questions asked in chapter 1.2 a research framework is required. The literature review of chapter 2 lays the groundwork for this research framework. Figure 11 shows the main building blocks.

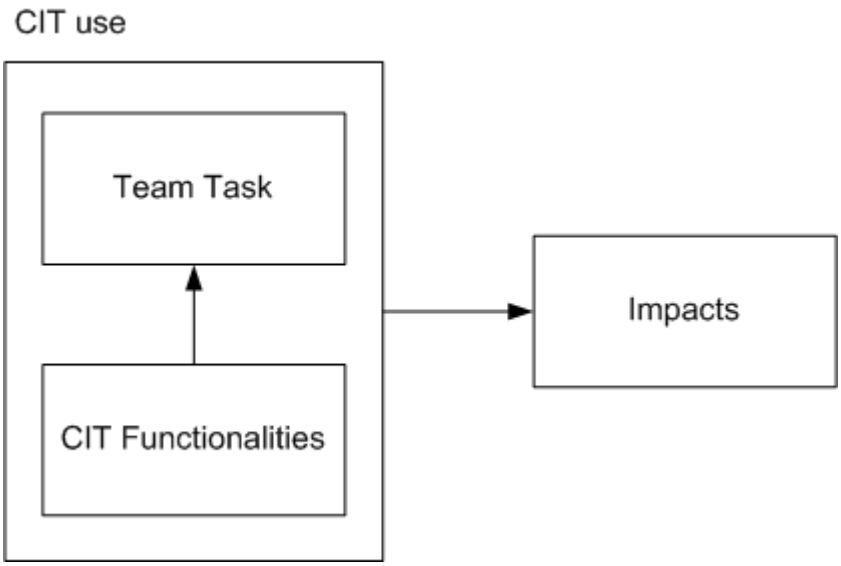


Figure 11: Research Framework (own)

The use of CIT functionalities is constrained to team tasks fulfilled within organizations. As a result of CIT usage in this particular context the impacts arise. These three building blocks are underpinned with literature.

Literature review has shown that the unit of analysis for research of impacts of CIT in organizations has most often been the “team”. This kind of social entity is suitable because members of a team (have to) work together (maybe supported by CIT) to achieve a common goal (see 2.1.1). Thus, they share responsibility. This setup is suitable to analyze impacts. Within the team space, “project teams” are predestined, since project work (opposed to operational work) is often characterized by a high degree of uncertainty and ambiguity, which highlights/(points on) the necessity to collaborate with each other.

Social interaction between team members can be divided into team tasks. Tasks are used in nearly all major areas of behavioral research (Hackman 1969, p. 97). But why are tasks suitable for research of the impacts of CIT? In order to gather information about the impacts of CIT within organizations, people need to use CIT to collaborate. As described in 2.1.2 three basic types of social interaction exist: communication, coordination and collaboration. Figure 2 shows that communication is a part of coordination and cooperation is a part of collaboration. Collaboration can further be separated in co-acting, interacting and contra-acting (see 2.1.2). Both interacting as well as contra-acting collaboration are the suitable form for this research, as CIT functionalities are actively used to interact with each other. With teams as the subject of analysis, “collaboration” (including communication and coordination) - also called collaborative work - as a form of social interaction needs to be divided into acts which teams fulfill in an intraorganizational context in order to analyze impacts of their CIT use. For impact research a diversity of acts is required which describe how teams collaborate. Literature describes such acts in tasks or better classification of team tasks. *Team tasks* are characterized as a portion of interaction that involves informally assumed goals as well as assigned jobs (to team members) (McGrath 1984, p. 14). In 2.1.3 classifications of team tasks are presented. The distinction in tasks of uncertainty and equivocally or in (processes) of conveyance and convergence is coarse and does not focus on teams i.e. these classifications do not focus on team collaboration in particular. The same holds for the fragmentation in non-routineness, interdependence and job title, and different types of complexities. Hackman (1968) with his three types of tasks, called production, discussion and problem-solving, does more likely describe what teams do collaboratively on day by day basis. But this classification is still too coarse, because the difference between what is to be produced, what is discussed or which types of problems are solved is not clear. The Group Task Circumplex by McGrath (1984) builds among other things on Hackman and

fills these gaps. This classification schema accomplishes the requirements best (and is recognized by a great number of authors). Thus, the team tasks for the research framework are:

- Planning tasks
- Creativity tasks
- Intellective tasks
- Decision-making tasks
- Cognitive conflict tasks
- Mixed-motive tasks
- Competitive tasks
- Performance task

CIT functionalities are the second building block of this research framework. Collaborative work can be performed face-to-face or virtually. Face-to-face collaborative work without CIT support is not further regarded here. To conduct impacts resulting from CIT – in analogy to team tasks – a systematical classification i.e. down to a level where impacts can be associated with most appropriately, is required. Many researchers already tried to classify CIT (see section 2.2.2). The Time-Space-Matrix divides it into two dimensions (time and space (location)), the 3C Model divides it into 3 dimensions (support for communication, coordination and cooperation) and application and functional level classifications divide CIT even further. A reasonable number of dimensions are suitable, in order to infer impacts to its triggers. An application level classification is still quite coarse and does not distinguish functionalities (e.g. groupware system instead of email, chat, calendar, etc.). A Functional level classification accomplishes the requirements most appropriate. The approach of Mittleman et al. (2008) is a recent published functional level classification (see 2.2.2). It is to mention that the authors use the term “tool or system”, but because of their low level of composition, they are regarded as functionalities. For the use in the research framework the elements of this classification are slightly renamed, reordered and one additional item is added. The mapping is shown in Table 5.

CIT functionalities of the research framework	Classification of Mittleman et al. (2008)
Conversation Functionality	Conversation Tools
Audio Conferencing Functionality	Audio Conferencing
Shared File Repository Functionality	Shared File Repositories
Group Scheduling / Coordination Functionality	-
Video Conferencing Functionality	Video Conferencing
Polling Functionality	Polling Tools
Search Functionality	Search Engines
Joint Document Authoring Functionality	Joint Document Authoring
Desktop Sharing Functionality	Desktop/Application Sharing
Group Dynamics Functionality	Group Dynamics Tools
Other Information Access Tools	Syndication Tools, Social Tagging Systemes

Table 5: Mapping between CIT functionalities used in the research framework and Mittleman et al (2008)

The new CIT functionality is “Group Scheduling / Coordination functionality”. A category focusing on the aspect of time and coordination has not been found. It is assumed that this category could be allocated to “aggregated systems”. This category was added, because this functionality allows teams to coordinate with each other. For example, a group calendar or a ticketing system are tools which include group scheduling / coordination functionality.

The third building block of the research framework is impacts. The literature review has unveiled 10 impacts of CIT (see 0):

- Higher effectiveness
- Increased creativity
- Higher quality of work
- Higher time savings
- Higher cost savings
- Higher parallelization of work
- Higher interruption of work
- Higher transparency of work
- Higher group cohesiveness
- Better work practices for collaboration

These impacts are composed by a comparative (to stress the direction of an impact) and an identifier. Except for “higher interruption of work”, these impacts possess a positive character. This list of 10 impacts is not seen as complete but these are the major ones which have already been identified and explored in scientific studies thus they provide a solid ground for this early stage of research.

As described in 1.1 in order to gain insights into possible usage pattern and conflicts of CIT usage in organizations, impacts are analyzed in two levels, the level of users of CIT (called service users) and the level of providers of CIT (called service providers). A conflict is understood as a strong difference between the views of both parties in regard to impacts. The distinction between these two stakeholders is made following Servqual, a widely used standard to measure service quality by stakeholders involved in the lifecycle of a service (Zeithaml, Parasuraman and Berry 1990). Despite the provider-user perspectives, no other concept of Servqual is applied.

To identify differences (usage pattern, conflicts) between these two levels, the view of expectation of the service providers (for what and how CIT functionalities are intended to be used) and the view of real usage of the service providers need to be analyzed. Figure 12 depicts the usage of the research framework on these two levels. The research framework is shown twice, once for service providers (top) and once for service users (bottom). The horizontal line isolates the two levels. The vertical two-sided arrow marks possible differences or conflicts between the two parties.

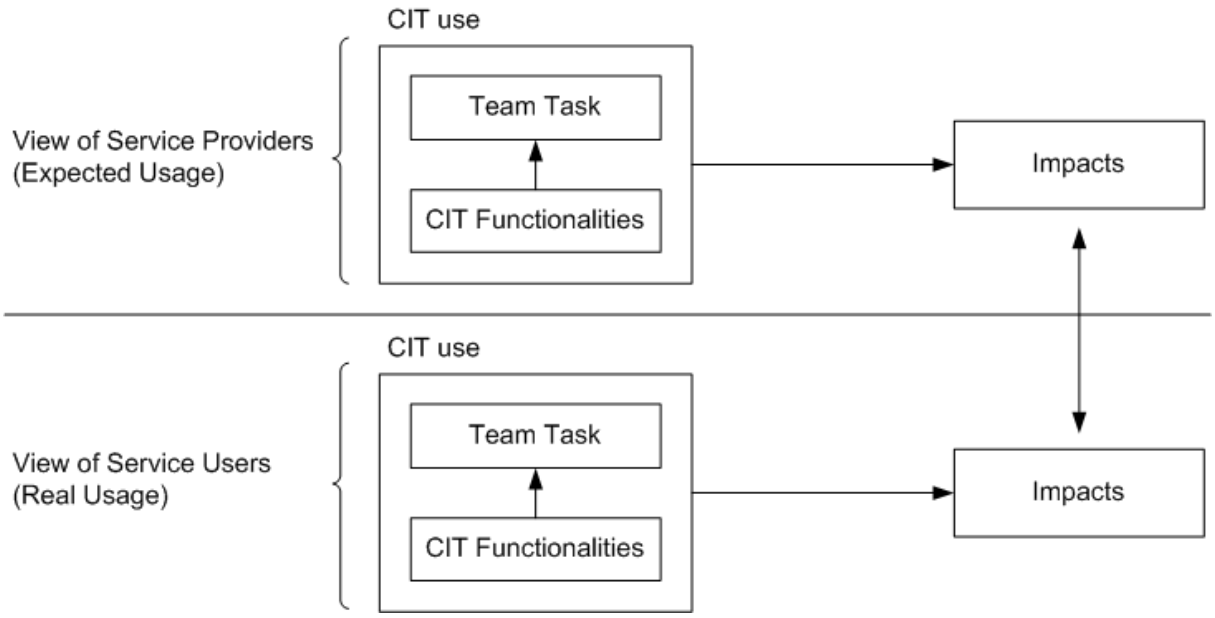


Figure 12: Use of the Research Framework in 2 Levels

4 Research Design

What were done so far are a literature review and the construction of a research framework. Now how to analyze impacts of CIT in intraorganizational teams using this framework and capturing the view of service providers and service users? In order to see what happens in organizations, a field study is required. An observation e.g. of teams working with CIT is not useful, because impacts of CIT may be hard to observe. A quantitative study helping to prove hypotheses would definitely be too early. Central in qualitative explorations is the assumption that social actors describe social situations and not just follow rules and norms. Like this they constitute process-like social reality (Atteslander 2008, p. 70 - 72). A qualitative exploration would be suitable because this allows to directly getting the views of service providers and service users. How to ask these two parties about usage of CIT and impacts? A questionnaire in the form of a survey (e.g. send per email to a large amount of participants without any personal contact) is not sufficient in this early stage where uncertainty and ambiguity in the research topic still exist. This leads to the suggestion, that a personal interview is the most appropriate form to collect relevant information. Because structure

already exists in form of the research model, an unstructured interview would be too weak. Thus, a semi-structured interview is best.

4.1 Interview Setup

The interview consists of two parts, a guideline and a survey tool (software). With the guideline more general questions are asked to gather environmental information about the interview partners and its organization and to provide them an orientation about what is done during the interview. Additionally some further information is gathered on behalf of the research institute. The interview guideline can be seen in appendix B. An interview takes 60 min and is conducted in German. That's to better communicate with the German speaking interview partners.

4.1.1 Sample Requirements

Some constraints to the sample i.e. the companies and the interview partners are made in order to gain consistency between the interviews.

For the assessment of the sample a bottom up approach was chosen. As described in the introduction of chapter 3, two contrary parties – service providers and service users – are interviewed to explore impacts. Because an interview takes 60 minutes, the effort to collect data through interviews should be kept within reason. Therefore only one representative of each party will be interviewed.

Service users are determined by project teams (as stated in the research framework). A suitable representative of a project team has to be involved or perceive the usage and impacts of CIT in team tasks. It is believed that a project manager is the best representative for a project team. Although he might not be ideal – think of the perception of cohesiveness within a team or higher interruption of work – he is the only one who potentially perceives the majority of the found impacts, because he builds the central point of a project team. Requirements to a project manager are the following. To be able to answer the questions of the interview on a qualitatively high level, he must be an experienced project manager, heaving successfully completed at least one project. Then, the current project should be in the realization phase. This might guarantee that his project team works well together and performs, as the stages of group development like forming, storming and norming of

Tuckman (1965) have already passed. Further the project should inherently require intensive collaboration. Software projects for example, or more general Business-IT projects are known for this. CIT tools must be used. The more categories of CIT covered, the better. The last point is the degree of virtuality. At least one member of a project team should be geographically dispearsed.

The service provider on the other side is more difficult to determine, sincesuch an instance isn't elected in organizations (as found out throughout the interviews). Such an authority should optimally be involved in the decision-making process for CIT i.e. during the evaluation, the procurement, the roll out and the operations. As such he is involved during the whole life cycle of such systems. But common in organizations is that there is the IT department, which introduces runs and changes such systems according to the needs of the stakeholders. The organizational development department or the human resource management department provides (in an optimal case) guidelines and trainings to the users of CIT in order to gain high(er) productivity. The board of management or a steering committee is in charge of budgeting investments in CIT. This means that most often there is not one single authority in charge of collaboration including responsibility for CIT-supported collaboration who can be interviewed with questions about impacts of CIT. The best candidate (across all of the organizations interviewed) is a so called head of CIT. Mostly this is a person who works in the IT department and is responsible for running and changing such systems e.g. a head of groupware systems. The head of CIT should also be experienced. This means he should know why the systems were procured and therefore what the expected benefits (impacts) are, he should have been involved in a whole life cycle of a CIT tool, should have received and implemented several requirements from stakeholders (service users) to improve the performance and usage of such systems. The easiest way to find out whether or not someone was qualified for an interview was to send him the interview guideline.

A company in which interviews take place must have its own internal project organization. It is assumed that this increases the possibility that a project team reflects the company culture and its idiosyncrasies. The same holds for the need of an internal IT department with its own head of CIT. This way the head of CIT may fully be involved in the life cycle of CIT tools. Further, an organization (like already required for a project team) should be

distributed to different locations nationally (or even internationally). Because research takes place in Switzerland and especially in Zurich, the service industry and in particular the financial sector offers a large amount of comparable companies which meet these requirements. One reason why financial institutions often have their own IT department is confidentiality.

4.1.2 Impact Survey Tool

To gather information about impacts of CIT from the two parties a software tool was developed, called Impact Survey tool. The Impact Survey tool is built after the research framework and helps to capture impacts of CIT in an interactive way. The tool distinguishes between an interview with a head of CIT and a project manager. The main difference is that the head of CIT is asked about the expected usage and impacts of CIT in team tasks. A project manager is asked about the real usage and impacts of CIT within his team or with stakeholders of a project. Below screen shots depict the screens for the head of CIT, because they include additional features. Where necessary, the differences to the screens of project managers are explained.

The following 4 screen shots of the impact survey tool and additional descriptions help to understand how information about impacts has been gathered. The software consists of two modes: head of CIT and project manager.

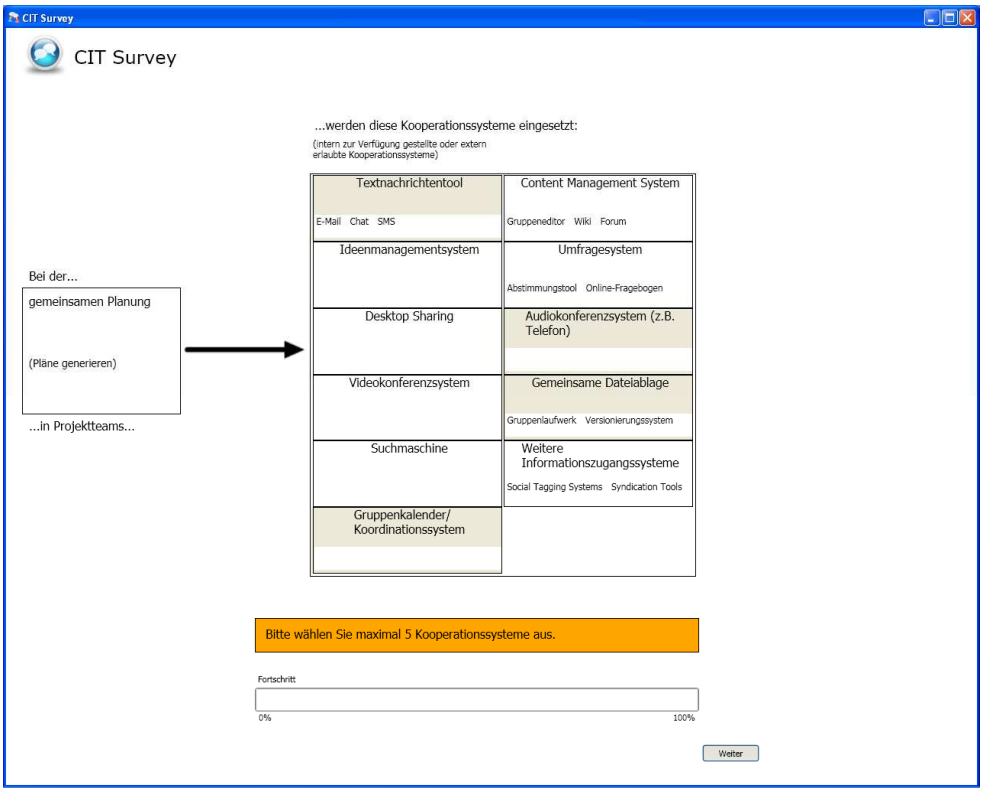


Figure 13: Impact Survey Tool Screen 1

Figure 13 shows the first screen which consists of several parts. A guiding sentence along the top, a task box on the left and a tool box on the right. Additionally there is an instruction and a progress bar at the bottom. The sentence beginning on the left hand side connects one of the 8 team tasks of the research framework at a time in the task box to the task categories of the research framework in the tools box. The instructions are: “Please choose at max 5 CIT tools”. The screen shot shows the following assembledsentence: “Our project teams use for mutual planning the following CIT tools: messaging system, audio conferencing system, shared file repositories and group calendar / coordination system”. A project manager is confronted with the sentence: “My project team uses …”.

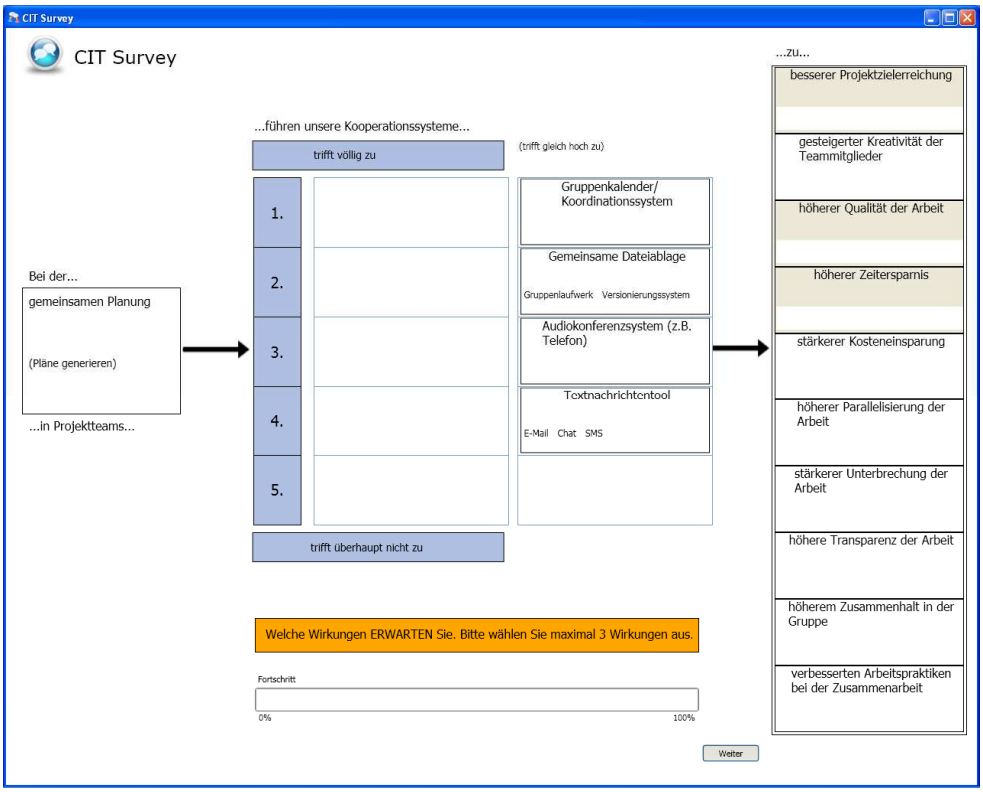


Figure 14: Impact Survey Tool Screen 2

Figure 14 shows the second screen. The setup on the second screen looks slightly different. On the left, nothing has changed. In the center part the chosen CIT functionality categories are displayed. On the right side a list with the 10 impacts from the research framework can be seen. The instruction at the bottom is formulated as: “Please choose at max. 3 impacts which emerge from the selected CIT tool categories in sum when used for mutual planning. A head of CIT is additionally told to only choose impacts which he expects from the usage of CIT tools. The guiding sentence has changed to: “If our project teams use these CIT tools for mutual planning, the following impacts emerge: higher effectiveness, higher quality of work and higher time savings”.

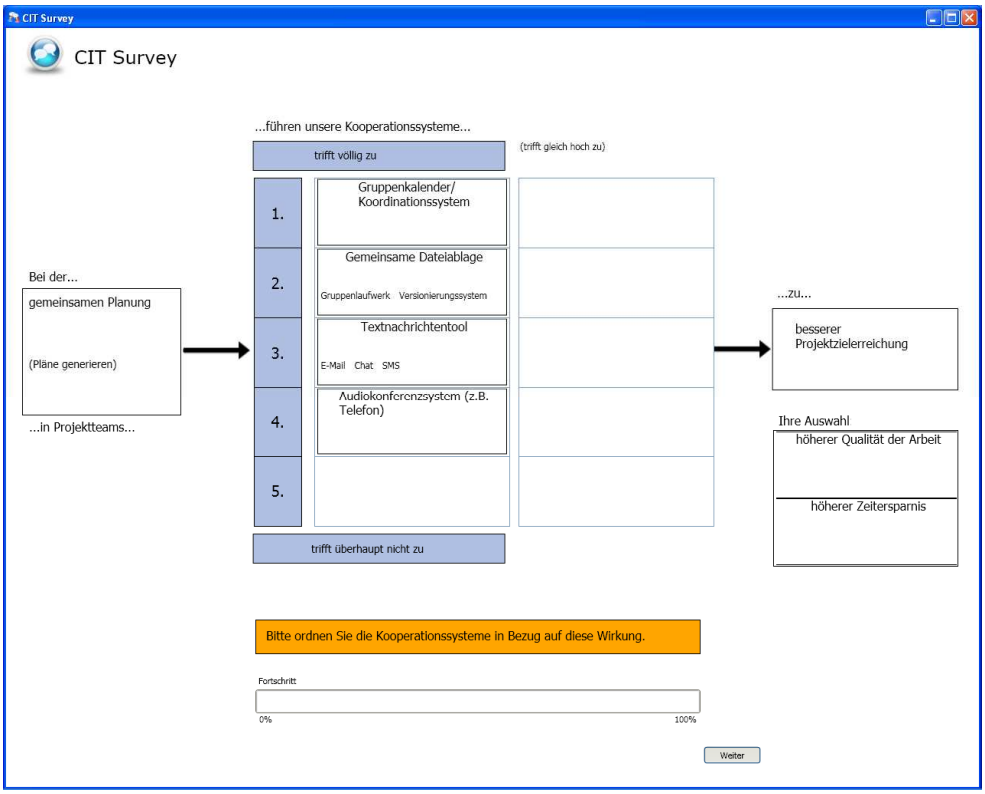


Figure 15: Impact Survey Tool Screen 3

On the left of the next screen (Figure 15) one of the chosen impacts is selected at a time. The center is divided into two 5 field sections. The left section is surrounded by a scale (a 5-point-Likert scale). The top field means that the user strongly agrees that this CIT functionality used in the given task leads at most to the selected impact. A CIT functionality on the second field from the top leads at second most to the selected impact and so on. The right section means that a CIT functionality can lead at equally most to an impact. The instruction bar says: “Please arrange the CIT tool with regard to the impact”.

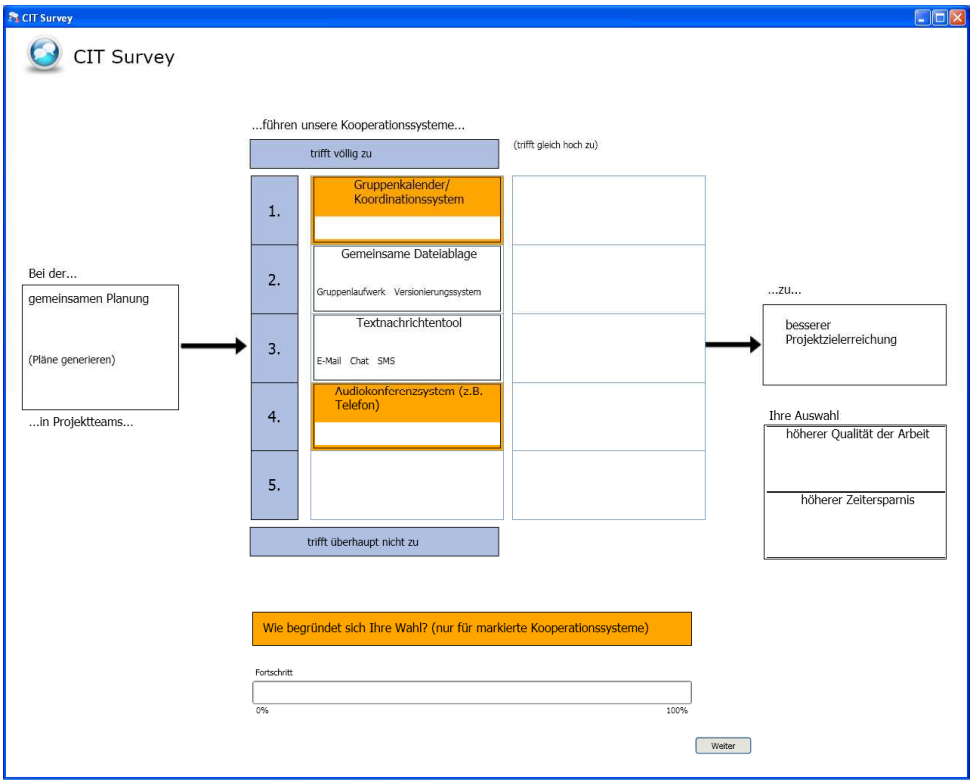


Figure 16: Impact Survey Tool Screen 4

Figure 16 shows that the top and the bottom CIT functionality are highlighted. The instruction says: “How do you explain this arrangement?”. Thus, they have to justify this arrangement. After this step the next round starts with the second of the 8 team tasks.

4.1.3 Pretests

Interview pretests are necessary to determine the quality of an interview. Things like scope (does the interview contains too many questions?), understandability (does the interview partner understands what is wanted to conduct?), methodology (are the means to conduct the necessary information appropriate?) and more can be reviewed with pretests. 7 pretests with head of CIT and project managers of the University of Zurich and SWITCH (a Swiss registrar for internet domains) were conducted. The inputs received from pretests are listed in appendix C.

4.2 Interviews

As soon as the interview guideline and the impact survey tool were finalized the "real" interview partners were contacted. In total 10 companies i.e. 20 interviews were realized.

4.2.1 Companies

The following 10 companies have been interviewed (arranged in alphabetical order):

- Alliance
- Credit Suisse
- Helsana
- Julius Bär
- Swiss RE
- SwissLife
- UBS
- Von Tobel
- Zürcher Kantonalbank
- Zurich

4.2.2 Data Collection

The interviews took place between October 9, 2009, and January 29, 2010 in 10 companies (each time a head of CIT and a project manager), thus in total 20 interviews. 18 interviews (9 pairs) were accepted as valid. 2 interviews were rejected, because those interviews were incomplete. Respondents received the interview guideline with the questions about two weeks before the interview took place. In advance they had to print out the guideline, to read the introduction and to fill it out by hand where asked. This prerequisite took about 20 minutes. The guideline was handed in filled out at the beginning of an interview. An interview took 60 minutes. Impacts were captured electronically by the impact survey tool[9]. The discussion was recorded via Dictaphone. The transcription and consolidation of the data were performed in Microsoft Excel.

5 Results

This chapter presents the results of the field study. An overview of the results is provided in appendix A. Service providers of CIT and service users were interviewed about expected and real CIT usage and the arising impacts differentiated by team tasks. The results show that some significant differences between the two parties exist.

[9] See 4.1.2

Respondents specified on a five-point Likert scale to what extend a CIT functionality used in a team task leads to a certain impact. The resulting consolidated measure is called the level of mean agreement or simply "mean". In each section the results are presented by a graph. The five levels of the Likert scale have the following meaning (in brackets the "height of agreement"):

5	strongly agree	(very high level of agreement)
4	agree	(high level of agreement)
3	neither agree nor disagree	(medium level of agreement)
2	disagree	(low level of agreement)
1	strongly disagree	(very low level of agreement)

m_p stands for level of mean agreement of **p**roviders and m_u stands for level of mean agreement of **u**sers. This chapter is divided into CIT functionalities, then impacts and then team tasks. Results are presented like the following example:

Higher quality

Planning tasks (m_p = 4 [55%, min = 3, max = 5], m_u = 4.5 [22%, min = 4, max = 5])

This statement describes the level of agreement that higher quality arises in planning tasks. In parenthesis at first the level of mean agreement of each party, plus in squared brackets the number of mentions (% of the total number of respondents by one party), thus the number of times one party has chosen a team task CIT functionality-impact-combination. In addition, respondents were told to provide an explanation for the CIT functionalities which they placed on their highest and lowest level of agreement. Cited explanations are presented in *italic*. The citations are marked with (p) is a provider or marked with (u) if a user made the explanation.

It is assumed that the values given by providers and users follow a normal distribution. Because the samples (9 interviews per party) are small, normal distribution is difficult to test[10]. For this thesis, statements about statistical significance are made with a minimum of four occurrences (or mentions) which severely limits the statistical power of this thesis. However, the aim of the work presented in this thesis is to provide an explorative and not a

[10] See http://www.bmj.com/cgi/content/full/338/apr06_1/a3166

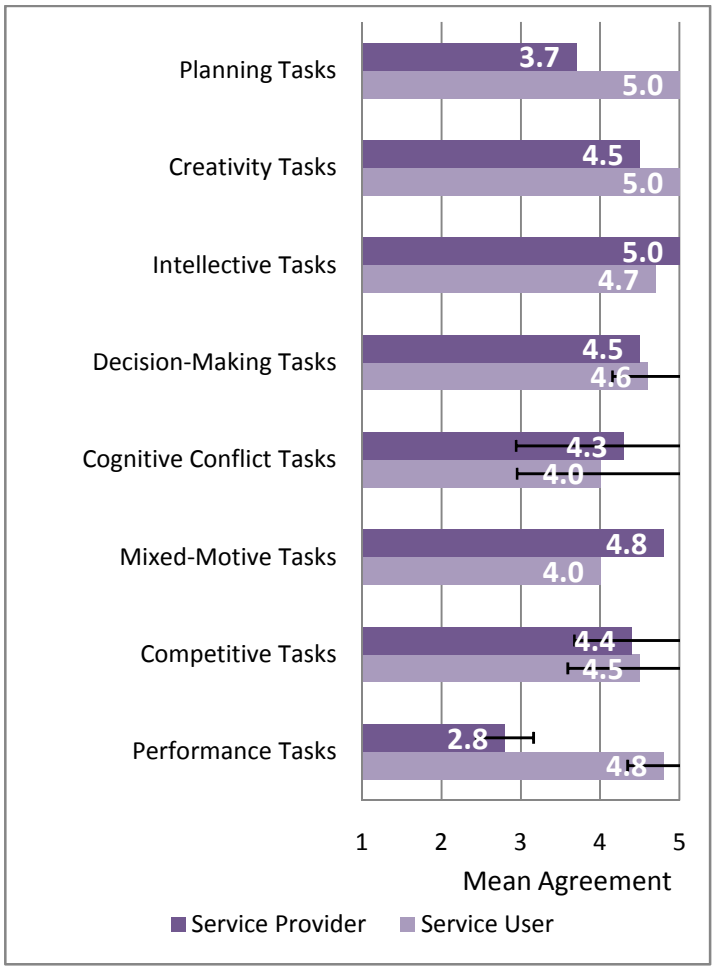
quantitative analysis. The following statistical measures or methods are used to describe this sample:

- Min, Max and Mode
- Confidence Interval (adjusted by a t-factor because of the small sample)
- Two-Sided T-Test

Min, max and mode describe the distribution of agreement values. Confidence intervals show whether or not the differences between the two parties are significant. Such a confidence interval is displayed in the graphs as a horizontal line going left and right at the end of a bar in a graph. The significance level for confidence intervals (and t-tests) is $\alpha = 0.05$. With a probability of 99% the real mean lies between the two ends of this line. In cases where the confidence intervals do not overlap, a t-test is calculated to show that a significant difference between the two means exists. Explanations provided by the users are taken to underpin such a statement.

5.1.1 Impacts of Conversation Functionality (Email, Chat, SMS)

Higher Project Effectiveness



Higher project effectiveness arises in all team tasks. Both parties show for most of the team tasks high or very high means.

Planning tasks (m_p = 3.7 [33%, min = 3, max = 5], m_u = 5 [22%, min = 5, max = 5])

About one third of providers see this impact arise in planning tasks. A provider argues that if you miss a meeting, you still can get informed by conversation functionality about what's happened. The mean is slightly high but the majority neither agrees nor disagrees. 22% of users show a very high mean without any outlier but do not provide any valuable explanation.

Creativity tasks (m_p = 4.5 [22%, min = 4, max = 5], m_u = 5 [11%])

Only a small part of providers and users see this impact arise in creativity tasks but both with high or very high means.

Intellective tasks (m_p = 5 [11%], m_u = 4.7 [33%, min = 4, max = 5])

Similar to creativity tasks (but the other way around), only 11 percent of providers specify a very high mean and 33 percent slightly a very high mean for intellective tasks. A user argues that conversation functionality helps to share knowledge about a project.

Decision-making tasks (m_p = 4.5 [22%, min = 4, max = 5], m_u = 4.6 [55%, min = 4, max = 5])

With regard to decision making tasks, 22% of providers and 55% of users see this impact arising. Providers show a high mean with a min of 4 and a max of 5. The confidence interval for users depicts that they agree or even show a better result that conversation functionality leads to higher project effectiveness when used in this task. A user describes that conversation functionality facilitates sharing of information about decisions made.

Cognitive-conflict tasks (m_p = 4.3 [44%, min = 2, max = 5], m_u = 4 [44%, min = 3, max = 5])

The highest support by now is given for cognitive conflict tasks. About 40 percent of both parties are neither agree nor disagree or show even better results, that conversation functionality leads to higher effectiveness in projects when used for this type of tasks. A user explains that these functionalities help to strengthen one's own position in a conflict. Another one argues that by having constructive discussions (via this functionality) this will help to drive a project forward.

Mixed-motive tasks (m_p = 4.8 [44%, min = 4, max = 5], m_u = 4 [44%, min = 3, max = 5])

The support for mixed motive tasks is the same as for the former task type. Providers show a high mean and values between 4 and 5. A provider, which argues against his provided value, says that one holds the down in writing (an email), since one can be affected to. Users show a bit a weaker result although the mean is still high. But with a min of 3 and a max of 5 they are slightly inconsistent in their agreement.

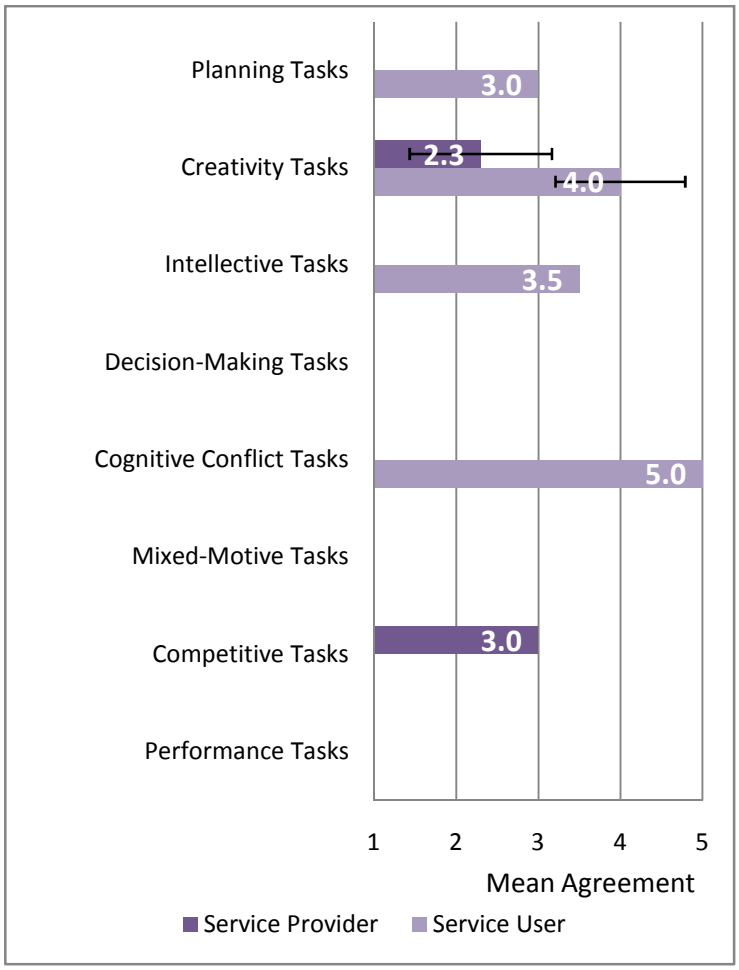
Competitive tasks (m_p = 4.4 [55%, min = 3, max = 5], m_u = 4.5 [44%, min = 3, max = 5])

Competitive tasks are well supported by both parties and according to the confidence intervals both tend to agree that this impact arises. With a support of 55% and a mean of between 4 and 5, providers clearly see the advantages of conversation functionality in this task. One provider underpins this result by saying that one can show the stakeholders textually why a project should be prioritized. Users show about the same mean and distribution.

Performance tasks (m_p = 2.8 [55%, min = 2, max = 3], m_u = 4.8 [44%, min = 4, max = 5])

A first time, providers and users provide a significant difference in how they see effectiveness in projects arise by using conversation functionality in performance tasks. The confidence intervals of providers and users lie far away from each other. The t-test is significant ($p < 0.0008$, $\alpha = 0.05$). Hence, providers neither agree nor disagree and users strongly agree that conversation functionality used in performance tasks leads to higher project effectiveness. A provider explains this by saying that often email is not the best tool for a certain task, but people use it for everything. On the other hand two users argue that email is good to quickly send status information (reached / not reached). A third user explains, if you are close to a deadline, chat is good to harmonize work packages.

Increased Creativity



Increased creativity arises in only five of the eight team tasks. Except for creativity tasks, only one party has chosen a team task. Decision making, mixed motive and performance tasks are not supported by anybody.

Planning tasks (m_u = 3 [22%, min = 3, max = 3])

Planning tasks are only supported by about 20 percent of users. According to their mean they neither agree nor disagree with values at 3.

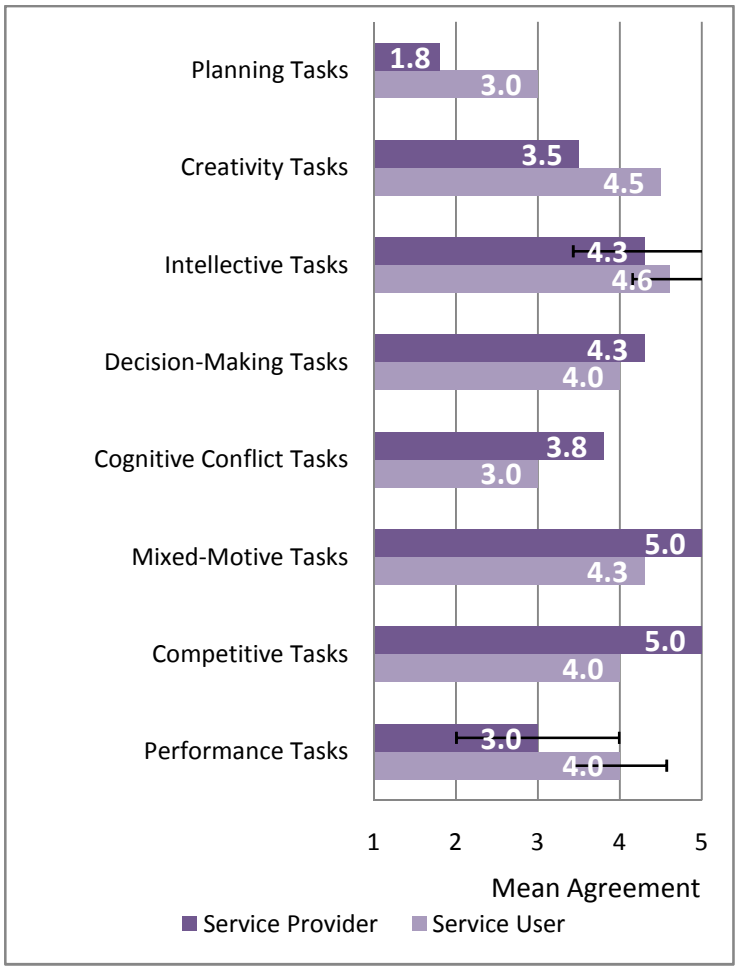
Creativity tasks
(m_p = 2.3 [44%, min = 1, max = 3], m_u = 4.0 [77%, min = 2, max = 5, mode = 5])

The highest support for increased creativity is provided for creativity tasks. Providers support it with 44% and users with 77%. The means between the two are quite different. Providers tend to disagree. A provider states that although email is an important communication and collaboration path, it might not foster creativity. He argues that email is highly overloaded. Users on the other side tend to agree. Their distribution is pretty consistent, although few strong outliers exist. One of the users says that email is favorable for creativity tasks, because you do not always have to arrange a meeting, but you can simply send an email with your open issues to the required recipients. Another one argues in the same context that one is more open minded at his desk. The t-test is significant ($p < 0.0287$, $\alpha = 0.05$). Hence, service providers tend to disagree and service users agree that the use of conversation functionality in creativity tasks leads to increased creativity. The explanations of both parties reflect these differences.

Intellective tasks (m_u = 3.5 [22%, min = 3, max = 4])
Cognitive-conflict tasks (m_u = 5 [11%])
Competitive tasks (m_p = 3 [11%])

Similar to planning, intellective, cognitive conflict and competitive tasks are not well supported. Former two are only supported by users. About 20% show a mean of 3.5. Only 11% support cognitive conflict tasks, but they strongly agree and one argues that everyone can contribute his standpoints by email without waiting until one can speak. The same height of support is given from providers to competitive tasks. According to their mean, they neither agree nor disagree.

Higher Quality



Higher quality is supported by both parties in all team tasks. Their means show that they agree or even strongly agree for most of the team tasks, except for planning, cognitive conflict and performance tasks.

Planning tasks (m_p = 1.8 [44%, min = 1, max = 3], m_u = 3 [11%])

According to the mean of providers, they disagree that this impact arises in planning tasks. One of them states that email is little formalized and that's why people use email so often to collect information. This, he states, can lead to higher quality. 11% of users show a higher mean at a level of neither agree nor disagree. The difference between the means of the two parties is quite large.

Creativity tasks (m_p = 3.5 [22%, min = 2, max = 5], m_u = 4.5 [22%, min = 4, max = 5])

In creativity tasks the means are somewhat higher, but the support isn't. About twenty percent of both parties tend to agree that conversation functionality can lead to higher quality. A user explains this by saying that emails (e.g. a document to review) are often send to more people than one would invite to a meeting, which could lead to higher quality of work.

Intellective tasks (m_p = 4.3 [44%, min = 3, max = 5], m_u = 4.6 [55%, min = 4, max = 5])

Both parties highly support that higher quality arises in intellective tasks. The means are high or even very high. According to the confidence intervals no significant difference exists. Thus, it can be stated that providers and users both at least slightly agree that conversation functionality used in intellective tasks leads to higher quality. Some critic comes from a provider which criticizes that one writes an email to a specific address and does not whether it will be processed or not. But two users oppose that email allows rapid access to experts and this (as mentioned by a third user) leads to the advantage that all relate to the same facts. Besides this critical statement of a provider only positive statements are made. Two providers argue that email allows to precisely describing a problem. One says that answering an email often does not take much time, thus work interruption from a primary task is little (no quality decrease).

Decision-making tasks (m_p = 4.3 [33%, min = 3, max = 5], m_u = 4 [33%, min = 3, max = 5])

Decision making tasks show less support and slightly lower means. About a third of each party believes that conversation functionality in this task leads to higher quality. Providers show values predominantly around 5. A provider argues that decisions made are more transparent when written down in an email and sent to all the stakeholders. The values of users have the same min and max, but are more distributed in between. A user similarly states that with email decisions are justified in writing.

Cognitive-conflict tasks (m_p = 3.8 [44%, min = 2, max = 5], m_u = 3 [11%])

Users provide with only 11% a lower support for cognitive conflict tasks then providers do with about 40%. Providers tend to agree. Users neither agree nor disagree. But somehow against their mean one argues that by discussing a topic of viewpoint in a chat channel, better solutions can be found.

Mixed-motive tasks ($m_p = 5$ [11%], $m_u = 4.3$ [33%, min = 4, max = 5])

The support for mixed motive is the other way around. Only 11% of providers strongly agree and 33% of users agree.

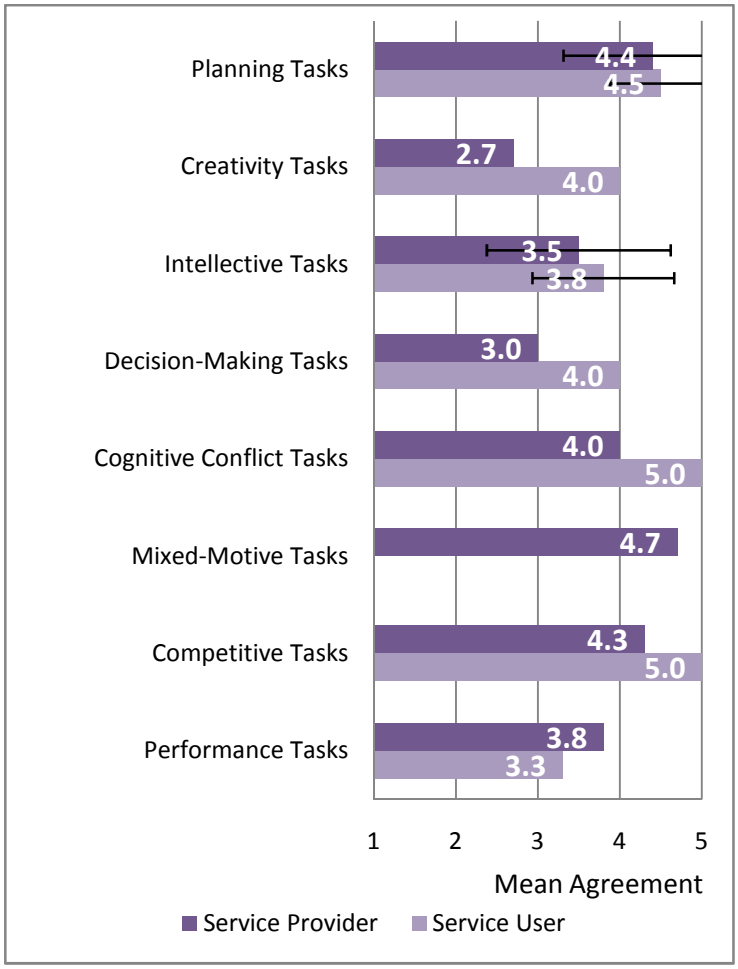
Competitive tasks ($m_p = 5$ [22%, min = 5, max = 5], $m_u = 4$ [11%])

Competitive tasks show a similar result. The mean of providers is very high with a support of 22% and the one of users is high but only with a support of 11%. A provider argues that with email, one can reach key people in a simple way and influence them to support the own project.

Performance tasks ($m_p = 3$ [55%, min = 2, max = 5], $m_u = 4$ [55%, min = 3, max = 5])

Performance tasks show once again (as seen in the results for higher project effectiveness) good support by both parties with 55%. The confidence interval shows that no significant difference can be found. But the one of providers goes from disagree to agree. Thus no trend can be stated. A provider with lower agreement mentions by pointing on a bad practice that when a document ends up in a mailbox, then it isn't accessible by third. Another provider with higher agreement says that with email one can quickly ask someone during the execution of work packages if help is required. According to the other confidence interval, the users do not have such differentiated agreements, and at least they do not disagree that conversation functionality in performance tasks lead to higher quality.

Higher Time Savings



Higher time savings arises in all team tasks and is supported by both parties.

Planning tasks (m_p = 4.4 [55%, min = 3, max = 4]; m_u = 4.5 [66%, min = 3, max = 5, mode = 5])

This impact is highly supported in planning tasks by both parties. 55% of providers agree and 66% of users tend to highly agree that this impact arises. The confidence interval of providers shows that they at least do not disagree. A provider argues that an email is rapidly written and usually people provide rapid feedback. Another one says that email allows to not leaving the desk to ask someone a question. The distribution of the values of users shows that the majority strongly agrees. The confidence interval begins almost at a high level of mean agreement. In one case, a user says (again) that email helps to quickly and easy exchange deadlines. Similarly to above statement of a provider, but this time with regard to chat, a user states that it is easy to ask a short question.

Creativity tasks (m_p = 2.7 [33%, min = 2, max = 4], m_u = 4.0 [33%, min = 3, max = 5])

Creativity tasks show a lower support and partly a lower agreement. Providers slightly disagree and show a support of about 30% and users agree on average and show the same support. Values of providers are distributed predominantly at 2. The ones of users are equally distributed between min and max.

Intellective tasks
(m_p = 3.5 [66%, min = 1, max = 5, mode = 5], m_u = 3.8 [66%, min = 2, max = 5, mode = 5])

Both, providers and users provide with 66% relatively high support but means below 4 for intellective tasks. Strong outliers exit. The confidence interval of providers shows no trend. A provider with high agreement describes that email is appropriate to formulate a problem as part of an intellective task. Further he states that group chat channels qualify to canalize users without requiring a personal bilateral contact. Users at least do not (strongly) disagree according to their confidence interval. Also a user who highly agrees states that before talking about a problem, it needs to be describes in text form and exchanged by email.

Decision-making tasks (m_p = 3 [22%, min = 2, max = 4], m_u = 4 [11%]);

Cognitive-conflict tasks (m_p = 4 [11%], m_u = 5 [22%, min = 5, max = 5])

For cognitive conflict tasks 11% of providers agree and 22% of users strongly agree with high consistency. A user says that with email questions can be asked without the need for a phone call or the arrangement of a face-to-face meeting. Another user argued that a chat protocol helps to get into a discussion.

Mixed-Motive tasks (m_p = 4.7 [33%, min = 4, max = 5])

Support for mixed motive tasks is only given by providers. 33% of them almost strongly agree that conversation functionality leads to higher time savings when used in this task. Values lie predominantly at 5. They explain this result as following. One states that if members of a team do not agree on an issue, then they start to debate a lot. Email, he adds, helps to save time in such situations.

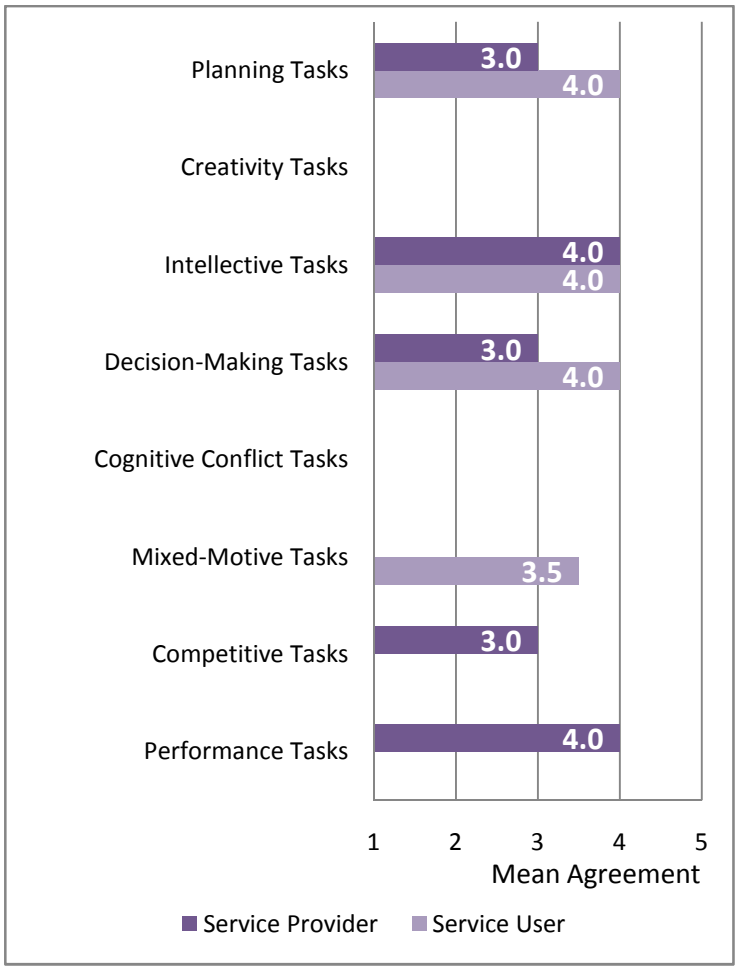
Competitive tasks (m_p = 4.3 [33%, min = 4, max = 5], m_u = 5 [22%, min = 5, max = 5])

Providers and users tend to agree.

Performance tasks (m_p = 3.8 [33%, min = 3, max = 5], m_u = 3.3 [33%, min = 3, max = 4])

The values of providers are predominantly at 3.

Higher Cost Savings



Higher cost savings arise in only three tasks. No one provides agreement for creativity or cognitive conflict tasks. According to the means both parties do not disagree. Respondents didn't provide any valuable explanations for these results.

Planning tasks ($m_p = 3$ [22%, min = 3, max = 3], $m_u = 4$ [11%])

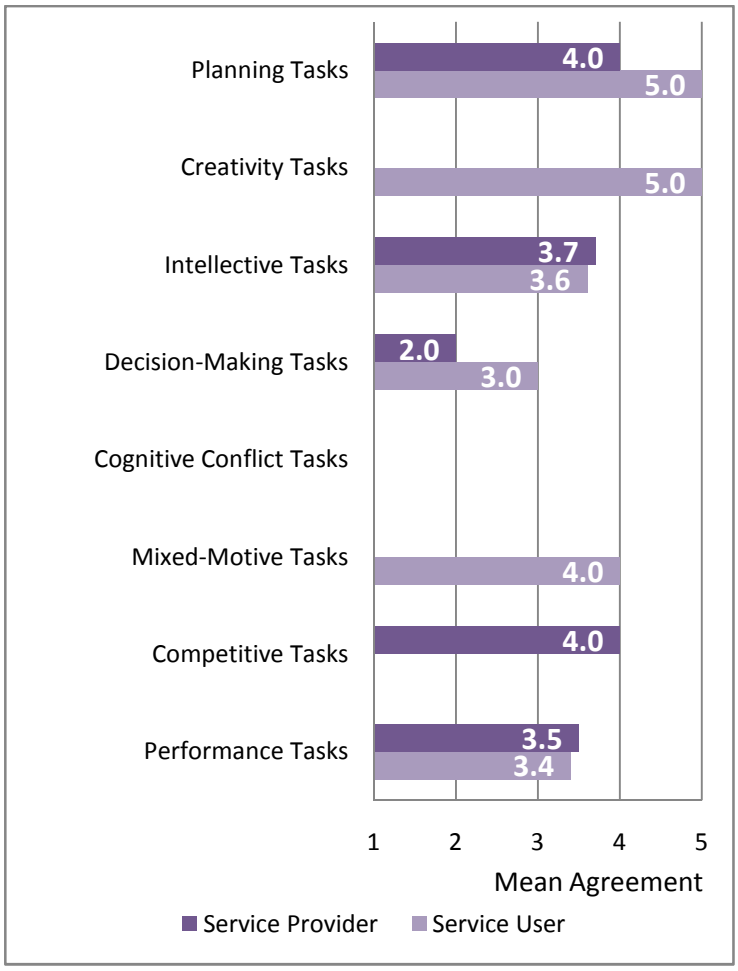
Providers tend to neither agree nor disagree.

Intellective tasks ($m_p = 4$ [33%, min = 3, max = 5], $m_u = 4$ [33%, min = 2, max = 5])

The values of users are predominantly at 5.

Decision-making tasks ($m_p = 3$ [11%], $m_u = 4$ [11%])
Mixed-Motive tasks ($m_u = 3.5$ [22%, min = 2, max = 5])
Performance tasks ($m_p = 4$ [11%])

Higher Parallelization



Higher parallelization arises in four tasks paired. No one provides agreement for cognitive conflict tasks. The means are between medium and high with some outliers in both directions.

Planning tasks ($m_p = 4$ [11%], $m_u = 5$ [33%, min = 5, max = 5])

11% of providers show a high mean. 33% of users show a very high mean. Their values are at a level of 5. A user explains this by saying that email serves to send work assignments to several colleagues. Another one mentions that one can be in several chat rooms at a time.

Creativity tasks ($m_u = 5$ [11%]):

Only 11% of users provided support for creativity tasks with a mean of 5.

Intellective tasks ($m_p = 3.7$ [33%, min = 3, max = 4], $m_u = 3.6$ [55%, min = 2, max = 5])

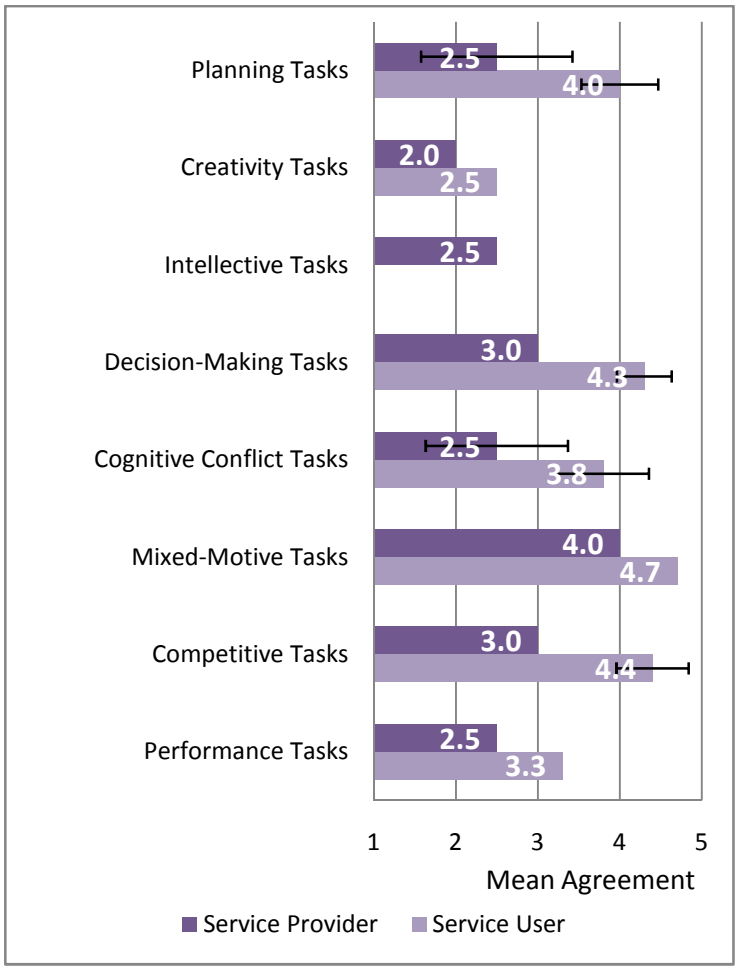
The values of providers have a min of 3 and a max of 4, predominantly at 4. The users have a min of 2 and a max of 5, predominantly at 4 too. Thus, users do not share a common

understanding of agreement. An outlier of the upper end says that email distribution lists facilitate to send a problem description to multiple people. He regards this as some sort of parallelization.

Decision-making tasks (m_p = 2 [11%], m_u = 3 [11%])
Mixed-Motive tasks (m_u = 4 [11%])
Competitive tasks (m_p = 4 [11%])
Performance tasks (m_p = 3.5 [22%, min = 3, max = 4], m_u = 3.4 [55%, min = 3, max = 4])

With regard to the confidence interval, it can be stated that users at least do not disagree that conversation functionality in performance tasks leads to higher parallelization. No valuable explanations are provided to underpin this result.

Higher Transparency



Higher transparency arises in all team tasks. Both parties specify for most team tasks a low level of mean agreement, especially providers tend to disagree. The number of mentions is high for most of the tasks (mostly only for users).

Planning tasks
(m_p = 2.5 [55%, min = 1, max = 4, mode = 3], m_u = 4 [66%, min = 3, max = 5, mode = 4])

The confidence intervals do not overlap. The t-test is significant ($p < 0.0498$, $\alpha = 0.05$). Hence, service providers slightly disagree and service users agree that the use of conversation functionality in planning tasks leads to higher transparency. The explanation of a service provider goes hand in hand with this statement. A provider states that documents are often sent by email with a subject called “here is the latest version”. He sees this as inappropriate because it is hard to find these documents again. He says that email brings no correlation between documents.

Creativity tasks (m_p = 2 [11%], m_u = 2.5 [22%, min = 2, max = 3])

Creativity tasks show a low support and both parties tend to disagree. A user who disagrees says: “you never know what you do not know”. He means that often one is not the recipient of an email. Information stored in a shared information base, he argues, could avoid this problem.

Intellective tasks (m_p = 2.5 [22%, min = 2, max = 4])

Their values vary quite strong, thus one provider disagrees and the other one agree.

Decision-making tasks
(m_p = 3 [22%, min = 3, max = 3]; m_u = 4.3 [77%, min = 4, max = 5, mode = 4])

In decision making tasks Providers show with only 22% low support and neither agree nor disagree. Users show with 77% the highest support by now. With regard to the confidence interval, it can be said that users tend to agree that conversation functionality used in decision-making tasks leads to higher transparency. An explanation by a service user supports this statement. He mentions that with email all involved parties know how a decision came to pass.

Cognitive-conflict tasks
(m_p = 2.5 [44%, min = 2, max = 3]; m_u = 3.8 [66%, min = 3, max = 5, mode = 4])

The confidence intervals of both parties slightly overlap, thus no significant differences can be found. But it can be stated that users tend to agree that conversation functionality used in cognitive conflict tasks lead to higher transparency. The explanation provided by a service user supports this statement which regards email as a means of evidence in such conflicting tasks.

Mixed-Motive tasks (m_p = 4 [33%, min = 4, max = 4], m_u = 4.7 [33%, min = 4, max = 5])

The values of providers are constant at a level of 4. The values of users are predominantly at 5. Three providers and a user state similarly that with an email, a conversation is documented. If one is working against other parties, communication is in text form and sent by email. The superior is always informed by a carbon copy.

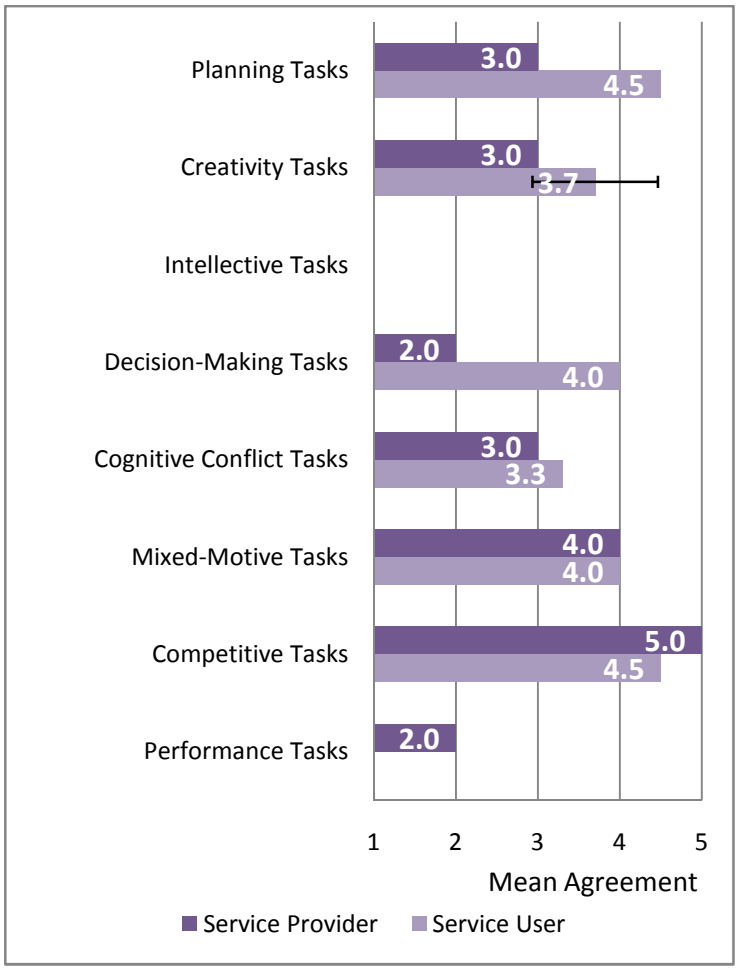
Competitive tasks (m_p = 3 [22%, min = 3, max =], m_u = 4.4 [55%, min = 4, max = 5])

According to the confidence interval, it can be said that users agree that conversation functionality used in competitive tasks leads to higher transparency. This result is not supported by any valuable explanation of a user. But a provider argues that email helps to document issues. Thus, a similar explanation as for mixed motive tasks is provided.

Performance tasks (m_p = 2.5 [33%, min = 2, max = 3], m_u = 3.3 [44%, min = 3, max = 4])

The values of providers are predominantly at 2. The values of users are predominantly at 3. Both a provider and a user argue that email simplifies the exchange of status information.

Higher Cohesiveness



Higher cohesiveness arises (at least partially) in all team tasks except in intellective tasks. Both parties show for most of the team tasks medium or high means. Providers in decision-making and in performance tasks show a low means.

Planning tasks (m_p = 3 [22%, min = 3, max = 3], m_u = 4.5 [22%, min = 4, max = 5])

Providers tend to neither agree nor disagree and users tend to agree.

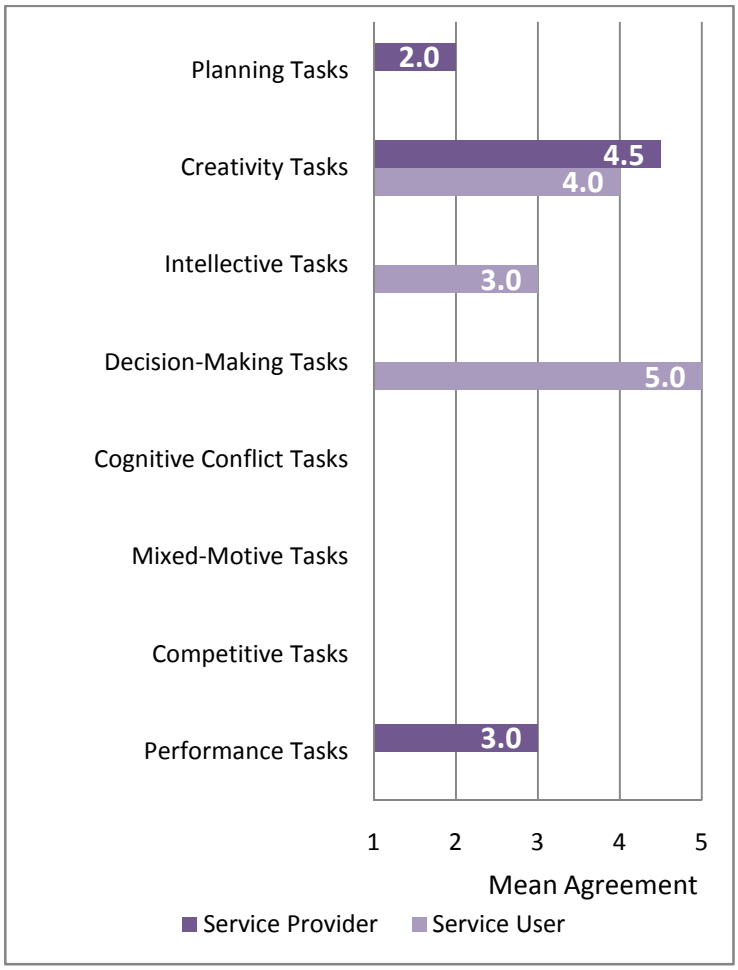
Creativity tasks (m_p = 3 [1]; m_u = 3.7 [66%, min =, max =], min = 2, max = 5, mode = 4)

With regard to the confidence interval of users, they tend to agree that conversation functionality used in creativity tasks leads to higher cohesiveness. The explanations (one pro and one contra) underpin this statement. One says that with symbols like smiley's in a chat session you can transmit quite a lot of emotions. And the other one criticizes that the reason for lower agreement is that there is no culture to work with email in his organization.

Decision-making tasks (m_p = 2 [11%], m_u = 4 [11%])
Cognitive-conflict tasks (m_p = 3 [11%], m_u = 3.3 [33%, min = 3, max = 4])

Mixed-Motive tasks (m_p = 4 [11%], m_u = 4 [11%])
Competitive tasks (m_p = 5 [11%], m_u = 4.5 [22%, min = 4, max = 5])
Performance tasks (m_p = 2 [11%])

Better Work Practices



Planning tasks (m_p = 2 [22%, min = 1, max = 3])
Creativity tasks (m_p = 4.5 [22%, min = 4, max = 5], m_u = 4 [33%, min = 3, max = 5])
Intellective tasks (m_u = 3 [22%, min = 2, max = 4])
Decision-making tasks (m_u = 5 [11%])

Better work practices arise in only one team task paired. The support is generally low for this impact. A user argues that instead of writing an idea on paper, it is sent via email to colleagues, because like this the idea will not get lost. Intellective tasks are only supported by 22% of users with a mean of 2. Their values vary strongly. Decision making tasks are only supported by 11% of users with a very high mean value. A user mentions that chat and email allow to immediately informing about an issue without waiting until the next regular meeting takes place.

Higher Interruption

Creativity tasks (m_u = 4 [11%])
Mixed-motive tasks (m_p = 4 [11%])

Higher interruption is very low supported by the respondents and no valuable explanation exists.

Summary

Results of conversation functionality show that most of the impacts analyzed are quite well supported for conversation functionality, with regard to significance and with explanations by the respondents.

Higher project effectiveness is highly supported and arises significantly in decision-making tasks (users agree), in cognitive conflict tasks (both parties do not disagree), and in competitive tasks (both parties slightly agree). Performance tasks show a significant difference between providers, who tend to disagree or neither agree nor disagree and users, who tend agree. Respondents point out that with email can be used throughout a project for recording and exchanging knowledge in a simple manner.

Increased creativity shows low support, except for creativity tasks, where a further significant difference can be found. Providers tend to disagree and users tend agree that email leads to increased creativity.

Higher quality is significantly supported by both parties in intellectual tasks which tend to agree (providers) or tend to strongly agree (users) and in performance tasks where only users tend agree. Respondents mention that emails are a simple form of communication. Quality of work increases when team members are better informed.

With regard to higher time savings both parties tend to agree in planning tasks. Low support exists for cost savings. Higher parallelization is supported by users which tend to agree in intellective and performance tasks.

Higher transparency shows a significant difference in planning tasks (providers tend to disagree and users tend to agree). In addition in decision-making, cognitive conflict, and competitive tasks users, at least slightly, tend to agree with significance. Providers mostly

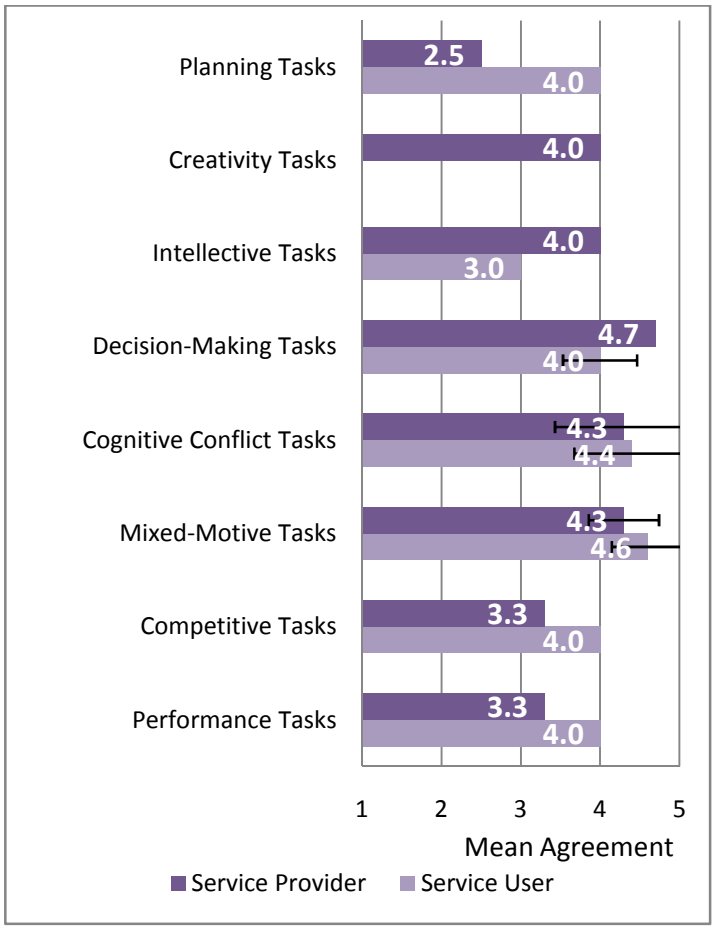
provide a lower agreement than users while both agree that a written message increases transparency.

For higher cohesiveness, some weak evidence was found for creativity tasks (users tend to do not disagree). Better work practices and higher interruption are very weakly supported by the respondents.

Email (and partly chat) is seen as a simple tool to quickly send a message to someone. For cognitive conflict and mixed motive tasks, respondents of both parties see advantages and disadvantages. An email is a means of evidence, which can be used against oneself. It is highly used in many work processes. Providers often provided lower level of mean agreement than users, because they would rather work with a higher diversity of tools.

5.1.2 Impacts of Audio Conferencing Functionality

Higher Project Effectiveness



Project effectiveness arises in all team tasks. Only creativity tasks are not paired. Both parties have in most team tasks a medium or high level mean. The number of mentions are

high in decision-making (only users), cognitive conflict, mixed motive, competitive (only providers) and performance tasks (only user). Those tasks are well supported by explanations.

Planning tasks (m_p = 2.5 [22%, min = 2, max = 3], m_u = 4 [11%])

Creativity tasks (m_p = 4 [11%])

Intellective tasks (m_p = 4 [11%], m_u = 4 [22%, min = 3, max = 3])

Decision-Making tasks

(m_p = 4.7 [33%, min = 4, max = 5]; m_u = 4 [66%, min = 3, max = 5, mode = 5])

In discussions, new solution can be found, which increase the success of a project (u). Talking about a decision via audio is as if you are sitting next to each other (face-to-face) (p). Discussions about variations are not held over the telephone (u).

Providers tend to agree and users agree with a support of 66%. According to the confidence interval for decision-making tasks, users do not disagree or slightly agree that audio conferencing functionality used in decision-making tasks leads to higher project effectiveness. The explanations provided by service users support this statement.

Cognitive conflict tasks (m_p = 4.3 [44%, min = 3, max = 5], m_u = 4.4 [55%, min = 4, max = 5])

By discussing standpoints throughout a project, it is more likely to reach the goals (p). Talking to each other helps to better coordinate the course of a project (p). Comprehension is an important factor for project success and audio supports it best (u).

Providers and user both provide relatively high support and both show high means. The confidence intervals for decision-making tasks unveil, both parties do not disagree or slightly agree that audio conferencing functionality used in cognitive conflict tasks leads to higher project effectiveness. The explanations provided by providers and users support this statement.

Mixed-Motive tasks (m_p = 4.3 [44%, min = 4, max = 5], m_u = 4.6 [55%, min = 4, max = 5])

Talking to conflicting parties is central in such conflicts in order to understand the underlying interests (u). Traveling is great to look in someone's eyes. If it is not possible, than audio is the best alternative (u). Audio helps to agree on something (u).

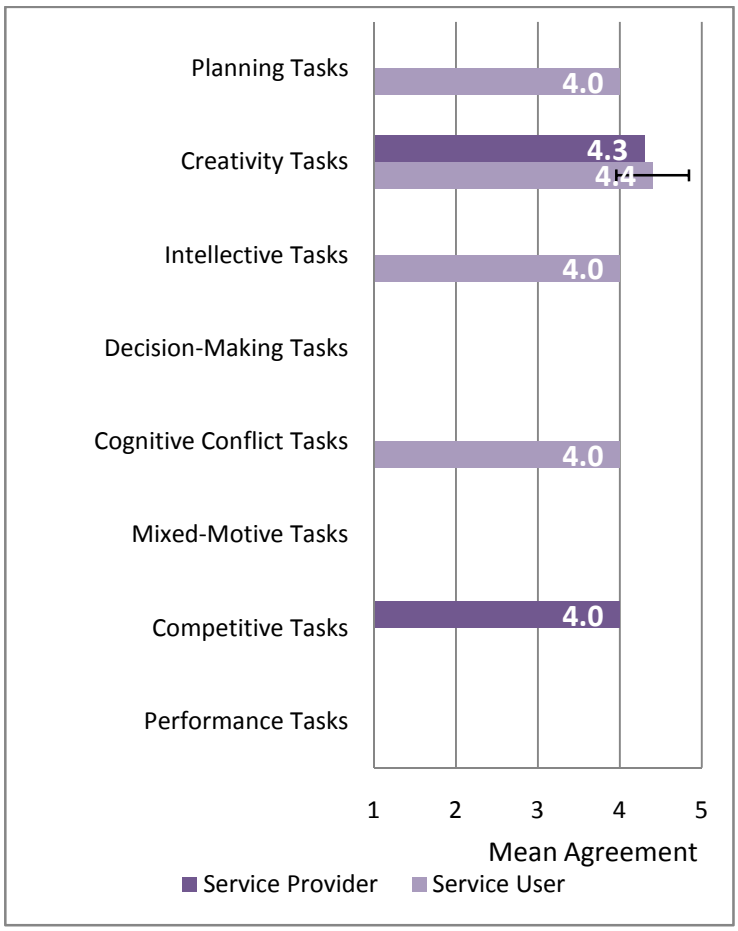
Both parties show relatively high support as well as high means. According to the confidence intervals for mixed-motive tasks, both parties slightly agree that audio conferencing functionality used in mixed-motive tasks leads to higher project effectiveness. The explanations provided by service users support this statement.

Competitive tasks (m_p = 3.3 [44%, min = 3, max = 4], m_u = 4 [22%, min = 4, max = 4])
You rather write an email, than pick up the phone (p).

Providers tend to not disagree and users tend to agree.

Performance tasks (m_p = 3.3 [33%, min = 2, max = 4], m_u = 4 [44%, min = 3, max = 5])
It is good to have a weekly status meeting in an audio conference (u). Status updates on a regular basis help on a low level to manage a project (u). It only favors to work synchronously (p).

Increased Creativity



Increased creativity arises individually in four and paired in only one team task. Decision-making, mixed-motive and performance tasks are not supported. The level of mean agreement is constantly high. But the number of mentions is just relatively high for users in creativity tasks. Otherwise it is low or very low.

Planning tasks ($m_u = 4$ [22%, min = 4, max = 4])

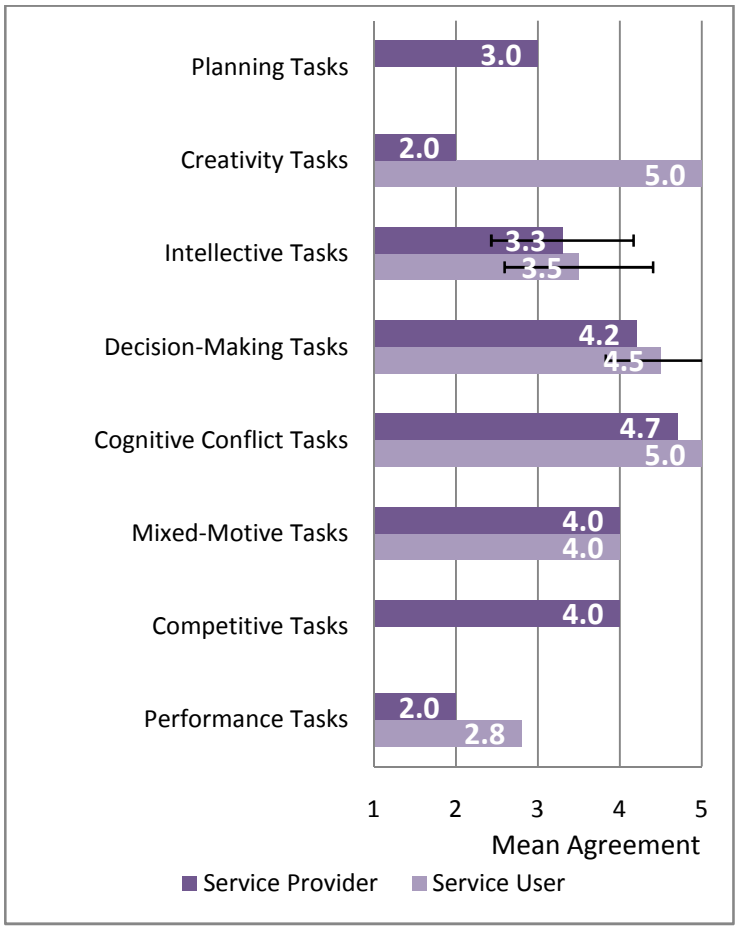
Users tend to agree.

Creativity tasks ($m_p = 4.3$ [33%, min = 4, max = 5], $m_u = 4.4$ [55%, min = 4, max = 5])
Audio helps to mutually generate good ideas (p). You can hear how ideas are created (u).

Providers tend to agree. Users agree too, but with a higher support. According to the confidence interval, users agree that audio conferencing functionality used in creativity tasks leads to increased creativity. The explanations provided by users support this statement.

Intellective tasks ($m_u = 4$ [11%]) **Cognitive-conflict tasks** ($m_u = 4$ [11%])
Competitive tasks ($m_p = 4$ [11%])

Higher Quality



Higher quality arises in most of the team tasks. Exceptions are planning and competitive tasks. The mean in most cases is between medium and high. Providers in creativity tasks and both parties in performance tasks show a lower result. The number of mentions is high in intellective, decision-making (only service providers) and performance tasks (only service users).

Planning tasks ($m_p = 3$ [11%])

Creativity tasks ($m_p = 2$ [11%], $m_u = 5$ [11%])

It is a must have for creativity tasks, because you can hear the enthusiasm/confidence in one's voice. This facilitates to have regards for somebody in the course of a brainstorming session (u).

Intellective tasks ($m_p = 3.3$ [44%, min = 2, max = 4], $m_u = 3.5$ [44%, min = 3, max = 5])

Audio may decrease quality of work between experts if a problem is hard to explain on the phone resp. hard to interpret (p). By inviting important experts to an audio conference, each

one can contribute his view of a problem. Higher quality of understanding results (u). Several trials to reach someone on the phone may be time intensive and may thus decrease the quality of a current work (p).

Both parties support with 44% and have about the same mean. The confidence intervals strongly overlap, thus no significant difference can be found, plus no trend can is shown. The two explanations of service providers explain why the statistical result is low.

Decision-Making tasks (m_p = 4.2 [55%, min = 3, max = 5], m_u = 4.5 [22%, min = 4, max = 5])
Spoken language helps to increase understanding and thus quality (u).

Providers show a relatively high support as well as a high mean. The confidence interval unveils that, providers agree that audio conferencing functionality used in decision-making tasks leads to higher quality. No explanations are given by a provider which could underpin this statement. However the one of a service user provides support.

Cognitive conflict tasks (m_p = 4.7 [33%, min = 4, max = 5], m_u = 5 [11%])
Viewpoints explained by someone can be used to support viewpoints of someone else (u). Discussions increase quality (2 p).

Providers tend to agree.

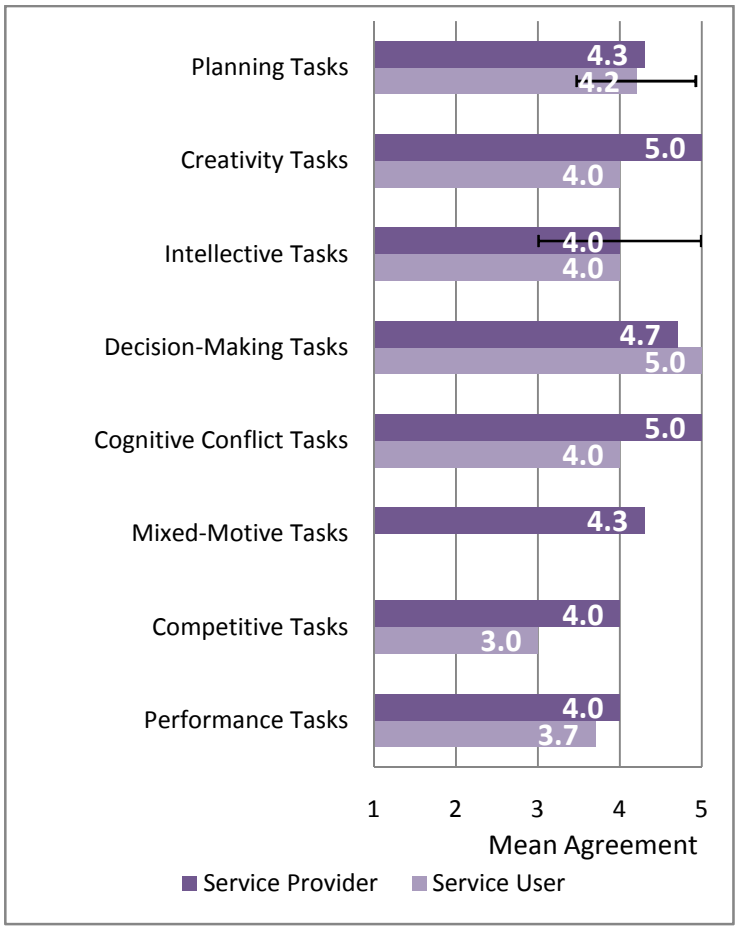
Mixed-motive tasks (m_p = 4 [11%], m_u = 4 [33%, min = 3, max = 5])

Competitive tasks (m_p = 4 [22%, min = 4, max = 4])

Providers tend to agree.

Performance tasks (m_p = 2 [11%], m_u = 2.8 [44%, min = 2, max = 4])
Audio conferencing helps to perceive a discussion more personal (u).

Higher Time Savings



Higher time savings arises in all team tasks. The means of both parties are constantly high with two moderate exceptions. The support is relatively high in planning (only users) and intellective tasks (only providers).

Planning tasks (m_p = 4.3 [33%, min = 4, max = 5]; m_u = 4.2 [66%, min = 3, max = 5, mode 5])
Allows to get in contact with someone virtually at any time (u). Dependency on availability is problematic (u). Spoken language is always faster and more efficient than written language (u). Traveling is not required anymore in cases where face-to-face meetings are not required (u).

Users provide relatively high support and a high level mean. According to the confidence interval, users do not disagree that audio conferencing functionality used in planning tasks leads to higher time savings. Most of the explanations underpin this statement.

Creativity tasks (m_p = 5 [11%], m_u = 4 [11%])

Intellective tasks (m_p = 4 [55%, min = 2, max = 5], m_u = 4 [33%, min = 4, max = 4])
Calling up an expert instead of meeting him is highly time saving (p). Audio conferencing is rarely used in intellective tasks (u).

Providers show a relatively high support and a high mean. It can be stated with regard to the confidence interval that, they do not disagree that audio conferencing functionality used in intellective tasks leads to higher time savings. The only one statement of a provider underpins this statement.

Decision-Making tasks (m_p = 4.7 [33%, min = 4, max = 5], m_u = 5 [11%])
Audio conferencing helps to quicker get to a decision (p).

Providers tend to agree.

Cognitive conflict tasks (m_p = 5 [11%], m_u = 4 [22%, min = 4, max = 4])

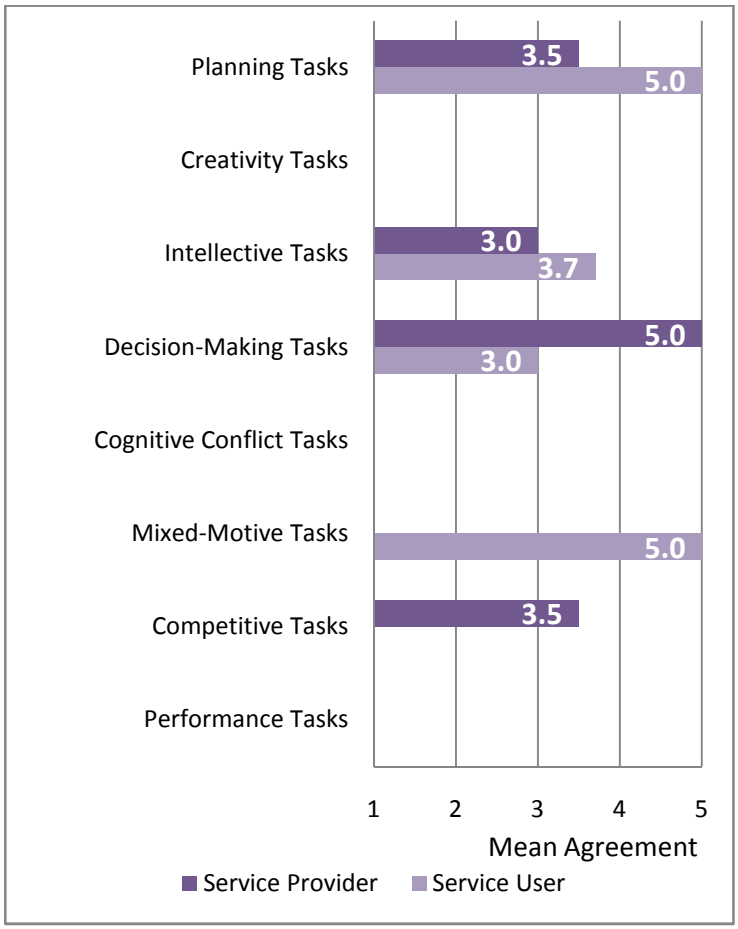
Users tend to agree.

Mixed-motive tasks (m_p = 4.3 [33%, min = 4, max = 5])

Providers tend to agree.

Competitive tasks (m_p = 4 [22%, min = 3, max = 5], m_u = 3 [11%])
Performance tasks (m_p = 4 [11%], m_u = 3.7 [33%, min = 2, max = 5])

Higher Cost Savings



Higher cost savings arises except for creativity, cognitive conflict and performance tasks at least partly in the results in all other team tasks. The means are between medium and high. The two provided statements for planning and decision-making tasks by either party point on the decreased need for traveling if audio conferencing is used.

Planning tasks (m_p = 3.5 [22%, min = 2, max = 5], m_u = 5 [11%])

Traveling is expensive. Especially in international projects less travel costs arise. Depending on the locations, time shifts only allow a small time frame. But this still helps to get an expertise. (u)

Intellective tasks (m_p = 3 [22%, min = 2, max = 4], m_u = 3.7 [33%, min = 3, max = 4])

Decision-Making tasks (m_p = 5 [11%], m_u = 3 [11%])

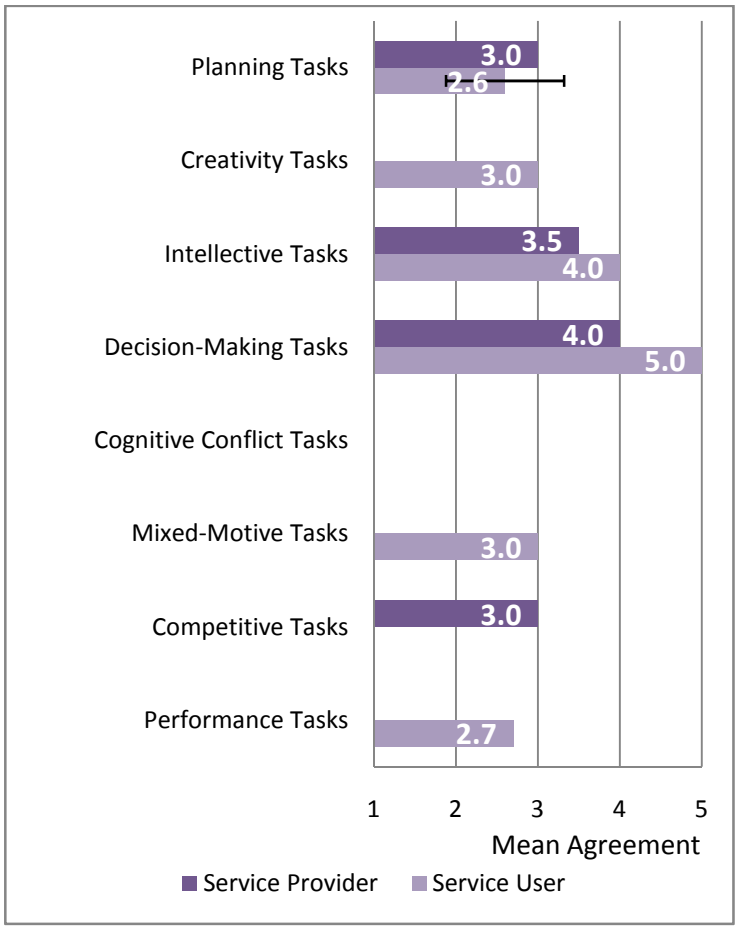
Audio conferencing saves travel costs and allows collect opinions of all decision makers during an audio session, which saves time to reach a decision (p).

Mixed-motive tasks (m_u = 5 [22%, min = 5, max = 5])

Users tend to strongly agree.

Competitive tasks (m_p = 3.5 [22%, min = 2, max = 5])

Higher Parallelization



Higher parallelization arises in all team tasks at least individually, except for cognitive conflict tasks. The means are around medium, with some outliers in both directions.

Planning tasks (m_p = 3 [11%], m_u = 2.6 [55%, min = 2, max = 4, mode = 2])

Users show a relatively high support, but the distribution of their values does not shows any trend.

Creativity tasks (m_u = 3 [11%])

Intellective tasks (m_p = 3.5 [22%, min = 2, max = 5], m_u = 4 [44%, min = 3, max = 5])

Working in parallel on an audio conference is only possible for listeners, but not for speakers (p). Geographically dispersed people may coordinate each other to optimize parallel working (u [1], p [1]).

Decision-making tasks (m_p = 4 [11%], m_u = 5 [11%])

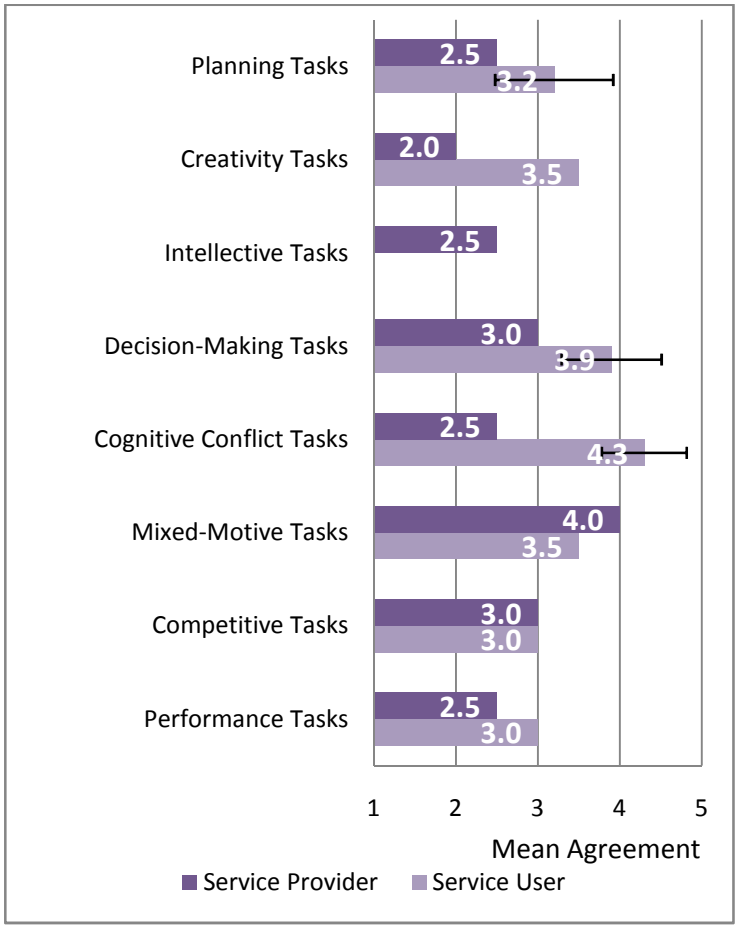
Mixed-Motive tasks (m_u = 3 [11%])

Competitive tasks (m_p = 3 [11%])

Performance tasks (m_p = 1 [11%], m_u = 2.7 [33%, min = 2, max = 4])

Regular status updates (u).

Higher Transparency



Higher transparency arises in all team tasks for both parties except for intellective tasks. The level of agreement is between low and medium, with few exceptions. Providers specify in most cases lower means then user. The number of mentions is high for users in planning,

decision-making and cognitive conflict tasks. Otherwise the means are between medium and low.

Planning tasks (m_p = 2.5 [22%, min = 2, max = 3], m_u =3.2 [66%, min = 2, max = 4, mode = 4])

Users show high relatively support but according to the distribution of their values, no trend can be shown.

Creativity tasks (m_p = 2 [11%], m_u = 3.5 [22%, min = 3, max = 4])
Intellective tasks (m_p = 2.5 [22%, min = 2, max = 3])

Decision-making tasks
(m_p = 3 [33%, min = 2, max = 4], m_u = 3.9 [77%, min = 2, max = 4, mode = 3])
By using audio instead of video conferencing, less information about another the other side is transferred (p). To decide for a solution a discussion needs to develop. The intonation of the voice can be used to express an opinion more characterized (u).

Again service users show a high support. The confidence interval unveils that users do not disagree that audio conferencing functionality used in decision-making tasks lead to higher transparency.

Cognitive-conflict tasks
(m_p = 2.5 [22%, min = 1, max = 4], m_u = 4.3 [77%, min = 3, max = 5, mode = 5])
Audio conferencing helps to underpin a commitment with several viewpoints more personally (u). It is most near to a face-to-face discussion (u).

Users show a very high support. With respect to the confidence interval it can be said that service users slightly agree that audio conferencing functionality used in cognitive conflict tasks lead to higher transparency. The explanations provide support for this statement.

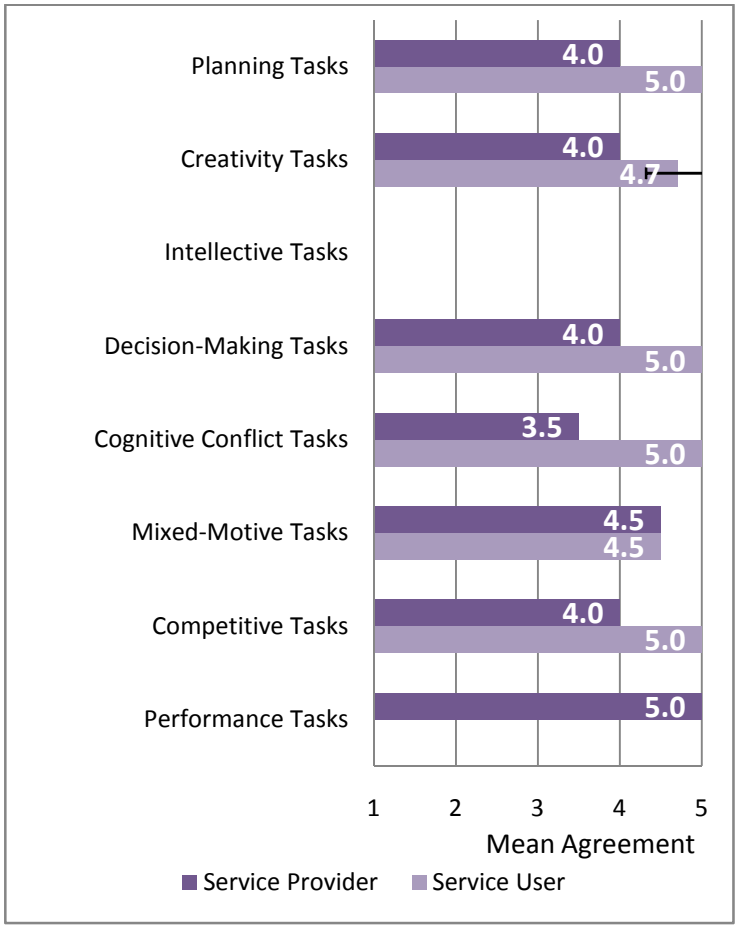
Mixed-Motive tasks (m_p = 4 [11%], m_u = 3.5 [22%, min = 3, max = 4])
Competitive tasks (m_p = 3 [22%, min = 3, max = 3], m_u = 3 [33%, min = 3, max = 3])

Both parties tend to neither agree nor disagree.

Performance tasks (m_p = 2.5 [22%, min = 2, max = 3], m_u = 3 [22%, min = 2, max = 4])

In general respondent provided low mean agreement for higher transparency. The number of agreements is little for all team tasks except planning, decision and cognitive conflict tasks. Interestingly, the difference between the numbers of agreements of service users and service providers is relatively high. Min, max and mode for these tasks show, that at least some outliers exist. The statements do not reflect the statistical results, except for one which stresses, that video conferencing leads to higher transparency than audio conferencing.

Higher Group Cohesiveness



Higher cohesiveness arises in all team tasks except for intellective tasks. The means are high, besides one case. The numbers of mentions are low. Just creativity and cognitive conflict tasks (only service users) show a very high or just high number.

Planning tasks ($m_p = 4$ [11%], $m_u = 5$ [22%, min = 5, max = 5])

Audio allows to remain at the same location. Besides holding meetings on a regular basis via

audio conferencing, spontaneous meetings are possible. This increases cohesion and as a result increases effectiveness of collaboration (u). Of all the tools, audio supports most effective team building (u).

Users tend to strongly agree.

Creativity tasks (m_p = 4 [11%], m_u = 4.7 [66%, min = 4, max = 5, mode = 5])
It is an advantage of audio conferences to have no delay. But hearing the voice of a speaker does not give you an idea about his current mood (u). It is near to physical presence in a face-to-face meeting, but things like smell cannot be perceived (u). Working on ideas with audio conferencing is more personal than via other tools (u).

Users show a relatively high support. The mean is high. According to the confidence interval, it can be said that users agree that audio conferencing used in creativity tasks leads to higher cohesiveness. The given explanations stress that even more signals of the team should be transmitted.

Decision-making tasks (m_p = 4 [11%], m_u = 5 [22%, min = 5, max = 5])

Users tend to agree.

Cognitive conflict tasks (m_p = 3.5 [22%, min = 3, max = 4], m_u = 5 [44%, min = 5, max = 5])
Everyone can express his opinion, this increases cohesion. And if people know each other, differences between video and audio conferencing in creating cohesion are not big anymore (u). Talking to each other increases goal attainment (u). Human interaction helps to understand each other (u).

Users strongly agree with significance.

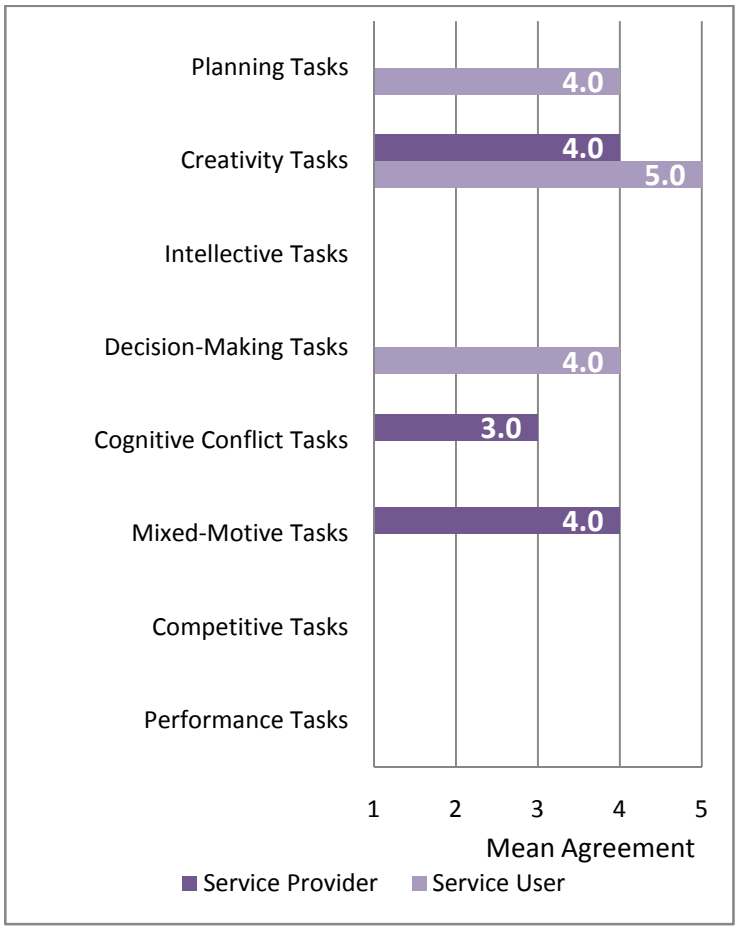
Mixed-Motive tasks (m_p = 4.5 [22%, min 4, max = 5], m_u = 4.5 [22%, min = 4, max = 5])
You can discuss an issue in a high degree of expressiveness (u).

Both parties tend to agree.

Competitive tasks (m_p = 4 [11%], m_u = 5 [11%])
One can personally expose oneself in an audio conference (u).

Competitive tasks (m_p = 4 [11%])

Better Work Practices



Better work practices arise in quite a few team tasks but only individually, besides one case. The level of agreement is mostly high. But the numbers of mentions are all very low. No trend can be shown.

Planning tasks (m_u = 4 [11%])

Creativity tasks (m_p = 4 [11%], m_u = 5 [11%])

You can stop someone from talking as soon as you can no longer follow someone's argumentation. In text conversations like email you cannot (u). Audio conferencing is only used in international projects (p).

Decision-making tasks (m_u = 4 [11%])

Cognitive-conflict tasks (m_p = 3 [11%])

Mixed-Motive tasks (m_p = 4 [11%])

Audio conferencing is 10 times more common that video conferencing (p).

Higher Interruption

Creativity tasks (m_p = 4 [11%], m_u = 5 [11%])

Everybody can call you up (u). You are blocked and you cannot do anything else besides (u).

Summary

Results of audio conferencing functionality show that most of the analyzed impacts are quite well supported, with regard to significance and with explanations by the respondents. Exceptions are better work practices and higher interruption.

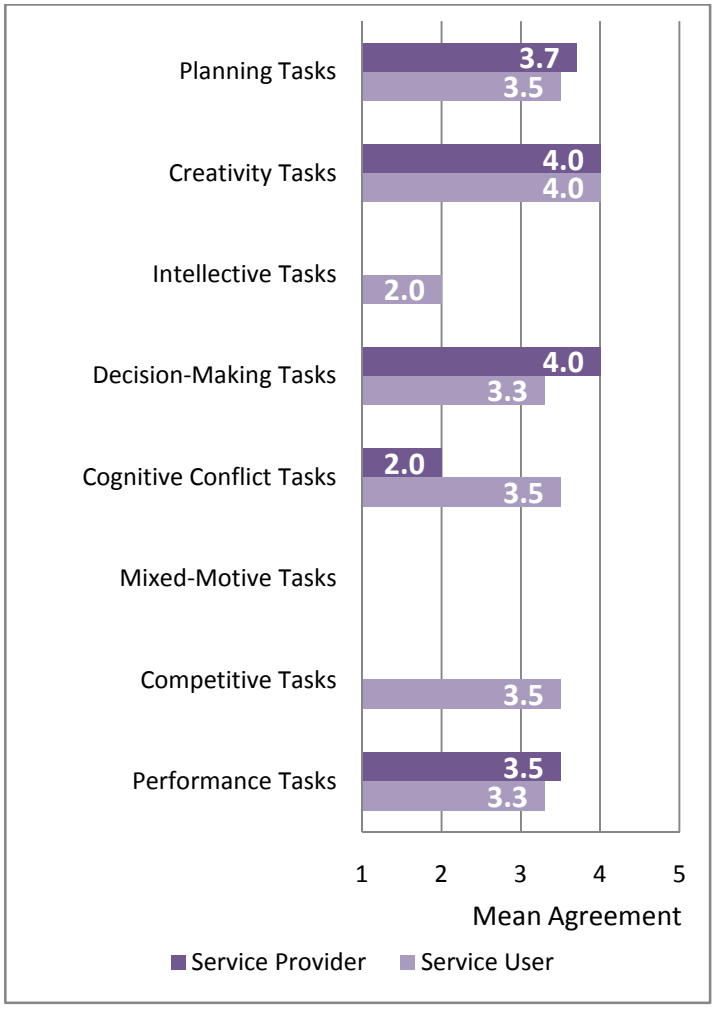
Higher project effectiveness is significantly supported in decision-making, cognitive conflict and mixed-motive tasks were service users tend to agree. Increased creativity is significantly supported in creativity tasks by users which tend to agree. Further, higher quality is significantly supported in decision-making tasks by service providers which tend to agree.

Then, higher time savings is significantly supported in planning and intellective tasks. Service users tend to agree in planning tasks and service providers at least do not disagree in intellective tasks. Higher transparency is supported in decision-making and in cognitive conflict task. For decision-making tasks, service users do not disagree or show even a better result. For cognitive conflict tasks, service users tend to agree. Finally, higher cohesiveness is supported by service users which agree in creativity tasks.

Respondents stress that audio conferencing is a good alternative to face-to-face meetings and reduces the need to travel. But audio does not allow, as chat does, that multiple parties can communicate at the same time.

5.1.3 Impact of Shared File Repository Functionality

Higher Project Effectiveness



Higher project effectiveness arises in all team tasks except for mixed motive tasks. Intellective and competitive tasks are only supported by users. The level of agreement is between medium and high, with two exceptions which disagree. The number of mentions is low or very low, besides performance tasks (only users).

Planning tasks (m_p = 3.7 [33%, min = 2, max = 5], m_u = 3.5 [22%, min = 3, max = 4])

Developed results need to be shared in order to decide whether or not the quality are appropriate (p).

Creativity tasks (m_p = 4 [11%], m_u = 4 [11%])

Intellective tasks (m_u = 2 [11%])

Decision-making tasks (m_p = 4 [11%], m_u = 3.3 [33%, min = 2, max = 5])

Alternatives can be documented and added with comments (u).

Cognitive-conflict tasks (m_p = 2 [11%], m_u = 3.5 [22%, min = 3, max = 4])

Shared file repositories allow to have documentation stored centrally (u).

Competitive tasks (m_u = 3.5 [22%, min = 3, max = 4])

Performance tasks (m_p = 3.5 [44%, min = 2, max = 4], m_u = 3.3 [33%, min = 2, max = 4])

Increased Creativity

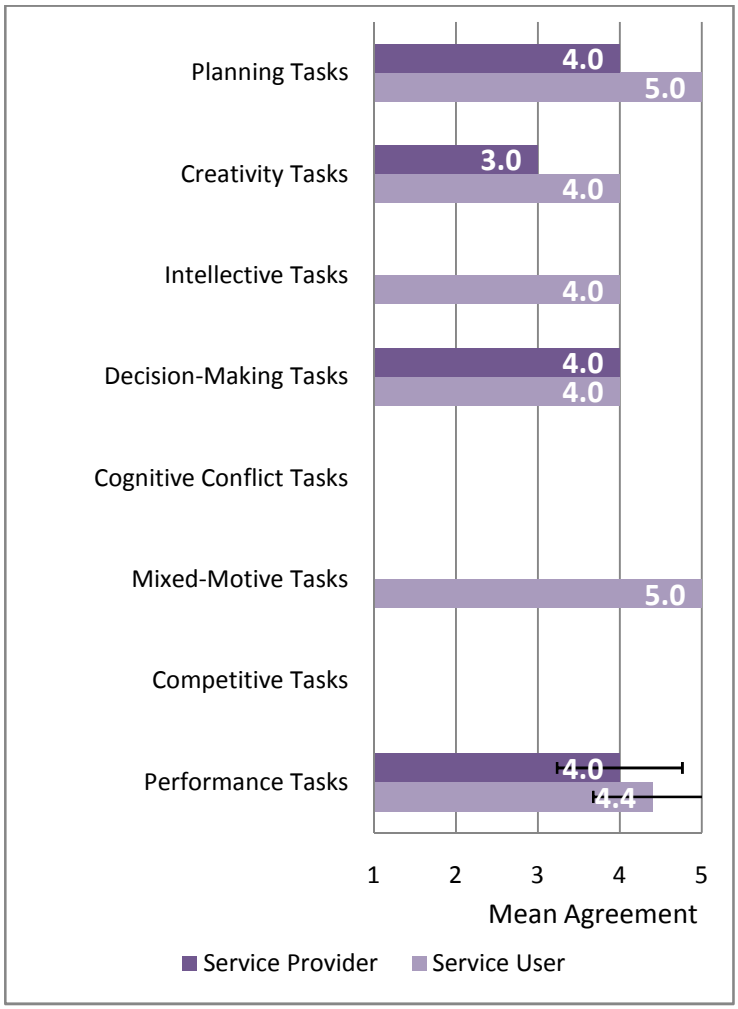
Increased creativity arises in only three tasks. The level of man agreement is between low and medium and the numbers of mentions are between low and very low. Only users supported this impact.

Planning tasks (m_u = 2.5 [22%, min = 2, max = 3])

Creativity tasks (m_u = 2.7 [33%, min = 2, max = 3])

Intellective tasks (m_u = 2.5 [11%])

Higher Quality



Higher quality arises in all team tasks except for cognitive conflict and competitive tasks. Intellective and mixed-motive tasks are only supported by users. The means are between high and very high, with one exception at medium level. The number of mentions is high for planning tasks (only service providers) and performance tasks.

Planning tasks (mp = 4 [44%, min = 2, max = 5], mu = 5 [11%])

Versioning helps to bring order into planning documents (p). You can monitor that collaboration happens, by looking at who contributed what with whom (u).

Creativity tasks (m_p = 3 [11%], m_u = 4 [11%])

Intellective tasks (m_u = 4 [22%, min =, max =])

Decision-Making tasks (mp = 4 [11%], mu = 4 [22%, min = 3, max = 5])

Due to the fact that plenty of people can write down his argumentation and feedback and

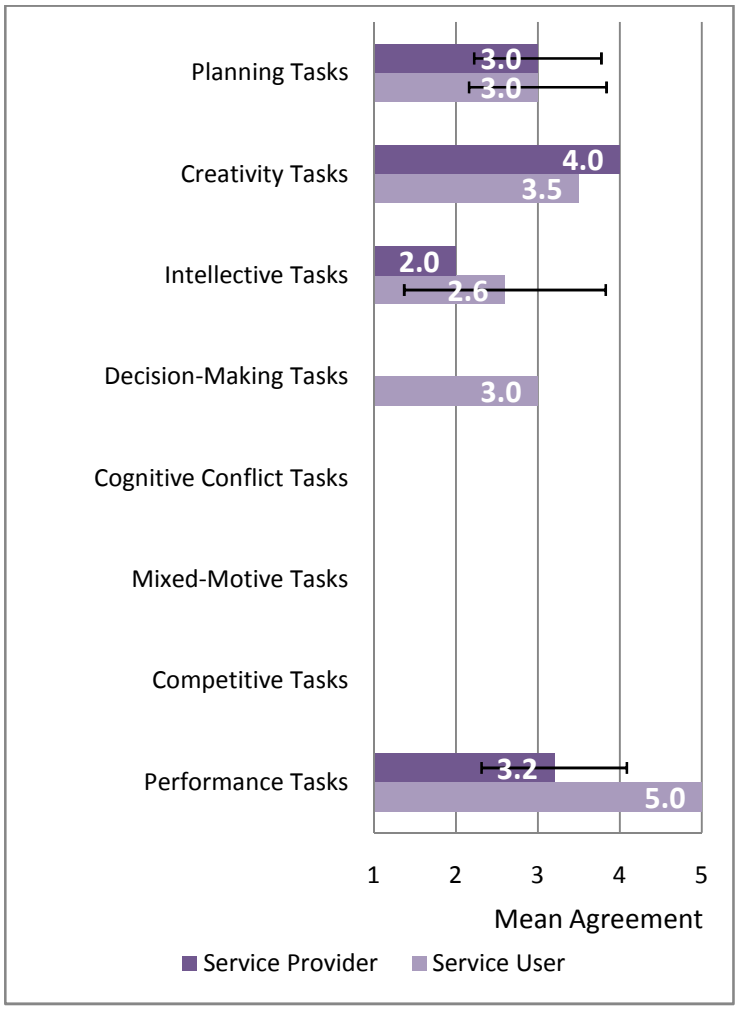
read it in a centrally stored document, decisions will arise which may be widely accepted and of high quality (u).

Mixed-Motive tasks (mu = 5 [11%])
Standpoints described in depth in a document can help to solve an issue (u).

Performance tasks (mp = 4 [55%, min = 3, max = 5], mu = 4.4 [55%, min = 3, max = 5])
One documents something and another one can provide feedback, higher quality results (u). Thanks to transparency, higher quality results (u). It is better to provide a review to a centrally stored document, because access is restricted to a single person. Received by email it is sometimes hard to merge feedback (u).

Both parties show high means as well as a high number of mentions. The confidence intervals strongly overlap, thus no significant difference can be found. But it can be stated that both parties at least do not disagree that shared file repositories used in performance tasks lead to higher quality.

Higher Time Savings



Higher time savings arises in five of the height team tasks. Decision-making tasks are only supported by service users and cognitive conflict, mixed-motive and competitive tasks are not supported. The means lie between medium and high, with two exceptions below and one above. The number of mentions are in many cases high or even very high.

Planning tasks

(mp = 3 [44%, min = 2, max = 4]; mu = 3 [88%, min = 1, max = 4, mode = 4])

Helps to build a repository which suits best the needs of a group within a certain topic. Time to search a something is reduced (p).

Both parties show the same medium level mean. But users provided twice as many mentions than providers. According to min, max and mode, the values of users are equally distributed with few strong outliers. The confidence intervals of both parties strongly overlap, thus no significant difference exists. Because the confidence intervals lie in the middle of the scale

and reach from almost disagree to agree, no trend can be stated. Compared with the numbers of mentions of both parties, very few valuable explanations are made.

Creativity tasks (mp = 4 [11%], mu = 3.5 [22%, min = 3, max = 4])

Intellective tasks (mp = 2 [11%]; mu = 2.6 [55%, min = 1, max = 5, mode = 2])
Descriptions about solved problems can be stored and shared with others (u). Problem solver save time if they can reuse documented and shared solutions to a problem (u). Searching for a solution can be time-consuming (p).

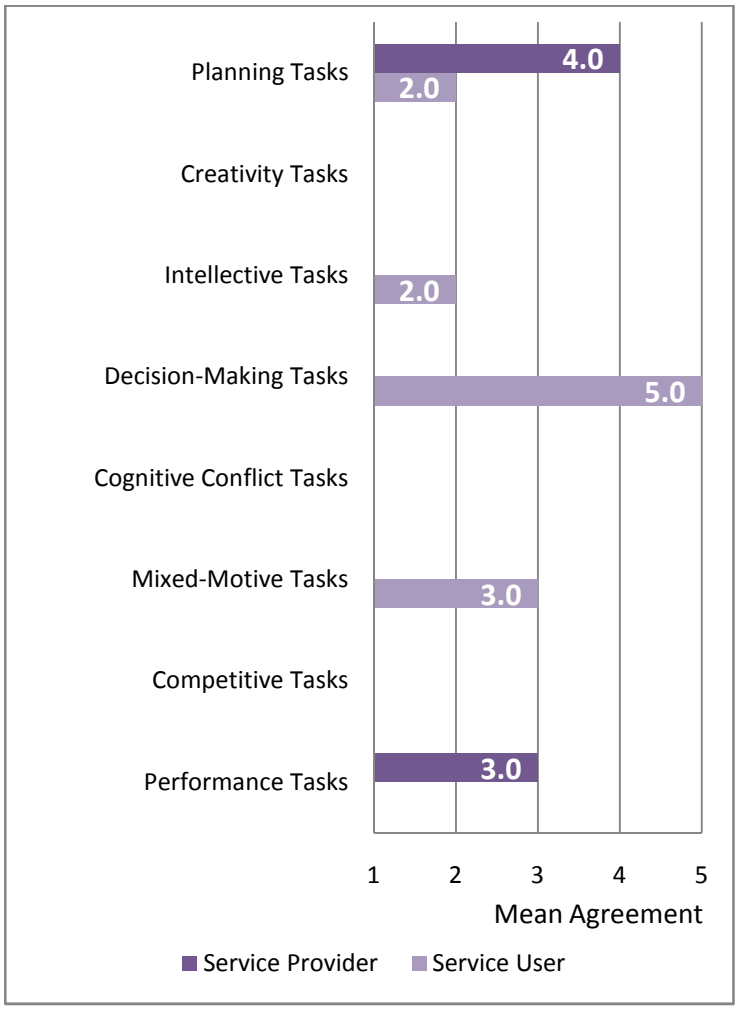
Users show a high number of mentions but a slightly low level of mean agreement. The confidence interval is too wide to show any trend.

Decision-making tasks (mu = 3 [11%])

Performance tasks (mp = 3.2 [55%, min = 2, max = 4], mu = 5 [33%, min = 5, max = 5])
Fast access to centrally stored resources (u). Usually documents are sent several times by email, than once stored in a centrally accessible storage (p). Using shared file repositories for collaborative work saves time (u).

Providers show a medium level mean and a high number of mentions. But the confidence interval is too wide to show any trend.

Higher Cost Savings



Higher cost savings arises in five of the height team tasks but mostly not paired. The numbers of mentions are too low and too few explanations are provided to make any further statement.

Planning tasks (m_p = 4 [11%], m_u = 2 [11%])

Intellective tasks (m_u = 2 [22%, min = 1, max = 3])

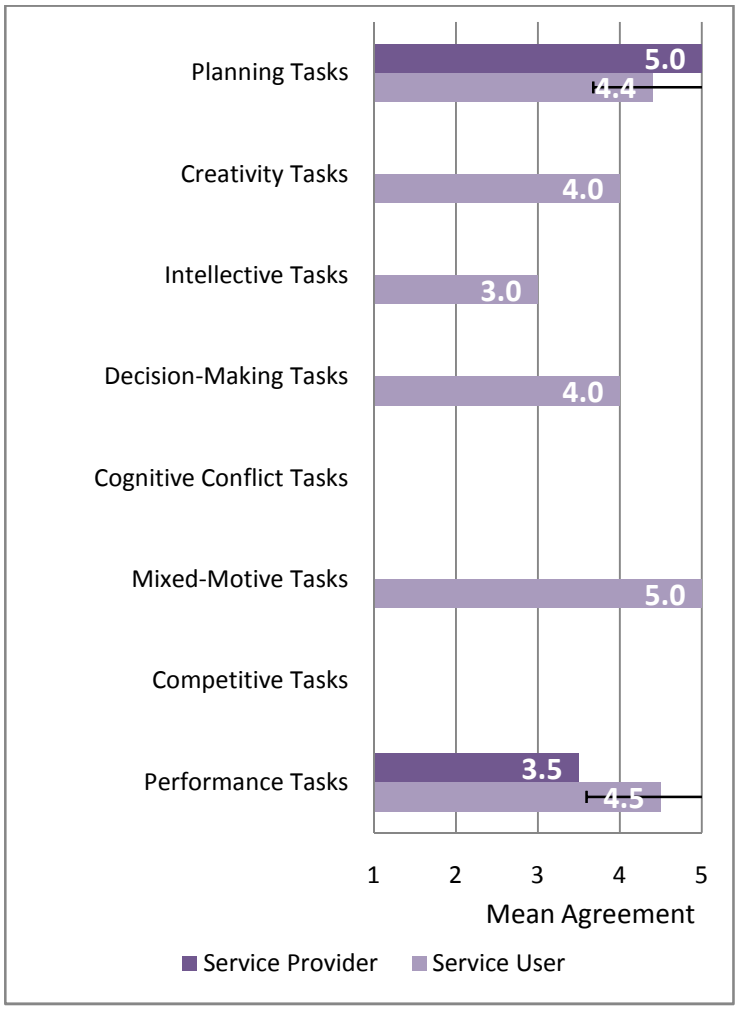
Decision-making tasks (m_u = 1 [11%], m_u = 5 [11%])

Documents in a shared file repository may support in decision-making and this can influence resource use (u).

Mixed-Motive tasks (m_u = 3 [11%])

Performance tasks (m_p = 3 [11%])

Higher Parallelization



Higher parallelization arises in six of the height team tasks mostly just supported by service users. The numbers of mentions are high for planning, intellective and performance tasks (only service users). Intellective and performance tasks are well supported by explanations.

Planning tasks (mp = 5 [11%], mu = 4.4 [55%, min = 3, max = 5])

Plans need to be editable by multiple people (u).

According to the confidence interval, it can be stated that service users do not disagree that shared file repositories used in planning tasks lead to higher parallelization. This statement is supported by one explanation.

Creativity tasks (mu = 4 [11%])

Intellective tasks (mu = 3 [44%, min = 1, max = 5])

Shared file repositories only help to document facts which have been developed in discussions

with other tools. Parallel work is supported, because simultaneous access is possible. (u). Synchronous access to a document facilitates that multiple people can write down ideas at the same time (e.g. in a brainstorming session) (u).

The two explanations are similar to the one in planning tasks.

Decision-making tasks (mu = 4 [11%])

Mixed-Motive tasks (mu = 5 [11%])

Everyone can write down his interests, but only if an appropriate company culture exists (u).

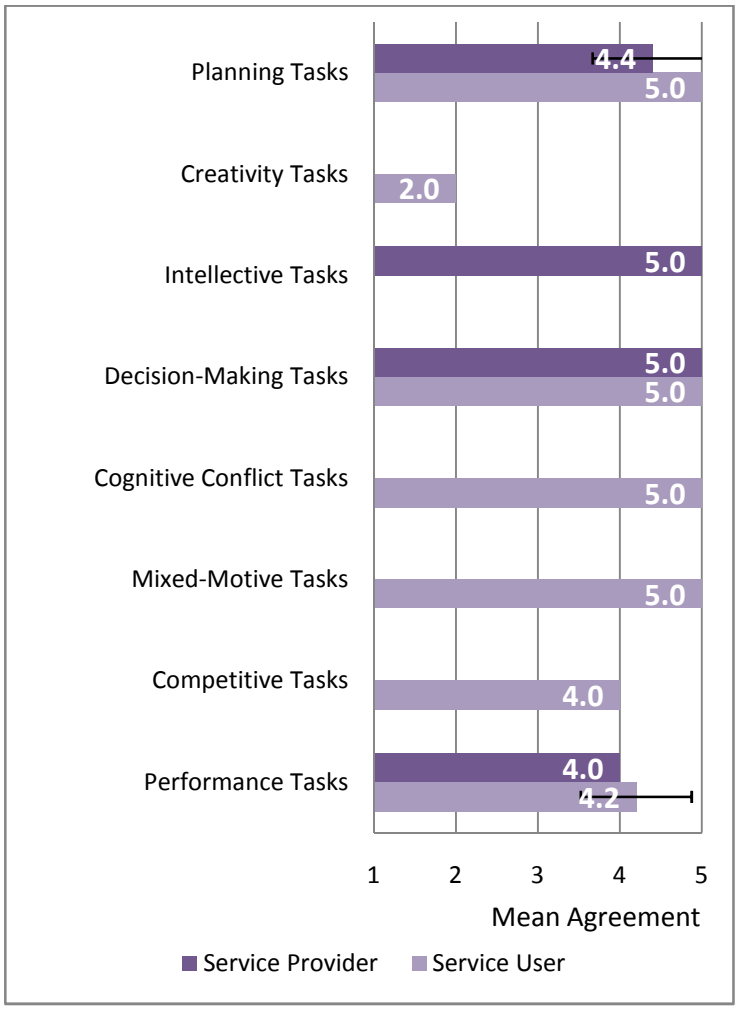
Performance tasks

(mp = 3.5 [22%, min = 3, max = 4], mu = 4.5 [66%, min = 2, max = 5, mode = 5])

Serves to centrally store results by several parties at the same time, which is required in projects (u). Several people can work synchronously on the same document (u). Information about who did something and at which time is available (u). Shared file access is a basis infrastructure for collaborative work in a project (u [22%, min =, max =]).

According to the confidence interval of users, it can be stated that they do not disagree that shared file repositories used in performance tasks lead to higher parallelization. The explanations strongly support this statement.

Higher Transparency



Higher transparency arises in all team tasks. Four times just supported by users. The numbers of mentions are generally low. A high number of mentions show planning, decision-making and performance tasks (only service users). Planning tasks are well supported by explanations.

Planning tasks

(mp = 4.4 [55%, min = 4, max = 5, mode = 4], mu = 5 [77%, min = 5, max = 5, mode = 5])

A shared file repository is the single source of information in projects: one is aware of who has worked on which document. Additionally different versions of a document are available (p). All parties work with the same information base. Versioning problems are rare. Without such a repository one is lost in an audio conference (u). A team can see among each other the current state of work and may influence it (u).

The confidence intervals of both parties strongly overlaps (because planning tasks show 7 times the same value, the confidence interval is not displayed), no significant difference can be found. But it can be stated that providers do not disagree and users strongly agree that shared file repositories used in planning tasks lead to higher transparency. The explanations fully support this statement.

Creativity tasks (mu = 2 [11%])
Allows to document spoken statements (u).

Intellective tasks (mp = 5 [11%])
You can see the work progress of other project members or external experts (p).

Decision-Making tasks (mp = 5 [11%], mu = 5 [44%, min = 5, max = 5])
Allows to document developed alternatives, which can be used for later polling (u). Shows mutual decisions (u).

Users show with significance to strongly agree.

Cognitive conflict tasks (mu = 5 [22%, min = 5, max = 5])
Allows to document standpoints and relationships (u).

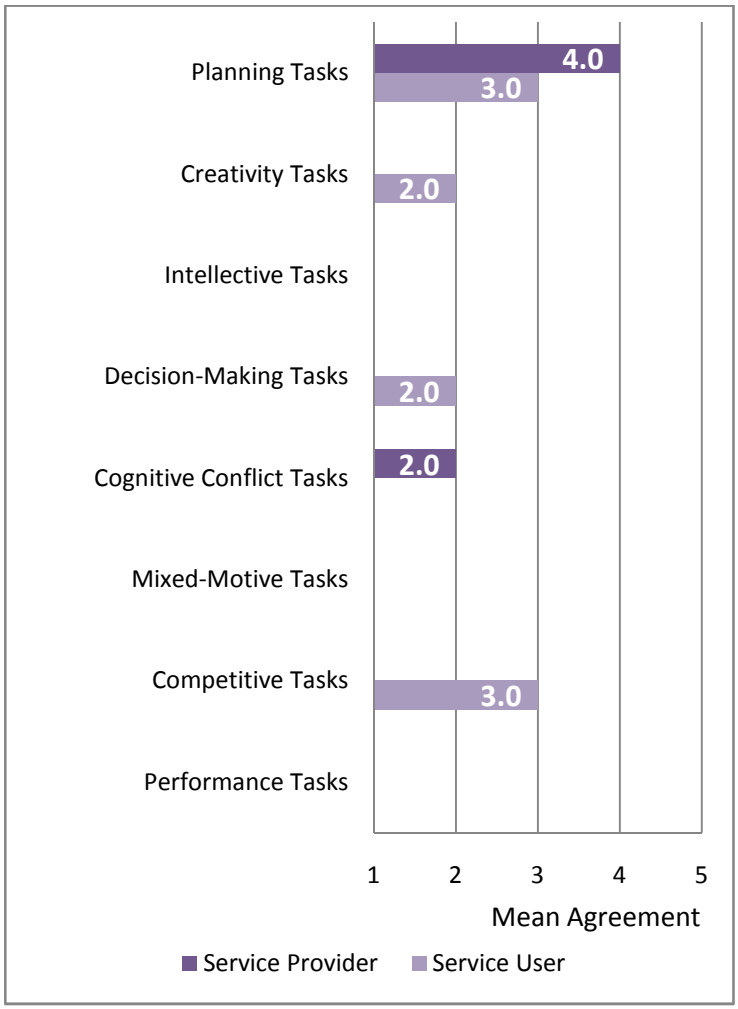
Users tend to agree.

Mixed-Motive tasks (mu = 5 [11%])
Allows do document discussed issues (u).

Competitive tasks (mu = 4 [11%])
Performance tasks (mp = 4 [11%], mu = 4.2 [55%, min = 3, max = 5])

According to the confidence interval, service users do not disagree that shared file repositories used in performance tasks lead to higher transparency. No explanations support this statement.

Higher Cohesiveness



Higher cohesiveness arises in five of the height team tasks. Since the numbers of mentions is very low, and explanations are rare, no further statements are made.

Planning tasks (m_p = 4 [11%], m_u = 3 [22%, min = 3, max = 3])

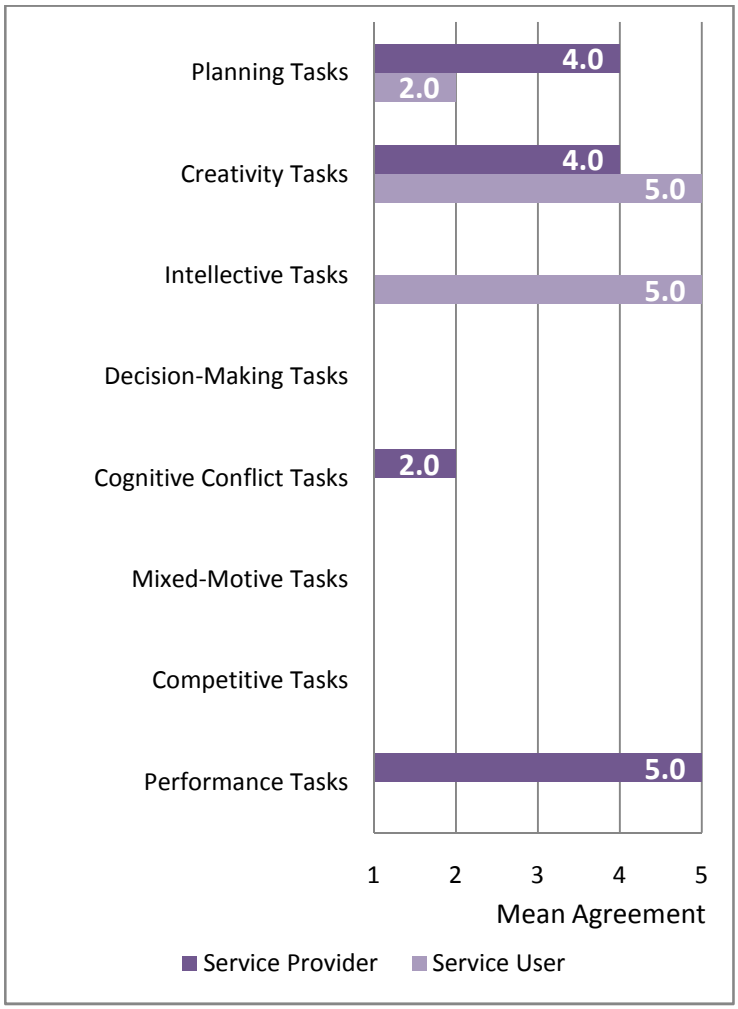
Users tend to neither agree nor disagree.

Creativity tasks (m_p = 1 [11%], m_u = 2 [22%, min = 2, max = 2])
It is most anonymous among other tools (u).

Users tend to disagree.

Decision-making tasks (m_u = 2 [11%]) **Cognitive-conflict tasks** (m_p = 2 [11%])
Competitive tasks (m_u = 3 [11%])

Better Work Practices



Better work practices arise in five of the height team tasks. The numbers of mentions are generally very low, but the most of the team tasks are underpinned by an explanation. The explanations show some negative aspects of shared file repositories.

Planning tasks (m_p = 4 [22%, min = 4, max = 4], m_u = 2 [11%])

Storing documents in a shared file repository may get out of control, because they store things several times (u).

Providers tend to agree.

Creativity tasks (m_p = 4 [11%], m_u = 5 [11%])

Helps to documents facts, but the mindset of someone is hard to conserve in written form (p). Leads people to store data centrally and share it (u).

Intellective tasks (m_u = 5 [22%, min = 5, max = 5])

Serves to solve things similarly via templates (u).

Users tend to strongly agree.

Cognitive Conflict tasks (m_p = 2 [11%])

Performance tasks (m_p = 5 [11%])

One is fast, has everything centrally stored at hand (p).

Higher Interruption This impact is not supported.

Summary

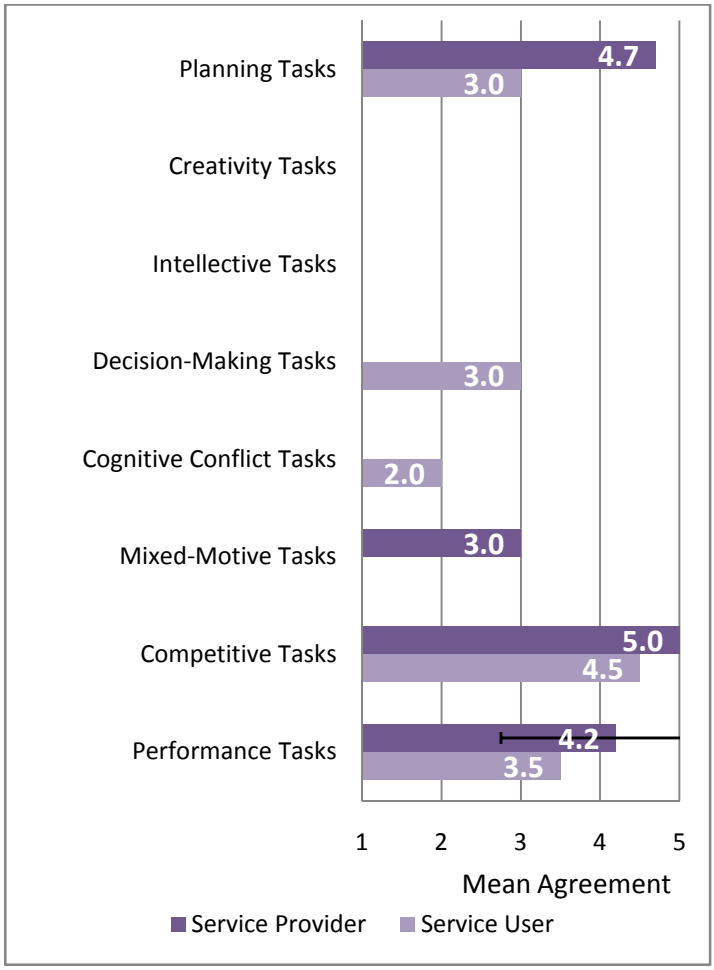
Results of shared file repository functionality show that only some of the impacts analyzed are quite well supported, with regard to significance and with explanations by the respondents.

Cognitive conflict tasks and mixed-motive tasks are mostly not supported. Higher quality is supported in performance tasks. Providers do not disagree and users tend to agree. Higher parallelization is supported in planning and performance tasks. In both cases users do not disagree. And finally, higher transparency is supported in planning tasks. Providers do not disagree and in performance tasks. Users do not disagree.

Respondents often mention the advantage that documents are stored centrally and thus all team members have access to it. This allows checking the work progress of others and providing feedback.

5.1.4 Impacts of Group Scheduling / Coordination Functionality

Higher Project Effectiveness



Higher project effectiveness arises in all team tasks, except creativity and intellective tasks. Three times support comes just from one party. The numbers of mentions are generally low or very low. A high number of mentions show performance tasks (only service provider).

Planning tasks (m_p = 4.7 [33%, min = 4, max = 5], m_u = 3 [11%])

A managed and correct project plan leads higher effectiveness in projects (p).

Providers tend to agree.

Decision-making tasks (m_u = 3 [11%]) **Cognitive-conflict tasks** (m_u = 2 [11%])

Mixed-Motive tasks (m_p = 3 [11%])

Competitive tasks (m_p = 5 [22%, min = 5, max = 5], m_u = 4.5 [22%, min = 4, max = 5])
Helps to solve conflicts in a project, shows facts about the current state and highlights which work is required further (p). Supports to better reach strategic objectives (u).

Providers tend to strongly agree and users tend to agree.

Performance tasks
(m_p = 4.2 [55%, min = 1, max = 5, mode = 5], m_u = 3.5 [22%, min = 2, max = 5])
Development of milestones is planning work. Group calendar is a widely used tool to coordinate deadlines and resources (p). Allows to precisely describe tasks and adhere to them. Monitoring is simple (u). One can work predictive and detect the critical path (p). Shows objectives of the different milestones (p). It is known who has what to do (p).

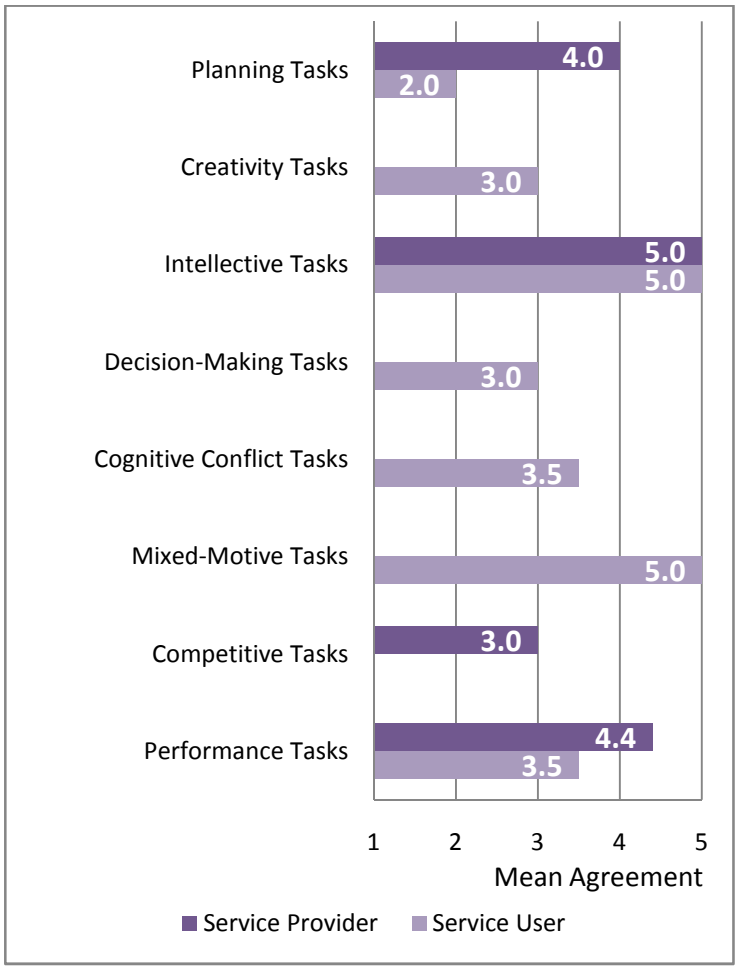
The confidence interval for providers is very wide which only allows the statement that they might not strongly disagree. The explanations all support a high agreement.

Increased Creativity

This impact is almost not supported.

Planning tasks (m_u = 1 [11%])
Cognitive-conflict tasks (m_u = 3 [11%])

Higher Quality



Higher quality arises in all team tasks. But 4 of those are just supported by one party. The numbers of mentions are generally low or very low. Only planning and performance tasks show a high number for service users.

Planning tasks (m_p = 4 [44%, min = 2, max = 5], m_u = 2 [11%])

Higher quality of work results from easier time planning (p). Helps to meet each other, to collaborate and as such to increase quality (u). Higher quality results because several people can easily review and comment on centrally stored project planning information (p).

Creativity tasks (m_u = 3 [11%])

Intellective tasks (m_p = 5 [22%, min = 5, max = 5], m_u = 5 [11%])

We made the experience that about a dozen solutions are contributed described in a ticketing system emerge (p). Brings experts together (u). Problem solving requires that people talk to each other (p).

Providers tend to strongly agree.

Decision-Making tasks (m_u = 3.5 [11%])

Cognitive conflict tasks (m_u = y [22%, min = 2, max = 5])

Facilitates the arrangement of a face-to-face group meeting (u).

Mixed-Motive tasks (m_u = 5 [11%])

Facilitates the arrangement of a face-to-face group meeting (u).

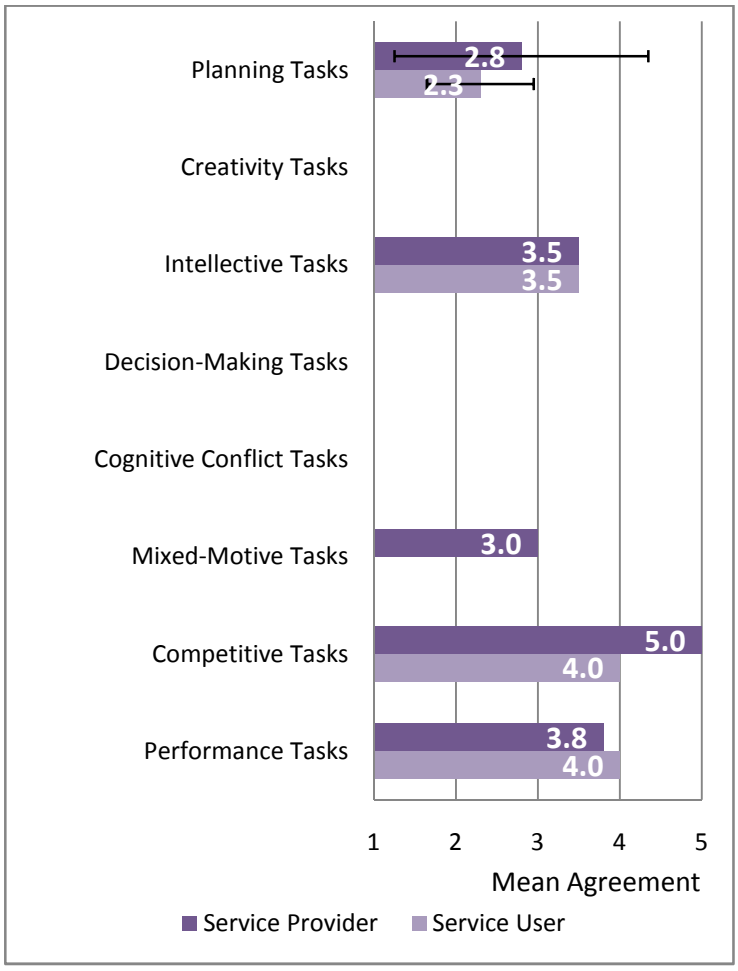
Competitive tasks (m_p = 3 [11%])

Makes potentials for optimization transparent (p).

Performance tasks (m_p = 4.4 [44%, min = 3, max = 5], m_u = 3.5 [22%, min = 2, max = 5])

Better synchronization of work packages leads to higher quality (u). Team members keep planning information up to date. This allows to keep track of the work progress (p). Team members are informed about time related issues. This positively influences quality (u).

Higher Time Savings



Higher time savings arise in only 4 team tasks. The numbers of mentions are generally low or very low, except for planning and performance tasks (only service providers).

Planning tasks

(m_p = 2.8 [44%, min = 1, max = 5]; m_u = 2.3 [77%, min = 1, max = 4, mode = 2])

Today's project management software (e.g. Gantt Charts) increase transparency, but to change a project plan with many relations among work packages may take a long time (p). It is not used often for collaborative work (u).

The confidence intervals strongly overlap, thus no significant difference exists and the one for providers is too wide to see any trend. The confidence interval of users shows a trend to disagree.

Intellective tasks (m_p = 3.5 [22%, min = 3, max = 4], m_u = 3.5 [22%, min = 2, max = 5])

Mixed-motive tasks (m_p = 3 [11%])

Competitive tasks (m_p = 5 [11%], m_u = 4 [11%])

Allows to go easy on resources (p).

Performance tasks (m_p = 3.8 [44%, min = 2, max = 5], m_u = 4 [22%, min = 4, max = 4])

Efficiently arrange a meeting (p). Other tools are used more often to collaborate (p).

Users tend to agree.

Higher Cost Savings

Higher cost savings arise in only a few team tasks and the number of mentions is very low. Thus no further statements are made.

Planning tasks (m_p = 4 [22%, min = 3, max = 5], m_u = 3 [11%])

Higher project transparency leads to more efficient resource use, adhering to project aims and decreases traveling (p).

Competitive tasks (m_p = 5 [11%])

Serves to detect cost optimization (p).

Performance tasks (m_p = 2 [11%])

Higher Parallelization

Higher parallelization arises in only a few team tasks and the number of mentions is very low, except for planning tasks. Thus no further statements are made.

Planning tasks (m_u = 3 [44%, min = 2, max = 4]

Intellective tasks (m_u = 3.5 [22%, min = 2, max = 5])

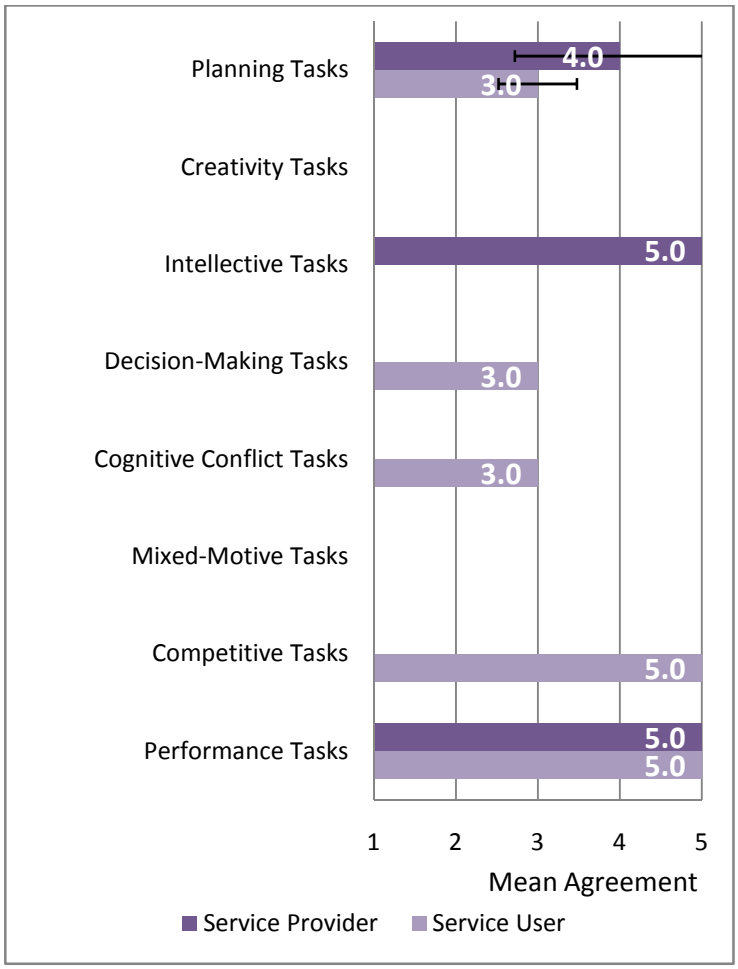
Each member of a team is better informed about the project. This facilitates to work in parallel (p).

Competitive tasks (m_p = 5 [11%])

Performance tasks (m_p = 2 [22%, min = 2, max = 2], m_u = 4.5 [22%, min = 4, max = 5])

Providers tend to disagree and users tend to agree.

Higher Transparency



Higher transparency arises in six of the height team tasks and mostly unpaired. Except for planning tasks very few numbers of mentions are provided.

Planning tasks (m_p = 4 [44%, min = 2, max = 5]; m_u = 3 [66%, min = 2, max = 4, mode = 3])
In order to assess a project, a project plan is required (p).

The confidence intervals strongly overlap, thus no significant difference can be found. Because the confidence intervals lie in the middle of the scale and are quite wide, no trend is shown.

Intellective tasks (m_p = 5 [11%])

Who did what to solve a problem (p [11%]*)?*

Decision-Making tasks (m_u = 3 [33%, min = 2, max = 4])

Facilitates that people can meet (u).

Cognitive conflict tasks (m_u = 3 [11%])

Competitive tasks (m_u = 5 [22%, min = 5, max = 5])

Resources are better organized, especially in a competitive situation (u). No later than at tier of management central project information needs to be made transparent (u).

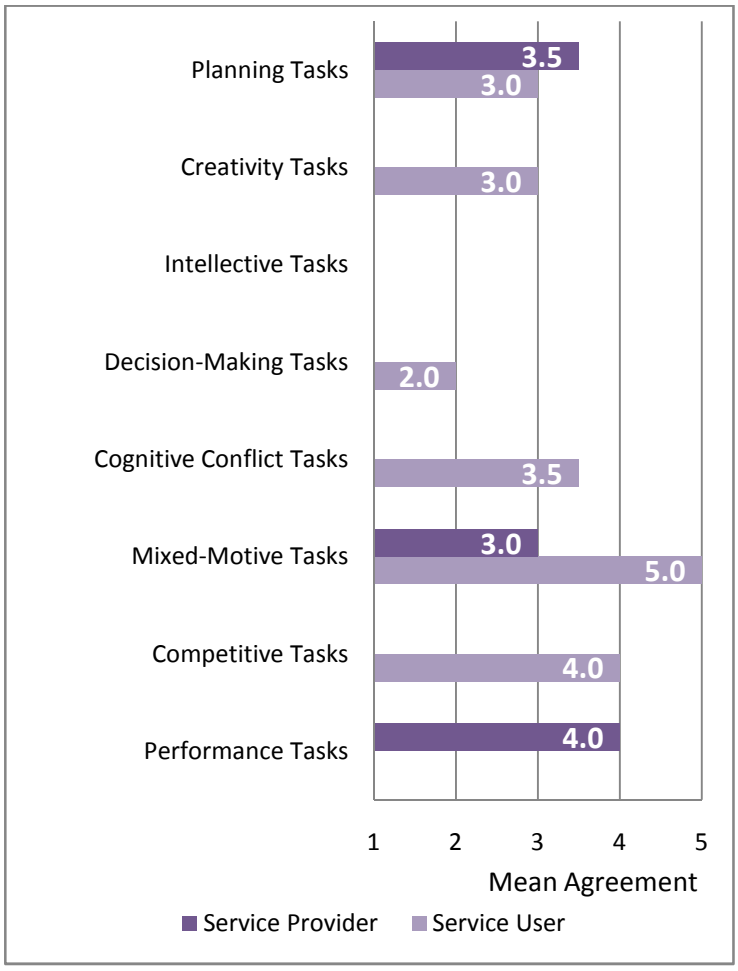
Providers tend to strongly agree.

Performance tasks (m_p = 5 [33%, min = 5, max = 5], m_u = 5 [11%])

Enables the development and communication of a project plan (u). It is an orientation guide (p).

Providers tend to strongly agree.

Higher Group Cohesiveness



Higher group cohesiveness arise in almost all team tasks, but the number of mentions is very low.

Planning tasks (m_p = 3.5 [22%, min = 2, max = 5], m_u = 3 [11%])

Cohesiveness is increased because everyone knows what to do and with whom (p).

Creativity tasks (m_u = 3 [11%])

It does not increases cohesiveness, because no emotion are transmitted (u).

Decision-making tasks (m_u = 2 [11%])

Cognitive conflict tasks (m_u = 3.5 [22%, min = 2, max = 5])

Brings groups together to discuss an issue face-to-face (u). Brings groups together to discuss an issue face-to-face (u).

Mixed-motive tasks (m_p = 1 [11%]) **Competitive tasks** (m_u = 4 [11%])

Performance tasks (m_p = 4 [11%])

Better Work Practices

This impact is almost not supported.

Planning tasks (m_p = 2 [22%, min = 2, max = 2], m_u = 3 [11%])

A project management tool is only used by a project manager (p).

Providers tend to disagree.

Creativity tasks (m_u = 3 [11%])

Performance tasks (m_p = 5 [11%])

One can proactively react on problems related with project planning (p).

Higher Interruption

This impact is not supported by any respondent.

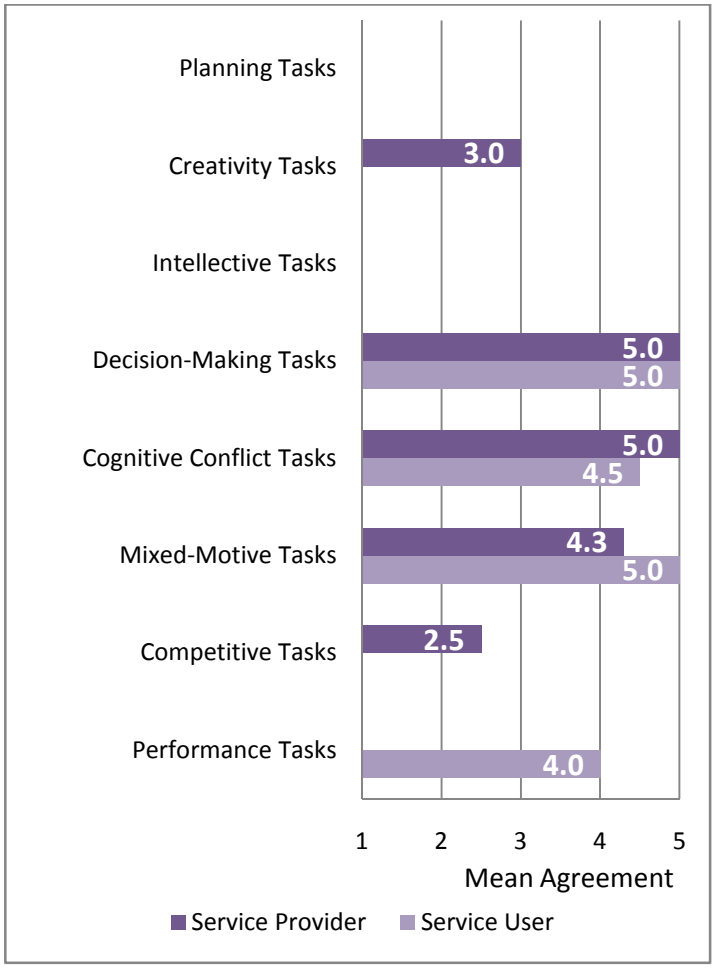
Summary

Results of group scheduling / coordination functionality show that only few of the impacts are supported. Some confidence intervals do not allow any trend; because they reach from disagree to agree. Higher time savings is significantly supported for planning tasks. Users do not agree and tend to disagree.

Respondents stress that group scheduling / coordination functionality allows a team to efficiently arrange a meeting and to then work collaborative via another media. Additionally it allows to better synchronize work packages and other resources of a project.

5.1.5 Impacts of Video Conferencing Functionality

Higher Project Effectiveness



Higher project effectiveness arises in six of the height team tasks and mostly unpaired. The numbers of mentions provided are very low.

Planning tasks (m_p = 1 [11%])

Creativity tasks (m_p = 3 [11%])

Decision-making tasks (m_p = 5 [11%], m_u = 5 [22%, min = 5, max = 5])

Synchronously you can get a commitment (u). Best alternative to a face-to-face meeting (u).

Users tend to strongly agree.

Cognitive-conflict tasks (m_p = 5 [11%], m_u = 4.5 [22%, min = 4, max = 5])

A common understanding of the objectives facilitates to reach them. Video conferencing provides supports better understanding, because you can see the others (p).

Users tend to agree.

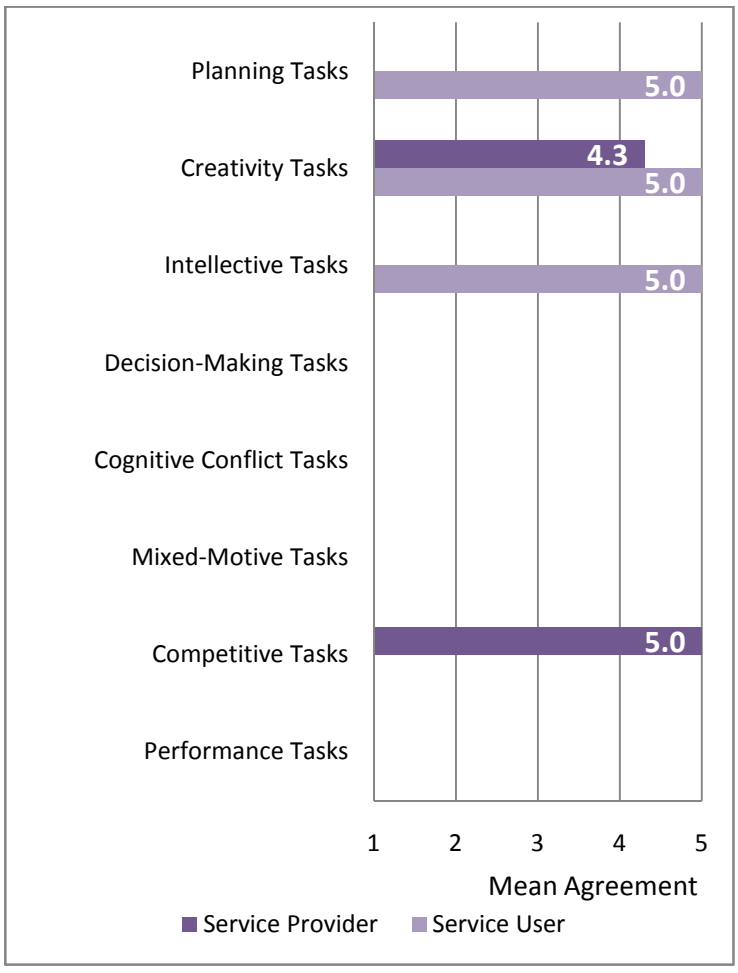
Mixed-Motive tasks (m_p = 5 [33%, min = 3, max = 5], m_u = 5 [11%])

You can see the commitment (u).

Competitive tasks (m_p = 2.5 [22%, min = 2, max = 3])

Performance tasks (m_p = 1 [11%], m_u = 4 [11%])

Increased Creativity



Increased creativity arises in only four team tasks and mostly unpaired. The level of mean agreement is high or very high. The numbers of mentions provided are very low. As mentioned for higher project effectiveness, the explanations point again on the advantage that you can hear and see someone in a video conference.

Planning tasks (m_u = 5 [11%])

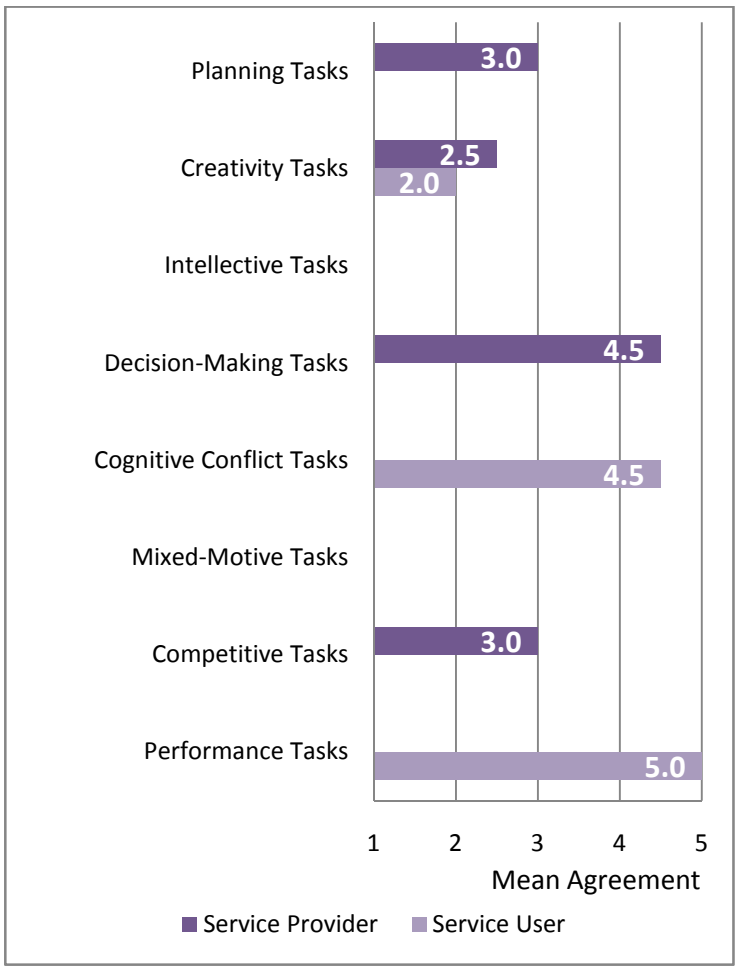
Creativity tasks (m_p = 4.3 [33%, min = 3, max = 5], m_u = 5 [11%])

You can see how someone reacts and you can respond to non verbal signals. A well functioning team can then more rapidly generate new ideas (p). The non-verbal language can have positive effects (u). People are encouraged to contribute someting (p).

Intellective tasks (m_u = 5 [11%])

Competitive tasks (m_p = 5 [11%])

Higher Quality



Higher quality arises in six team tasks and mostly unpaired. The level of mean agreement is medium to high. The numbers of mentions provided are very low.

Planning tasks (m_p = 3 [11%])

Creativity tasks (m_p = 2.5 [22%, min = 2, max = 3], m_u = 2 [11%])

Decision-making tasks (m_p = 4.5 [22%, min = 4, max = 5])

It is most important for synchronous discussions. But some months later you probably have forgotten some details. It is therefore good to supplement it with a text conversation tool (p).

Providers tend to agree.

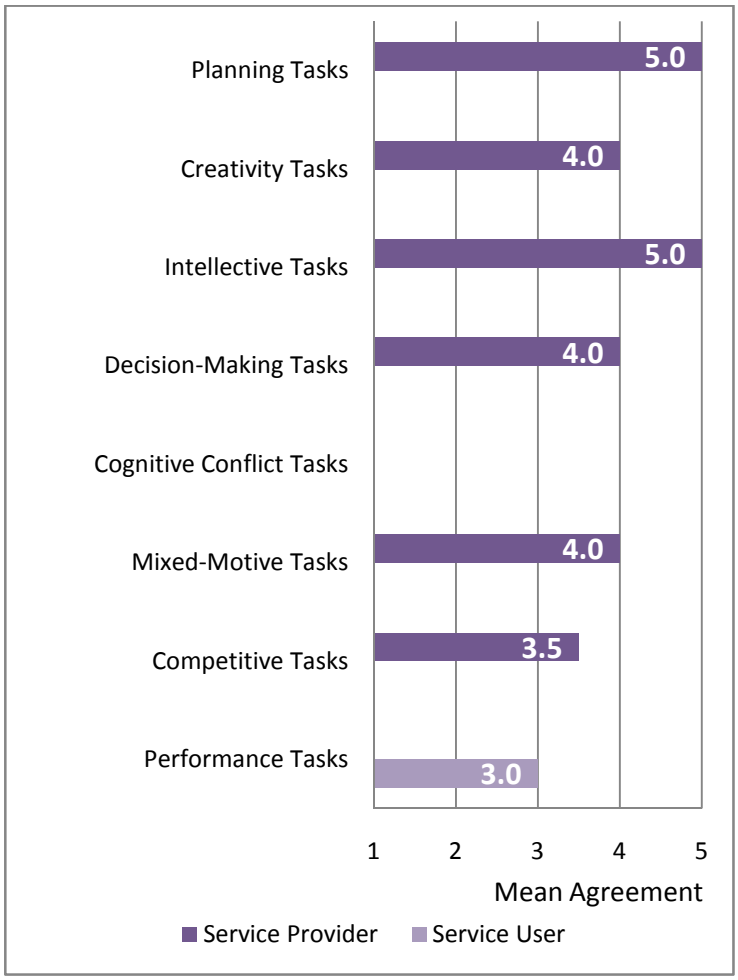
Cognitive-conflict tasks (m_u = 4.5 [22%, min = 4, max = 5])

Users tend to agree.

Competitive tasks (m_p = 3 [11%])

Performance tasks m_p = (1 [1], m_u = 5 [11%])

Higher Time Savings



Higher time savings arises in six team tasks but only unpaired. The level of mean agreement is mostly high. The numbers of mentions provided are very low.

Planning tasks (m_p = 5 [11%])

Creativity tasks (m_p = 4 [11%])

Intellective tasks (m_p = 5 [11%])

Decision-making tasks (m_p = 4 [22%, min = 3, max = 4])

Mixed-Motive tasks (m_p = 2 [22%, min = 3, max = 5])

Together, drinking a beer is the best. This is the second-best (p). In conflict situations people rarely talk to each other (p).

Competitive tasks (m_p = 3.5 [22%, min = 2, max = 5])

Performance tasks (m_u = 3 [11%]

Higher Cost Savings

This impact is almost not supported.

Planning tasks (m_p = 3 [22%, min = 1, max = 5])

Intellective tasks (m_u = 5 [11%])

Competitive tasks (m_p = 4 [11%])

Higher Parallelization

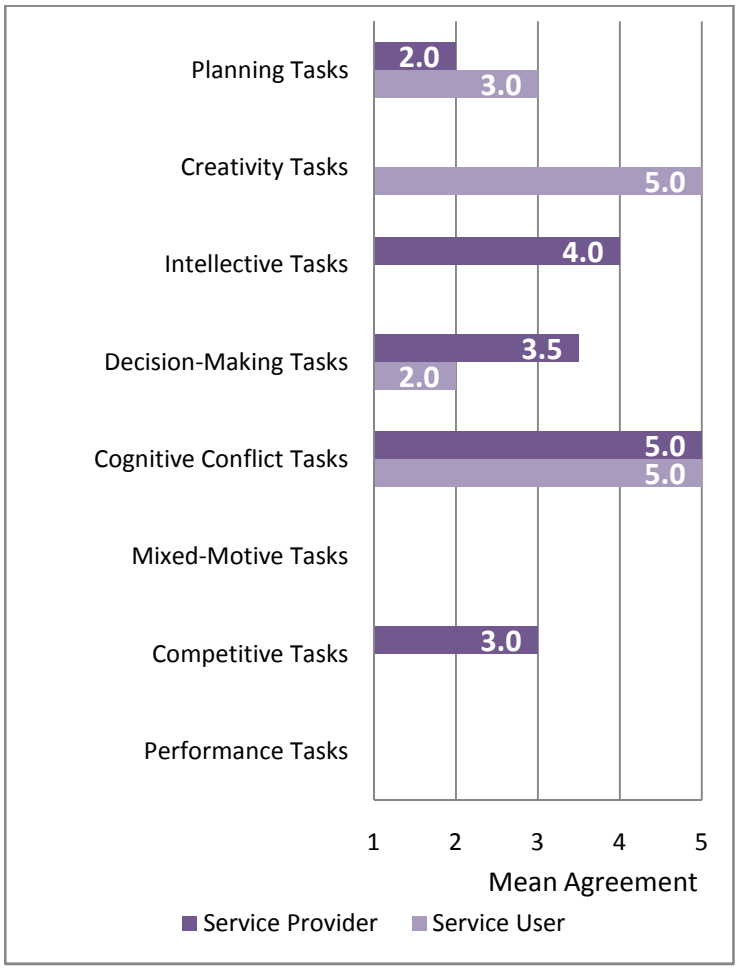
This impact is almost not supported.

Intellective tasks (m_u = 3 [11%])

Decision-making tasks (m_p = 5 [11%])

Competitive tasks (m_p = 2 [11%])

Higher transparency



Higher transparency arises in six team tasks and sometimes unpaired. The level of agreement is mostly above medium. But the numbers of mentions are very low.

Planning tasks (m_p = 2 [22%, min = 1, max = 3], m_u = 3 [11%])

Creativity tasks (m_u = 5 [11%])

One can see how someone brings in a theme (u).

Intellective tasks (m_p = 4 [11%])

Decision-making tasks (m_p = 3.5 [22%, min = 3, max = 4], m_u = 2 [11%])

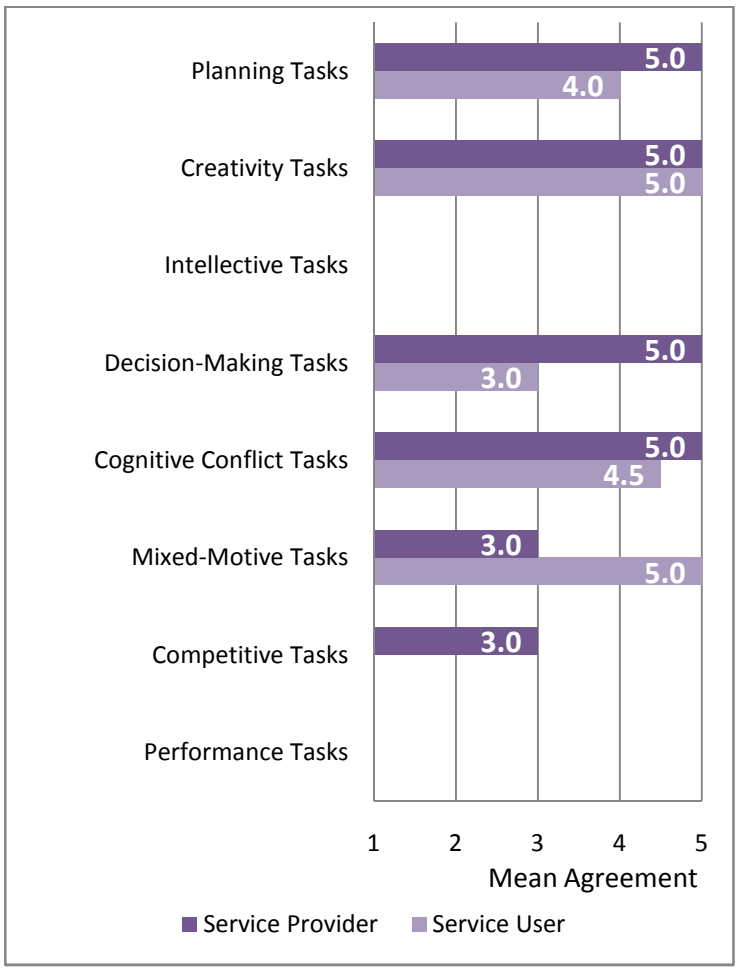
It does not document a decision (u).

Cognitive-conflict tasks (m_p = 5 [11%], m_u = 5 [11%])

Competitive tasks (m_p = 3 [11%])

Performance tasks (m_p = 1 [11%])

Higher Cohesiveness



Higher cohesiveness arises in six team tasks and mostly paired. The level of mean agreement is mostly very high. The numbers of mentions provided are very low.

Planning tasks (m_p = 5 [11%], m_u = 4 [11%])

It is very personal (p).

Creativity tasks (m_p = 5 [11%], m_u = 5 [22%, min = 5, max = 5])

You can see the body language. But sometimes this is too much information (u). The non-verbal language can have positive effects (u).

Users tend to strongly agree.

Decision-making tasks (m_p = 5 [11%], m_u = 3 [11%])

Cognitive-conflict tasks

(m_p = 5 [22%, min = 5, max = 5], m_u = 4.5 [22%, min = 4, max = 5])

Allows to interact socially (p). A newly build team should first of all work with video conferencing, in order to get to know each other (u).

Providers tend to strongly agree and users tend to agree.

Mixed-Motive tasks (m_u = 5 [11%])

There is no written exchange of such information. People need a more personal context to speak about conflicts of interest (p). Gesture reinforces the cohesive (u).

Competitive tasks (m_p = 3 [11%])

Better Work Practices

This impact is almost not supported.

Planning tasks (m_p = 3 [11%])

Creativity tasks (m_p = 3 [11%], m_u = 5 [11%])

Cognitive-conflict tasks (m_p = 5 [11%])

The more signals (e.g. emotions) are transmitted the better (p).

Mixed-motive tasks (m_p = 1 [11%])

Higher Interruption

This impact is almost not supported.

Creativity tasks (m_u = 4 [11%])

Summary

Results unveil that most impacts arise by using video conferencing functionality. In most cases only a subset of the team tasks are supported. The level of mean agreement is mostly high. But the support is too low to make any statements regarding significance. There is thus no clear trend which team task is better or worse supported. One unusual occurrence is seen for higher time savings. Providers supported higher time savings in 5 tasks, but users only in 1.

Respondents stress that video conferencing allows transmitting non-verbal signals. This helps to better understand other team members in creativity, cognitive conflict and mixed motive tasks. But as opposed to e.g. chat, no documentation exists after a discussion.

5.1.6 Impacts of Polling Functionality

Results show that polling functionality is supported with a low number of mentions. Where appropriate, additional comments are provided.

Higher Project Effectiveness

- Creativity tasks (m_p = 2 [11%])
- Decision-making tasks (m_p = 4 [11%])

Cognitive-conflict tasks (m_p = 2 [11%], m_u = 4 [11%])

Mixed-motive tasks (m_u = 1 [11%])

Competitive tasks (m_p = 3 [11%])

Increased Creativity

Creativity tasks (m_p = 3.7 [33%, min = 2, max = 5], m_u = 3 [11%])

It should be used to collect ideas from a large number of people (p). Is used, but the responses to surveys are very small (p [22%, min =, max =]).

Higher Quality

Creativity tasks (m_p = 3.5 [22%, min = 2, max = 5])

Structure and Content is often more considered (p).

Decision-making tasks (m_p = 4.7 [33%, min = 4, max = 5])

Many different opinions come together (p). Feedback leads to higher quality (p).

Providers tend to agree.

Cognitive-conflict tasks (m_p = 3.5 [22%, min = 2, max = 5])

Higher Time Savings

Creativity tasks (m_p = 3 [11%])

Decision-making tasks (m_p = 1.5 [11%])

It takes time to create a survey (p).

Competitive tasks (m_p = 3 [11%])

Higher Cost Savings

Creativity tasks (m_p = 2 [11%])

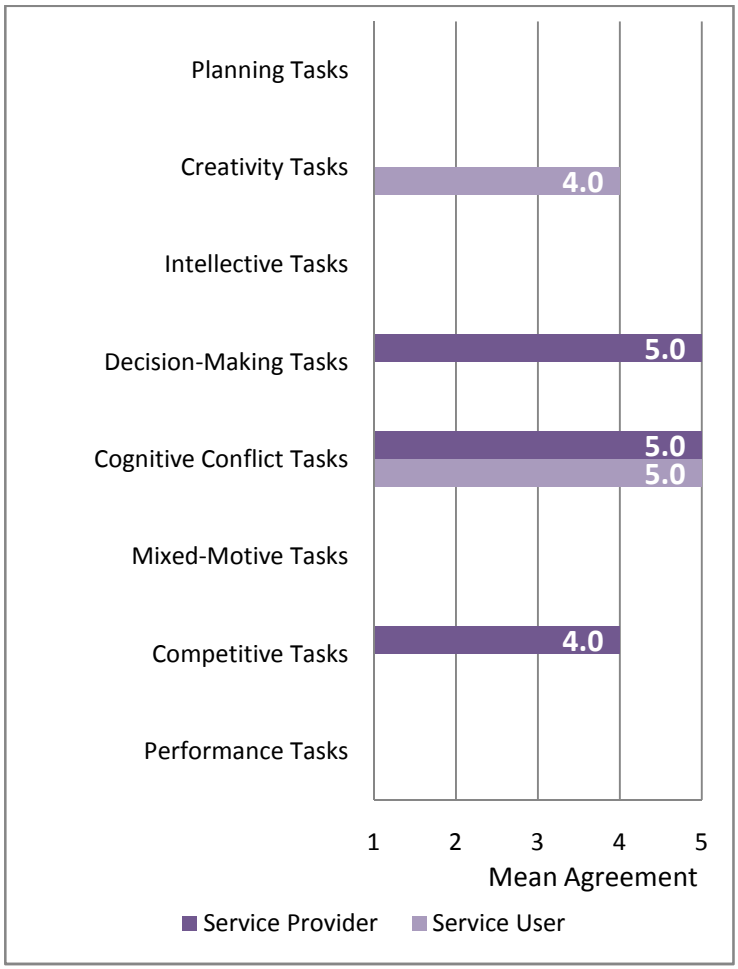
Decision-making tasks (m_p = 4 [11%])

Competitive tasks (m_p = 2 [11%])

Higher Parallelization

This impact is not supported.

Higher Transparency



Creativity tasks (m_p = 1 [11%], m_u = 4 [11%])

You do not know what happens with your contributions (p).

Decision-making tasks (m_p = 5 [33%, min = 5, max = 5])

Feedback is structured and in text form (p). The result of a survey is easy to evaluate (p).

Providers tend to strongly agree.

Cognitive-conflict tasks (m_p = 5 [22%, min = 5, max = 5], m_u = 5 [11%])

Suitable for democratic decisions (p).

Providers tend to strongly agree.

Competitive tasks (m_p = 4 [22%, min = 4, max = 4])

You can query other about how they feel about their own project (p).

Providers tend to agree.

Higher Cohesiveness

Creativity tasks (m_u = 3 [11%])

Decision-making tasks (m_p = 1 [11%])

Cognitive-conflict tasks (m_u = 4 [11%])

Mixed-motive tasks (m_u = 1 [11%])

Better work practices

This impact is not supported.

Higher Interruption

This impact is not supported.

Summary

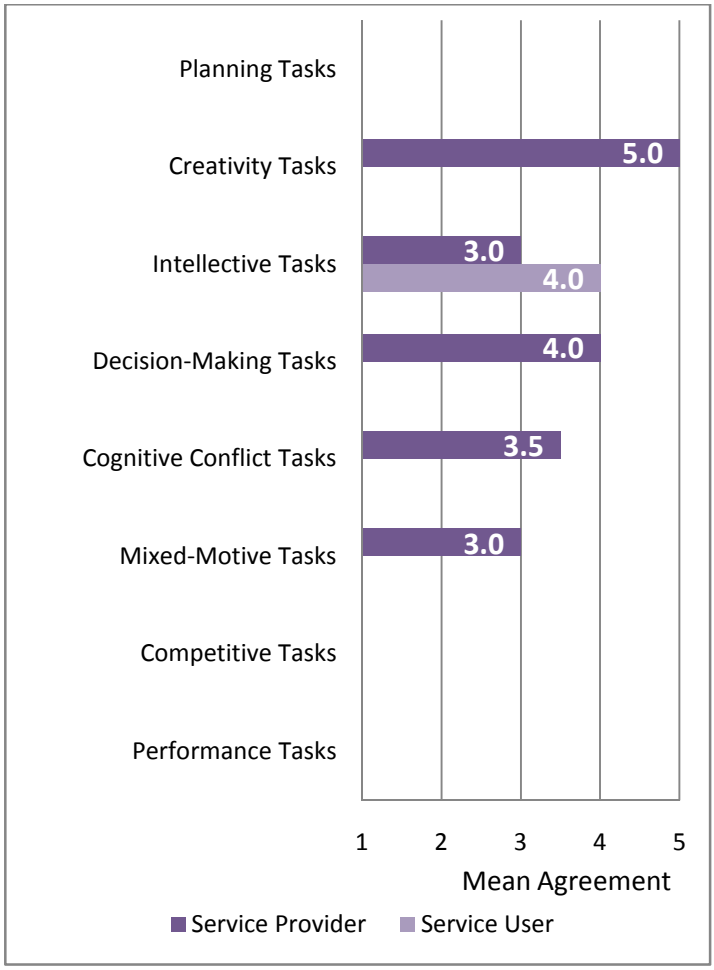
Support for polling functionality is very low, but most means are above medium. Respondents stress that polling functionality is a good way to collect information in a structured form from many people. Like this it supports idea generation in creativity tasks,

supports higher quality, because feedback to an issue can be collected and saves time, because content is structured and available in a data base.

5.1.7 Impacts of Search Functionality

Results show that search functionality is supported with a low number of mentions. Where appropriate, additional comments are provided.

Higher Project Effectiveness



Creativity tasks (m_p = 5 [11%])

A lot of contributions can be found with aspects, which would otherwise not come to you (u).

Intellective tasks (m_p = 3 [11%], m_u = 4 [33%, min = 4, max = 4])

Users tend to agree.

Decision-making tasks (m_p = 4 [22%, min = 3, max = 5])

Cognitive-conflict tasks (m_p = 3.5 [22%, min = 3, max = 5])

Mixed-motive tasks (m_p = 1 [11%])

Increased Creativity

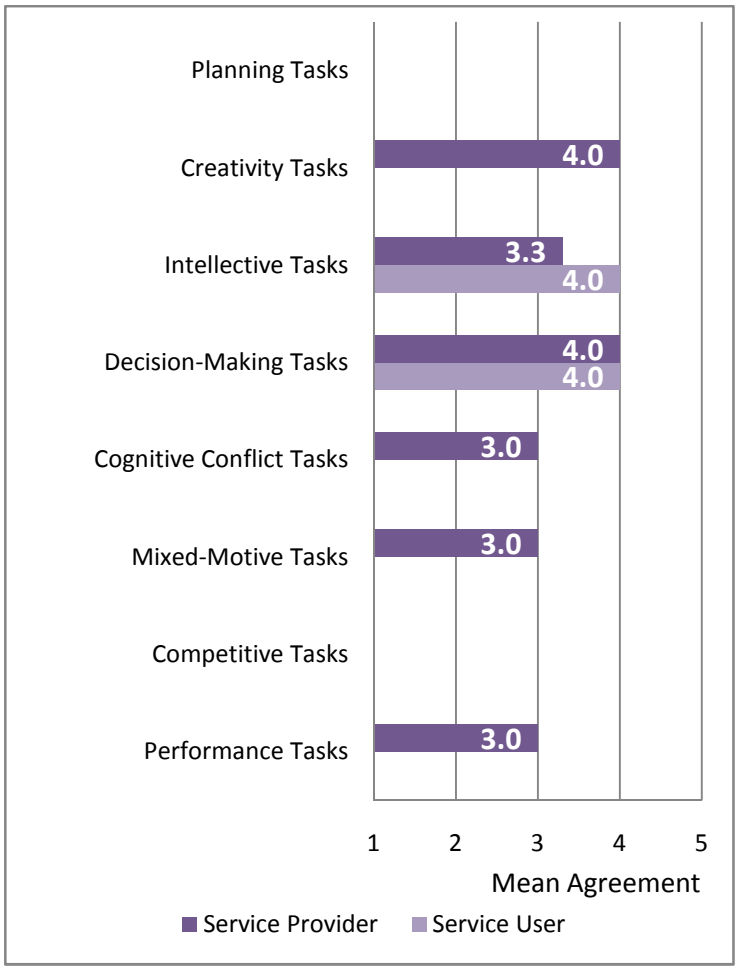
Creativity tasks (m_p = 5 [11%], m_u = 3.5 [22%, min = 2, max = 5])

Are there already some approaches to my question (p)? It inspires you to new ideas (u).

Intellective tasks (m_u = 5 [11%])

Helps to inspire about what others do in the internet (u).

Higher Quality



Creativity tasks (m_p = 4 [11%])

Intellective tasks (m_p = 3.3 [33%, min = 3, max = 4], m_u = 4 [33%, min = 4, max = 4])

Users tend to agree.

Decision-making tasks (m_p = 4 [22%, min = 3, max = 5], m_u = 4 [11%])

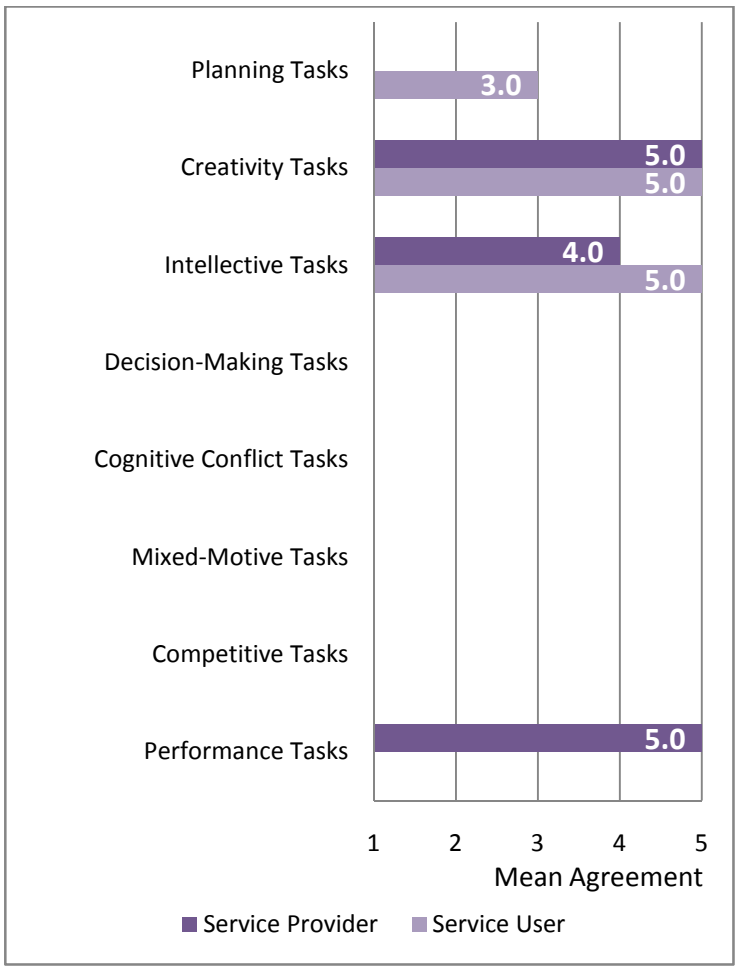
Mixed-motive tasks (m_p = 1 [11%])

Cognitive-conflict tasks (m_p = 3 [22%, min = 3, max = 3])

Providers tend to neither agree nor disagree.

Performance tasks (m_p = 3 [11%1])

Higher Time Savings



Planning tasks (m_u = 3 [11%])

Creativity tasks (m_p = 5 [11%], m_u = 5 [22%, min = 5, max = 5])

Users tend to agree.

Intellective tasks (m_p = 4 [44%, min = 3, max = 5], m_u = 5 [33%, min = 5, max = 5])
The likelihood that someone in the internet already has solved a problem is big (p). You do not need to solve a problem which someone else has already solved (u).

Users tend to strongly agree.

Performance tasks (m_p = 5 [11%])

Higher Cost Savings

Creativity tasks (m_p = 5 [11%])

Intellective tasks (m_p = 4 [33%, min = 3, max = 5], m_u = 4.5 [22%, min = 4, max = 5])
Internal experts need not be charged if you can search the internet for a problem (p).

Users tend to agree.

Performance tasks (m_p = 5 [11%])

Higher Parallelization

Planning tasks (m_u = 2 [11%])

Intellective tasks (m_p = 4.5 [22%, min = 4, max = 5], m_u = 5 [22%, min = 5, max = 5])

Both parties tend to agree or even strongly agree.

Higher Transparency

Planning tasks (m_u = 2 [11%])
Decision-making tasks (m_p = 4 [11%], m_u = 3 [11%])
Cognitive-conflict tasks (m_p = 2 [11%])
Mixed-motive tasks (m_p = 2 [11%])

Higher Cohesiveness

Creativity tasks (m_u = 2 [11%])**Better Work Practices**
Creativity tasks (m_u = 4 [11%])
Intellective tasks (m_u = 4 [11%])

Higher Interruption

This impact is not supported.

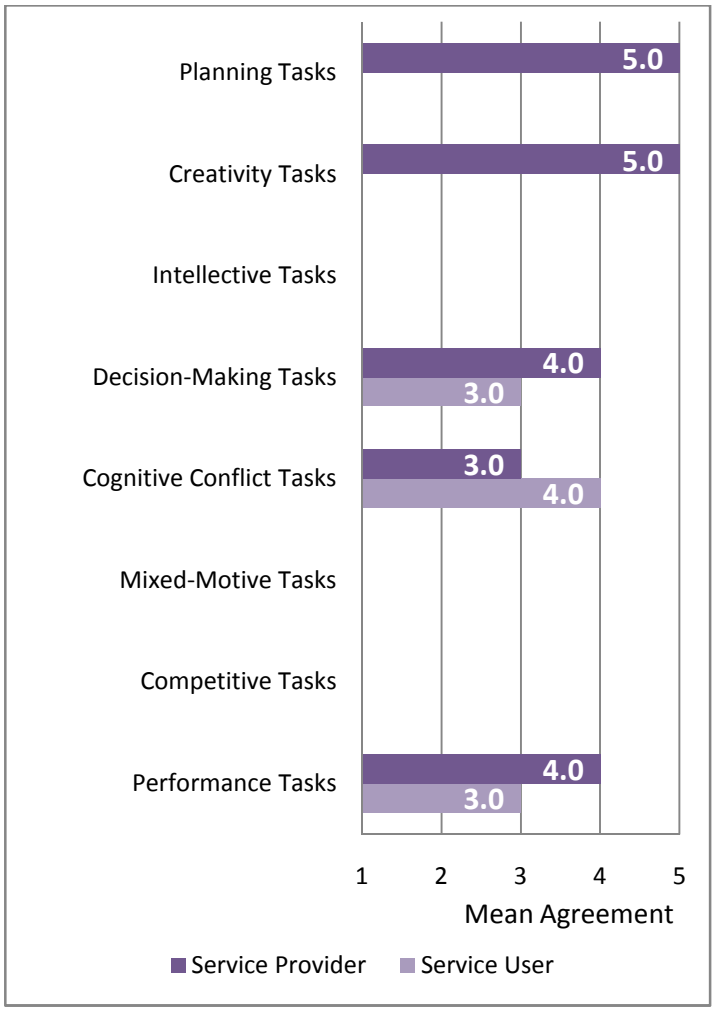
Summary

Support for search functionalities is low as well. But a slight pattern can be seen. Most impacts are supported in intellective tasks by both parties. Respondents stress that to most common problems a solution can be found in the internet.

5.1.8 Impacts of Joint Document Authoring Functionality

Results show that joint document authoring functionality is supported with a low number of mentions. The resulting data are presented without any additional statements.

Higher Project Effectiveness



Planning tasks (m_p = 5 [11%], m_u = 1 [11%],)

It is easy to maintain content (u). To allocate a content to a project is often not easy (u).

Creativity tasks (m_p = 4 [11%])

Wikis help to store ideas during daily work (p).

Decision-making tasks (m_p = 4 [11%], m_u = 3 [11%])

Cognitive-conflict tasks (m_p = 4 [11%], m_u = 4 [11%])

Performance tasks (m_p = 4 [33%, min = 3, max = 5], m_u = 3 [11%])

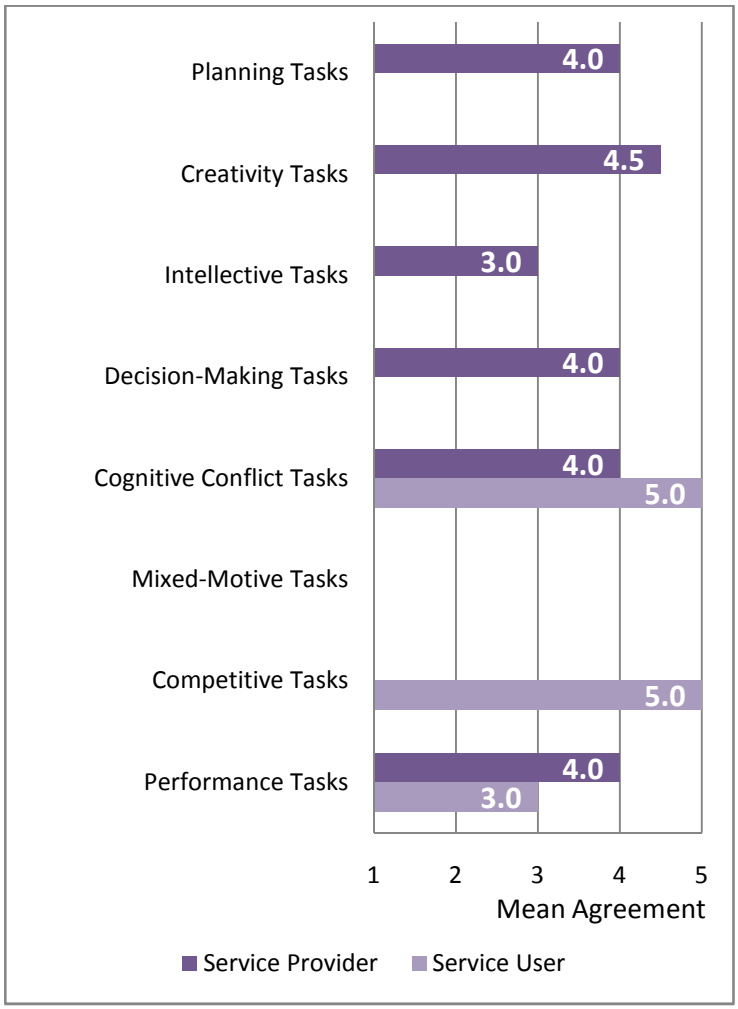
You can choose whether you want to work synchronously or asynchronously with a Wiki (p).

Increased Creativity

Creativity tasks (m_p = 2 [22%, min = 2, max = 2], m_u = 3 [22%, min = 2, max = 4])

Providers tend to disagree.

Higher Quality



Planning tasks (m_p = 4 [22%, min = 3, max = 5])

Creativity tasks (m_p = 4.5 [22%, min = 4, max = 5])

Providers tend to agree.

Intellective tasks (m_p = 3 [11%])

Decision-making tasks (m_p = 4 [11%])

It helps do document a project (p).

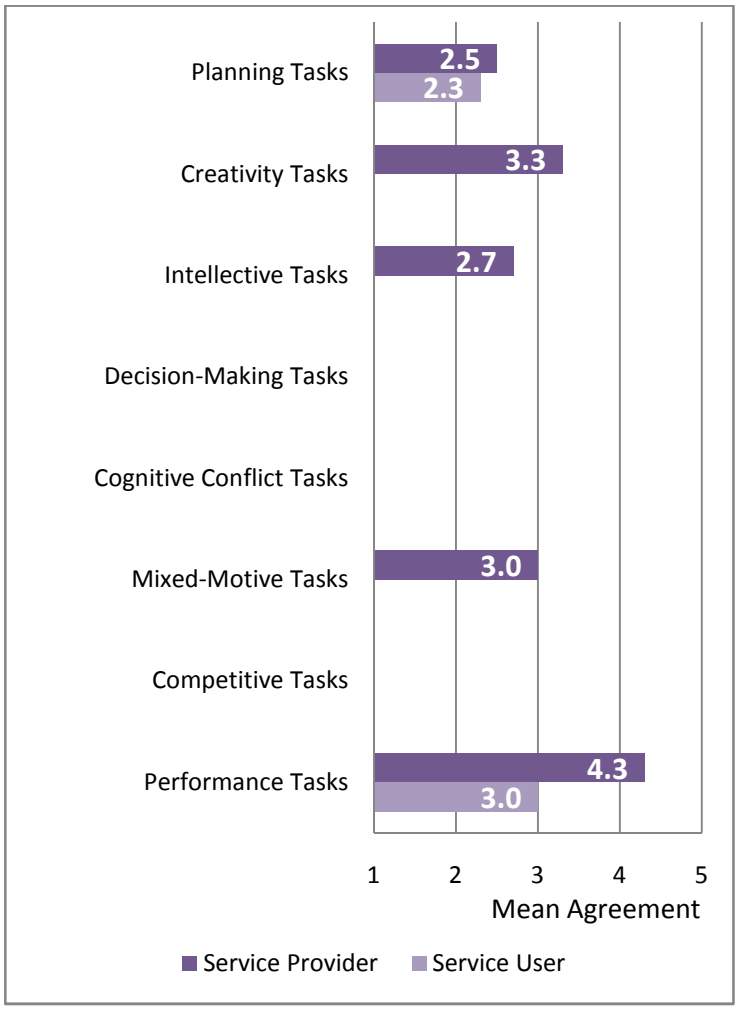
Cognitive-conflict tasks (m_p = 4 [11%], m_u = 5 [11%])

It helps to capture ideas (u).

Competitive tasks (m_u = 5 [11%])

Performance tasks (m_p = 4 [33%, min = 3, max = 5], m_u = 3 [22%, min = 3, max = 3])

Higher Time Savings



Planning tasks (m_p = 2.5 [22%, min = 1, max = 4], m_u = 2.3 [33%, min = 1, max = 5])

Very few know how to deal with content management systems (u). It is not often used because it is not widely known (p). It is not suitable for planning, because of a leak of structure (u).

Creativity tasks (m_p = 3.3 [33%, min = 1, max = 5])

Wiki means "fast" and it really supports fast and easy information exchange (p). Helps to structure content (p).

Intellective tasks (m_p = 2.7 [33%, min = 2, max = 3])

Mixed-motive tasks (m_p = 1 [11%])

Performance tasks (m_p = 4.3 [44%, min = 3, max = 5], m_u = 3 [11%])

Providers tend to not disagree.

Higher Cost Savings

Planning tasks (m_p = 1 [11%])

Creativity tasks (m_p = 4 [11%])

Intellective tasks (m_p = 5 [11%])

Higher Parallelization

Planning tasks (m_u = 3.7 [33%, min = 3, max = 4])

Creativity tasks (m_u = 3 [11%])

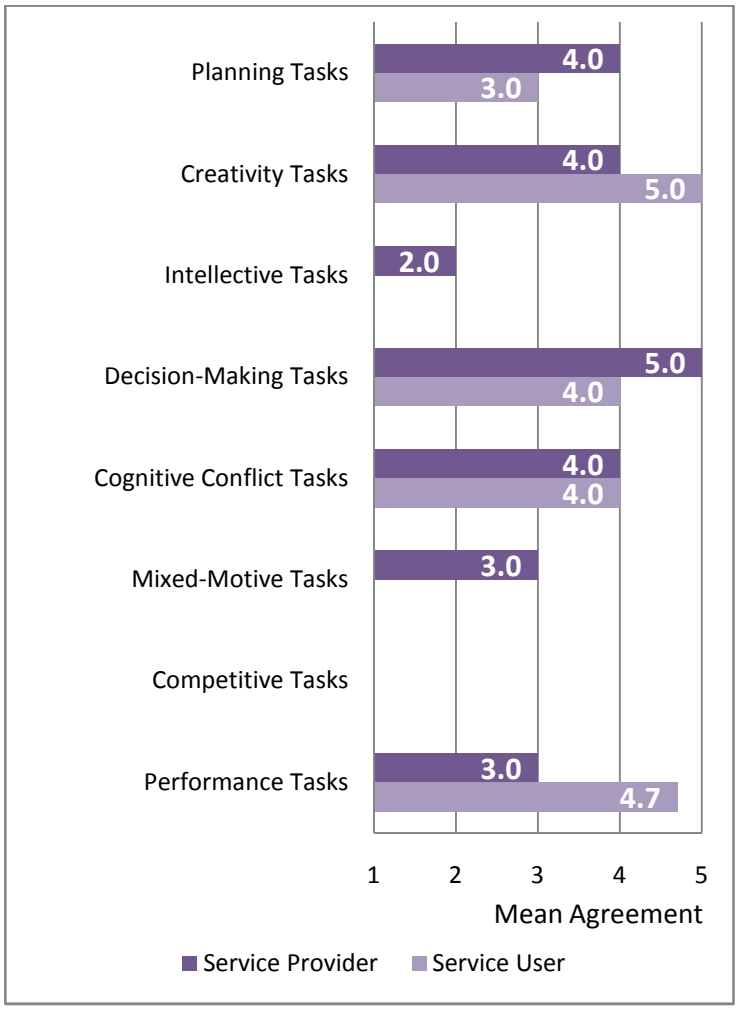
Intellective tasks (m_p = 5 [11%])

Performance tasks (m_p = 5 [22%, min = 5, max = 5], m_u = 4 [22%, min = 4, max = 4])

Allows to simultaneously working on a document (p).

Both parties tend to agree or strongly agree.

Higher Transparency



Planning tasks (m_p = 4 [22%, min = 3, max = 5], m_u = 3 [11%])

Creativity tasks (m_p = 4 [11%], m_u = 5 [11%])

The content may be associated with a person (u).

Intellective tasks (m_p = 2 [11%])

Decision-making tasks (m_p = 5 [11%], m_u = 4 [11%])

Cognitive-conflict tasks (m_p = 4 [11%], m_u = 4 [11%])

Mixed-motive tasks (m_p = 1 [11%])

Performance tasks (m_p = 3 [11%], m_u = 4.7 [33%, min = 4, max = 5])

Users tend to agree.

Higher Cohesiveness

Planning tasks (m_p = 1.5 [22%, min = 1, max = 2])

Providers show a trend to highly disagree.

Creativity tasks (m_p = 2 [11%], m_u = 3.5 [11%])

Decision-making tasks (m_u = 4 [11%])

Cognitive-conflict tasks (m_u = 4 [11%])

Better work practices

Planning tasks (m_p = 5 [22%, min = 5, max = 5], m_u = 5 [11%])

Providers show a trend to highly agree.

Creativity tasks (m_p = 5 [11%])

Performance tasks (m_p = 3 [11%])

Higher interruption

This impact is not supported.

Summary

Support is very low for joint document authoring. A pattern can be seen for higher quality. Most tasks are supported by providers. Respondents stress that project content can more easily be managed.

5.1.9 Impacts of Desktop Sharing Functionality

Results show that desktop sharing functionality is supported with a low number of mentions. Where appropriate, comments are provided.

Higher Project Effectiveness

Intellective tasks (m_u = 3.5 [22%, min = 2, max = 5])

Increased Creativity

Planning tasks (m_u = 5 [11%])

Creativity tasks (m_p = 4 [11%], m_u = 3 [11%])

Several people can look at or simultaneously work on the same document (p).

Higher Quality

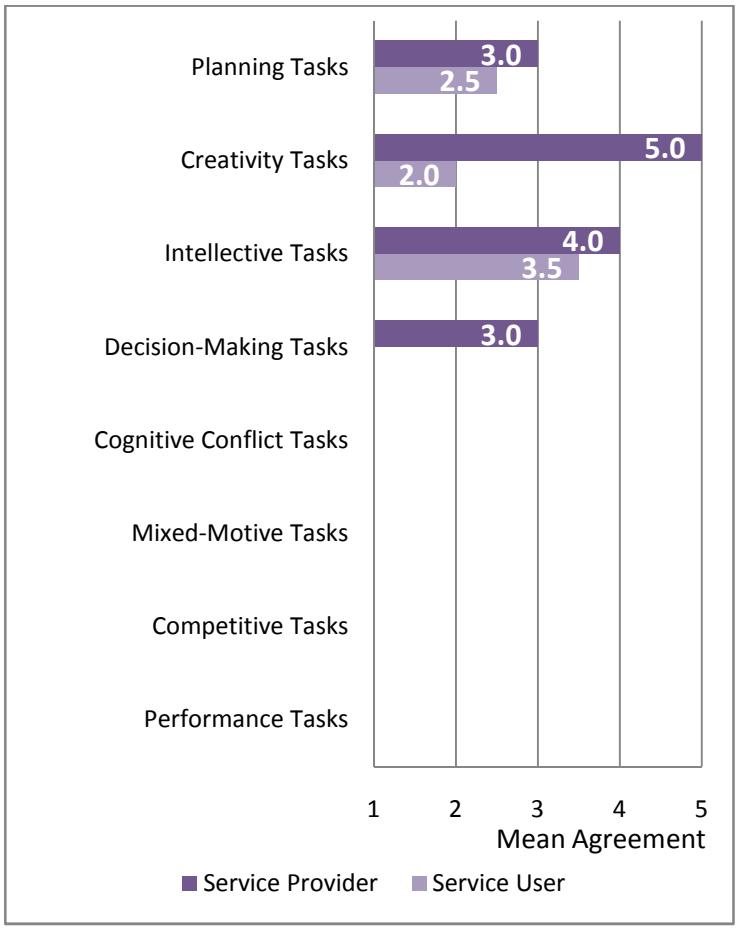
Creativity tasks (m_p = 4 [11%])

Intellective tasks (m_p = 4.3 [33%, min = 4, max = 5], m_u = 3.5 [22%, min = 2, max = 5])

Providers tend to agree.

Decision-making tasks (m_p = 4 [11%])

Higher Time Savings



Support is generally low.

Planning tasks (m_p = 3 [11%], m_u = 2.5 [22%, min = 1, max = 4])

Creativity tasks (m_p = 5 [11%], m_u = 2 [11%])

Intellective tasks (m_p = 4 [44%, min = 3, max = 5], m_u = 3.5 [22%, min = 3, max = 4])

If someone can see your screen, you do not spend much effort do describe what's happening. In combination with a phone, high quality remote support can be guaranteed (p). No traveling is required (u).

Both parties tend to agree. Explanations by both parties support this trend

Decision-making tasks (m_p = 3 [11%])

Higher Cost Savings

Support is low and values do not show any trend.

Planning tasks (m_u = 1 [11%],

Intellective tasks (m_p = 4.5 [22%, min = 4, max = 5], m_u = 3.5 [22%, min = 2, max = 5])

Decision-making tasks (m_p = 5 [11%])

Higher Parallelization

Planning tasks (m_p = 1 [11%], m_u = 3 [22%, min = 1, max = 5])

Allows seeing the same on a screen (u).

Intellective tasks (m_p = 3.5 [22%, min = 2, max = 5], m_u = 4.5 [22%, min = 4, max = 5])

It is inefficient if more than two people work together (p). This makes it easy with an expert to solve a problem (u).

Decision-making tasks (m_p = 3 [11%])

Higher Transparency

Planning tasks (m_p = 1 [11%], m_u = 2.3 [33%, min = 1, max = 5])

It is favorable if something on one's screen needs to be explained step by step which cannot effectively be explained on the phone (u).

Intellective tasks (m_p = 2 [11%])

Decision-making tasks (m_p = 3 [11%])

Competitive tasks (m_u = 5 [11%])

Higher Cohesiveness

Creativity tasks (m_u = 3 [11%])

Decision-making tasks (m_p = 3 [11%])

Competitive tasks (m_u = 3 [11%])

Better work practices

Intellective tasks (m_u = 3 [11%])

Higher Interruption

This impact is not supported.

Summary

Support for desktop sharing is low. Best support can be seen for intellective tasks. Respondents stress the advantage that one can see exactly what the other party sees. This helps to more efficiently solve a problem without the need to leave the desk.

5.1.10 Impact of Group Dynamics Functionality

Group dynamics functionality is not supported.

5.1.11 Summary of Results

A big picture of the results (graphs arranged by CIT functionality, impact and team tasks) is provided in appendix A. The CIT functionalities conversation, audio conferencing and shared file repository, thus the upper third, are mostly used in most of the team tasks. Group scheduling / coordination, video conferencing and joint document authoring belong to a second group. Polling, search and desktop sharing build a third group. And finally a fourth group, namely group dynamics functionalities and further information access functionalities (syndication, tagging, etc.) have not been chosen by any respondent.

The impacts increased creativity, better work practices and especially higher interruption show huge gaps, meaning that they arise only in few or even no team task with very low support. Higher cost savings and partly higher parallelization show also huge gaps.

The first group of CIT, thus conversation, audio conferencing and shared file repository are best supported and hold the most significant results. Table 6 shows these results were "Type" means the following:

P	only service providers show a significant result
U	only service users show a significant result
P&U	both parties show almost the same significant result
Diff	a significant difference exists between the two parties

CIT Functionality	Impact	Team Task	Type	Level of Agreement (Confidence Interval)
Conversation	Higher Project Effectiveness	Decision-making	U	High - Very High
		Cognitive conflict	P&U	Medium - Very High
		Competitive	P&U	Medium - High
		Performance	Diff	Low - Medium (p) High - Very High (u)
	Increased Creativity	Creativity	Diff	Very Low - Medium (p) Medium - High (u)
	Higher Quality	Intellective	P&U	Medium - High (p) High - Very High (u)
		Performance	U	Medium - High
	Higher Time Savings	Planning	P&U	Medium -High
	Higher Parallelization	Intellective	U	Medium - High
		Performance	U	Medium - High
	Higher Transparency	Planning	Diff	Very Low - Medium (p) Medium - High (u)
		Decision-making	U	High - Very High
		Cognitive conflict	U	Medium - High
		Competitive	U	High - Very High
Audio Conferencing	Higher Project Effectiveness	Decision-making	U	Medium - Very High
		Cognitive conflict	U	Medium - Very High
		Mixed-motive tasks	U	High - Very High
	Increased Creativity	Creativity	U	High - Very High
	Higher Quality	Decision-making	P	High - Very High
	Higher Time Savings	Planning	U	Medium - Very High
		Intellective	P	Medium - Very High
	Higher Transparency	Decision-making	U	Medium - Very High
		Cognitive conflict	U	High - Very High
	Higher cohesiveness	Creativity	U	High - Very High
Shared File Repository	Higher quality	Performance	P&U	Medium - Very High
	Higher parallelization	Planning	U	Medium - Very High
		Performance	U	Medium - Very High

	Higher Transparency	Planning	P	Medium - Very High
		Performance	U	Medium - Very High

Table 6: Significant results

The results in Table 6 unveil that conversation functionality shows the most (6 of 10 impacts are supported; 14 results), audio conferencing the second most (6 of 10 impacts are supported; 10 results) and shared file repository the third most significant results (3 of 10 impacts; 5 results). Most of the results in Table 6 show a medium up to very high level of mean agreement, thus they lie between "I neither agree nor disagree" and "I strongly agree". In cases where only one party shows significant results, service users show 18 significant results and service providers only 3. The two parties show in three cases significant differences. In all three cases service providers show a lower and service users a high level result.

By going from row to row in appendix A, some further details can be seen. First of all, the impacts better work practices and higher interruption are almost not supported. The results for conversation functionality show that higher project effectiveness arises in all team tasks with high means. The impacts higher quality and higher time savings show almost the same results. Higher transparency and higher cohesiveness show a weaker result, but still provide medium level means. Most often service providers and service users have almost equal means. Respondents state that email (and partly chat) as a representative of conversation functionality is seen as a simple tool to quickly send a message to someone. For cognitive conflict and mixed motive tasks, respondents of both parties see advantages and disadvantages. An email is a means of evidence, which can be used against oneself. It is highly used in many work processes. Providers often provided lower mans than users did, because they state that users should use more than one tool to accomplish their work.

Results of audio conferencing functionality show that most of the analyzed impacts are quite well supported, with regard to significance and with explanations by the respondents. Results for audio conferencing and conversation functionality are partly similar. Respondents stress that audio conferencing is a good alternative to face-to-face meetings and reduces the need to travel. But audio does not allow, as chat does, that multiple parties can communicate at the same time.

Results of shared file repository functionality show that only some of the impacts analyzed are quite well supported, with regard to significance and with explanations by the respondents. Cognitive conflict tasks, mixed motive tasks and competitive tasks are not or almost not supported. Respondents often mention the advantage that documents are stored centrally and thus all team members have access to it. This allows additionally checking the work progress of others and providing feedback.

Results of group scheduling / coordination functionality show that only few of the impacts are supported. Some confidence intervals do not allow any to state any trend, because they reach from disagree to agree. Respondents stress that group scheduling / coordination functionality allows a team to efficiently arrange a meeting and to then work collaborative via another media. Additionally it allows to better synchronizing work packages and other resources of a project.

Only service providers (except for one case) specified that higher time savings arise by using video conferencing. And the results for video conferencing show further that both parties specify between a medium and a high level of mean agreement in 5 of 8 team tasks for higher cohesiveness. They stress that video conferencing allows transmission of non-verbal signals. This helps to better understand other team members in creativity, cognitive conflict and mixed motive tasks. But as opposed to e.g. chat, no documentation exists after a discussion.

Support for polling functionality is very low, but most means are above medium. Respondents stress that polling functionality is a good way to collect information in a structured form from many people. Like this, it supports increased creativity in creativity tasks and it supports higher quality, because the more feedback the higher the quality. Plus it saves time, because content is structured and available in a data base.

The results for search and desktop sharing functionality show that often both parties specified that this impact arises in intellective tasks. The given explanations by the respondents support this pattern. Respondents stress that to most common problems a solution can be found in the internet.

Finally, the results for joint document authoring are low. A trend can be seen for higher quality. Most tasks are supported by providers. Respondents stress that project content can more easily be managed with such a tool.

6 Discussion

Initially, the following research questions[11] were posed: Which CIT functionalities are used in which team task? Which CIT functionalities used in a team task yield to which impacts? Which differences in weighting between users and providers of CIT result? The results provide answers to all these questions.

It has been shown that conversation, audio conferencing, shared file repository and partly group scheduling / coordination functionality show the most significant outcomes. In three cases service providers and service users showed a significant difference in their level of mean agreement.

One such difference is shown in the following statement: Conversation functionality used in performance tasks leads to higher project effectiveness. Service providers disagree and service users agree to this statement. This means that using CIT functionalities like email, chat or SMS during the execution of a project, thus when work packages are processed and milestones are headed, service providers opposed to service users specify (or expect) that objectives of a project are not any better reached. Service users argue that email helps to exchange status updates, for example telling whether a certain aim is reached or not. It is further stated that chat is good to harmonize work packages when deadlines get close. On the other hand two service providers argue in a transferred sense that email is used for more than it should be used. By looking at other results made by service providers, they suggest in order to reach higher project effectiveness in performance tasks the use of group scheduling / coordination, joint document authoring, shared file repository and audio conferencing functionality. Service providers explain this by saying that the coordination of deadlines and resources should be done with group scheduling / coordination functionality. Prediction of critical paths, details about objectives of the different milestones can easily be seen with those tools. And it is known, who has what to do. Then, with regard to joint document authoring, a service provider says that one can choose whether to work

[11] See 1.2

synchronously or asynchronously by using a wiki (group editor) to jointly work on a document. With respect to time savings and performance tasks a provider says that storing documents in a shared file repository is better than sending it several times by email. Finally, service providers state with a medium level mean that audio conferencing only favors to work synchronously. Hence, it can be interpreted that service providers suggest (or expect) in performance tasks to use a higher diversity of CIT functionalities than services users in reality do in order to have higher project effectiveness.

How comes that email is so popular for service users and almost no more sophisticated tool is used for performance tasks? The Critical Mass theory[13] states that a communication media is used if one is able to reach the counterparts. Hence, to reach the stakeholders of a project internally and externally email is probably besides audio the most widespread tool. The Social Influence model[13] states that media choice depends on the influence of one's own and other's statements, and subjective considerations. Thus, if project members can efficiently communicate with all parties without large training or implementation efforts and nobody complaints about it, then they probably decide for email. Finally, the Channel Expansion theory[13] states that the more experiences made with a communication media the higher its richness is perceived. For instance emotions can be transferred by using smiley's.

The Task-Technology-Fittness model[13], which bases on the Media Richness[13] theory is empirically tested and shows the fit between team tasks (only the group processes of McGrath's Circumplex (1984)) and different CIT functionalities. This model suggests in performance tasks a poor fit for SMS, between a medium and a good fit for email, a poor fit for instant messaging and a medium fit for audio. According to this model the service providers are right with regard to SMS, chat and audio, but slightly wrong with regard to email.

The above explanation that chat is used to harmonize work packages (instead of email) could be explained by the media synchronicity theory[12], which states that in cases were high uncertainty exists asynchronous media should be used and in cases with high equivocally synchronous media should be used. The described process is a sort of convergence, thus a

[12] See 2.2.3

reduction of equivocally is required. According to this theory chat is a good choice to harmonize work packages.

The next significant difference between the two parties exists for conversation tools in creativity task, thus in tasks where ideas need to be generated. Service providers disagree and service users agree that conversation tools lead to higher creativity. Former explain this result by saying that email is important, but because this media is highly overloaded (in terms of the amount of messages received) it may not foster creativity. Service users say on the other hand that one is more open minded at his desk and that the arrangement of a meeting is not necessary because one can simply send open issues via email. To again use the media synchronicity theory, a creative process consists at least of two parts: a convergence part and a conveyance past i.e. idea generation and idea assessment / selection. Thus, sending an assignment is convergence and the use of an asynchronous media is the right choice after the Media Synchronicity theory. But then for assessing those ideas a media with a higher immediacy of feedback (the extent to which a media enables to give rapid feedback) is required, like chat or audio conferencing. But the two points mentioned in above explanations (namely an overloaded media does not fosters creativity and generating ideas isolated at the desk) are not answered by now. Both points highly depend on ones situation. Literature for the first point has not been found. For the second point, imagine someone is sitting in a noisy open space office, than concentration and may be also creativity may be decreased (Neath 2000).

The last of the three significant differences regards again conversation functionality, this time in planning tasks. Service providers disagree and service users agree that conversation functionality leads to higher transparency. A service provider explains this result with the point that documents (with information relevant for planning) are often sent by email without a suitable subject (which makes it difficult to afterwards relate such a document to a certain context). Instead of email, service providers suggest to use group scheduling / coordination, shared file repository and joint document authoring to get higher transparency in planning tasks, thus (except for audio conferencing) the same CIT functionalities as mentioned above. Service providers explain that a shared file repository is a single source of information in which one has all the versions of a document available and in which one can find out who has worked on which document. It is interesting to see that service users

together provide almost the same explanations. Further, with regard to group scheduling / coordination, a service provider states that in order to assess a project a project plan is required (which can be provided by group scheduling / coordination functionality). Literature to underpin this issue of transparency was not found. But it is speculated that if shared file repositories are not sophisticated enough (e.g. versioning control) or users do not know how to use them or not all users have access to it, then instead of sharing documents in a central repository they are simply send by email.

The results show further that most of the significant outcomes are made by service users. These outcomes have in common that the number of mentions is at least high and the level of mean agreement is at least medium. An explanation could be, that the work of project managers does not differ much from organization to organization. But the function and hence the work of a so called head of CIT differs more, because it is not a standard function in an organization.

Conversation functionality and partly audio conferencing show with regard to higher project effectiveness a high level of mean agreement and a high number of mentions for almost all team tasks. This leads to the assumption that this is a task independent impact. In order to state the same for other situations a quantitative study is required to proof this assumption.

The results for video conferencing show generally low support. The introduced study of Bajwa, Graham et al. (2007) shows that for conferencing CITs (which include video as well as audio conferencing) only 18% of the explored companies have a high availability and a high utilization. But companies with low or high availability and low utilization of conferencing CITs make together 68%. Thus, the usage of video conferencing is generally low. The explanations of service providers as well as of service users both have in common that video conferencing is seen as a good alternative for face-to-face meetings, because one can see non-verbal signals like gestures in the face of someone or you can see the whole body of someone. Additionally respondents state that emotions are transmitted. Because too low support exists for video conferencing in this study, low use of video conferencing cannot be explained.

The results unveil additionally that some CIT functionalities are not or just very rarely used in team tasks. Information access functionalities like syndication or tagging, and group

dynamics functionalities (like idea management tools or meeting support tools) are generally not used in any team task by any respondent. Some respondents mentioned en passant that they know that tools supporting theses functionalities exist (or they even use it privately at home via the internet), but they are not yet implemented by the internal IT department.

7 Conclusion

In this thesis, a research framework to empirically explore impacts of CIT has been developed. An intensive literature review has proceeded. The main building blocks of this framework are 8 team tasks, 11 CIT functionalities, 10 impacts and two levels of view, the service provider view and the service user view. In total 20 interviews in 10 organizations were conducted. 18 interviews were accepted as valid.

The results show that conversation functionalities like email, chat and SMS, but also audio conferencing and shared file repository functionality are highly used in team tasks. Group scheduling / coordination, video conferencing, joint document authoring and search functionalities are not highly used and the remaining ones almost not. The impacts higher project effectiveness, higher quality, higher time savings were best, higher transparency and higher cohesiveness were lower supported by the respondents. Increased creativity, higher cost savings and higher parallelization where even lower and only in a few team tasks. The least support was seen for the impacts better work practices and higher interruption.

Three conflicts (or significant differences) between service providers and service users were found for conversation functionalities. The first one is: Service providers disagree and service users agree that conversation functionality in performance tasks leads to higher project effectiveness. The second one is: Service providers disagree and service users agree that conversation functionality in creativity tasks lead to increased creativity. And the third one is: Service providers disagree that conversation functionality used in planning tasks leads to higher transparency. In addition, many significant results were found, were both or only one party showed more than 55% support. Many of the results were underpinned by explanations, which allowed to further analyzing the results.

This explorative analysis is a first step toward a deeper understanding in CIT usage and its impacts. The results imply that most CIT functionalities are still not available or used in Swiss financial institutions. Those which are implemented and used show good support for a

majority of the impacts found in the literature. Some differences between service provider and service users with regard to media choice and impacts were found. Further research is required to gain a deeper view in the nature of CIT usage and thus in the support of collaborative work in organizations.

8 Limitations and Further research

The developed research framework and the research design are generally suitable for empirical CIT impact research. Especially in this early stage of research, this framework allowed to produce a big picture of CIT use and the resulting impacts by distinguishing between different team tasks. But some critical remarks need to be made in order to support further research. It seemed that the respondents were cognitively overcharged with the many and the difficulty of the decisions they were confronted with in only 45 - 60 min. This may be because of two reasons. On one hand the number of elements, thus 8 team tasks, 11 categories of CIT functionalities and 10 impacts is very high. For each team task respondents had to chose max 5 CIT functionalities and max 3 impacts out of that many items.

The research framework should therefore be simplified. The results show that many CIT functionalities are not or almost not (yet) used for intraorganizational collaborative work, at least not in the examined organizations. They could be left away. Then as seen in the empirical study of Gupta et al. (2006) the number of team tasks could be reduced to the 4 group processes as defined by McGrath (1984). Or to not too simplify the task space only the cognitive conflict and mixed-motive tasks could be combined to a negotiation task, because often the respondents had problem to distinguish. The number of impacts could also be reduced. As seen in the results, the impacts increased creativity, better work practices and higher interruption didn't show much support (although increased creativity in creativity tasks was highly supported). Then thinking in 3 dimensions (Team task > CIT Functionality > Impact) is another point which increases the complexity of this framework and asks quite too much of the respondents. So many times arranging CIT functionalities on a 5-point-Likert scale by simultaneously taking the current team task and the chosen impact into account is quite a challenge.

The use of 4 mentions to state statistical significance is low. The statistical power of these empirical results is therefore low too. In order to gain results with higher statistical power more interviews are required. Or based on the results of this analysis it could be taken into considerations to setup a survey with a much more simplified research framework. This survey could be in the form of a web-based tool in analogy to the CIT survey tool used for this study or in the form of a questionnaire.

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Appendix

A Analysis of Impacts of CIT

B Interview Guidelines

Guideline of the Head of CIT

Universität Zürich
Institut für Informatik

Interviewleitfaden

Wirkung von Kooperationssystemen in Unternehmen

Einführung (5 min)

Dieses Interview ist Teil einer **Studie** des Instituts für Informatik (IFI) der Universität Zürich. Ziel dieser Studie ist die Analyse der Wirkungen von Kooperationssystemen in Unternehmen. Weiter sollen aufgrund der Ergebnisse mögliche Verbesserungspotentiale zur Nutzung solcher Kooperationssysteme identifiziert werden. Unter einem **Kooperationssystem** sind IT-Systeme gemeint, welche die Zusammenarbeit unterstützen. Beispiele dafür sind E-Mail, Chat, SMS, Gruppeneditoren, Ideenmanagementsysteme, Umfragesysteme, Desktop Sharing, Audiokonferenzsysteme (z.B. Telefon), Videokonferenzsysteme, Gemeinsame Dateiablagen und Gruppenkalender / Koordinationssysteme. Zudem werden auch Informationszugangssysteme wie Suchmaschinen dazugezählt. Mit dem Begriff **Wirkung** ist jede Art von Veränderung (Nutzen, Einflüsse, Konsequenzen, usw.) dieser Systeme auf Unternehmen gemeint. Wir interessieren uns besonders für den Einsatz von Kooperationssystemen in Projekten.

Durch Ihre Teilnahme an der Studie, können Sie sich mit anderen Unternehmen in Bezug auf den Einsatz von Kooperationstechnologien und deren Wirkungen vergleichen. Auf Wunsch lassen wir Ihnen gerne die Ergebnisse dieser Studie zukommen. Zudem leisten Sie einen wichtigen Beitrag zur Forschung in der Wirtschaftsinformatik.

Ihre Antworten werden vertaulich behandelt und fliessen anonym in die Studie ein. Lediglich die teilnehmenden Unternehmen werden - getrennt von den Aussagen - aufgeführt.

Ich bitte Sie **im Voraus** den Interviewleitfaden **auszudrucken**, **durchzulesen** und die grau **markierten Felder von Hand auszufüllen**.

Das Interview dauert **60 Minuten**. Um das Interview in dieser Zeit durchzuführen, ist ein **plangemässiger Fortschritt notwendig**. Bitte begründen Sie jeweils **kurz** Ihre Aussagen.

Aufbau des Interviewleitfadens

1. Allgemeines

2. Intraorganisationale Zusammenarbeit

3. Einsatz von Kooperationssystemen in Projekten und dessen Wirkungen

1. Allgemeines	
1.1 Name	
1.2 Unternehmen	
1.3 Bereich	
1.4 Funktion	
1.5 Telefon	
1.6 E-Mail	

1 / 4

2. Intraorganisationale Zusammenarbeit (10 min)

2.1 Gibt es Projektteams, die auf mehrere Standorte verteilt sind?

JA	NEIN

2.1.1 Wie stark überschneiden sich die Hauptarbeitszeiten zwischen den geographisch verteilten Projekten? (in Stunden)

0 - 2	2 - 4	4 - 8	voll-ständig

2.2 Die Zusammenarbeit der Teams in Projekten ist sehr ausgeprägt.

ich stimme überhaupt nicht zu						ich stimme vollständig zu
1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

2.3 Der Dienstweg hindert an der Zusammenarbeit mit anderen Mitarbeitenden im Unternehmen.

ich stimme überhaupt nicht zu						ich stimme vollständig zu
1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

2.4 Die Zusammenarbeit zwischen den Unternehmensbereichen ist sehr intensiv.

ich stimme überhaupt nicht zu						ich stimme vollständig zu
1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

2.5 Wer bestimmt welche Mittel zur Unterstützung der Zusammenarbeit eingesetzt werden?

2.5.1 Wie wird entschieden? (Entscheidungsprozess gesucht)

2.5.2 Werden diese Mittel nach der Einführung wieder einmal auf deren Nutzen hin überprüft?

JA	NEIN

3. Einsatz von Kooperationssystemen in Projekten und dessen Wirkungen (45min)

3.1 Aus welchen Phasen besteht Ihr Projektmanagement-Prozess?

Bitte schreiben Sie Ihre internen Bezeichnungen in die grau markierten Felder.

Hier sehen Sie generische Phasen eines Projekts fett markiert dargestellt. Darunter finden Sie jeweils eine kurze Beschreibung der Phase. Das "Controlling / Monitoring" bildet dabei eine Querschnittsphase, welche sich über alle anderen Phasen erstreckt.

	Initialisierung	**Planung**	**Ausführung**	**Abschluss**	**Controlling / Monitoring**
	Alle Abläufe zur Bestimmung des Umfangs und der Authorisierung eines Projekts	Alle Abläufe zur Detaillierung des Umfangs und der Planung eines Projekts	Alle Abläufe zur Erreichung der Ziele gemäss Projektplan	Alle Abläufe, die zum Abschluss eines Projekts beitragen	Alle Abläufe zur Messung, Überwachung und Korrektur der Projektausführung
Ihre internen Bezeichnungen:					

3.1.1 Die auf der linken Seite stehenden generischen Gruppenaufgaben verstehen sich als gemeinsam in Projektteams ausgeübte Tätigkeiten. Diese Aufgaben werden je Projektphase wie folgt ausgeübt: 10 (sehr intensiv)…1(sehr gering). Bitte verteilen Sie je Gruppenaufgabe 10 Punkte.

Gruppenaufgaben						
Gemeinsame Planung (Pläne generieren)						Total 10 Punkte
Gemeinsames Brainstorming (Ideen generieren)						Total 10 Punkte
Gemeinsames lösen von Problemen durch Expertenwissen (Lösen von Problemen mit korrekter Antwort)						Total 10 Punkte
Gemeinsame Wahl der bestmöglichen Lösung (Entscheidung über einen Sachverhalt ohne korrekte Antwort treffen)						Total 10 Punkte
Gemeinsames Erarbeiten von Zielen unter diversen Standpunkten (Lösen von Gesichtspunktkonflikten)						Total 10 Punkte
Zusammenarbeiten unter Interessenskonflikten (Lösen von Interessenskonflikten)						Total 10 Punkte
Gemeinsames arbeiten gegen konkurren-zierende Projekte (Lösen von Machtkonflikten)						Total 10 Punkte
Gemeinsames Erfüllen von Meilensteinen (Leistungsorientierte Aufgaben ausführen)						Total 10 Punkte

3.2 In welcher Gruppenaufgabe erwarten Sie den Einsatz welcher Kooperationssysteme?

3.3 Welche Wirkungen (Nutzen, Einflüsse, Konsequenzen, usw.) erwarten Sie aus dem Einsatz der Kooperationssysteme in bestimmten Gruppenaufgaben?

3.3.1 Wie stark erwarten Sie, dass diese Wirkungen eintreffen?

3.3.2 Denken Sie, dass man dies in Projekten auch so sieht? JA | NEIN

3.4 Als wie wichtig nehmen Sie die Nutzung der Kooperationssysteme in diesen Gruppenaufgaben war?

3.5 Welche Risiken beim Einsatz von Kooperationssystemen in Ihrem Unternehmen sind Ihnen bekannt?

3.4.1 Gibt es Kooperationssysteme, die bewusst nicht zur Verfügung gestellt werden? JA | NEIN

3.4.1.1 Warum nicht?

3.4.2 Gibt es Mitarbeitendengruppen, die keinen Zugang zu gewissen Kooperationssystemen haben? JA | NEIN

3.4.2.1 Weshalb?

Guideline of the Project Manager

Universität Zürich
Institut für Informatik

Interviewleitfaden

Wirkung von Kooperationssystemen in Unternehmen

Einführung (5 min)

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Das Interview dauert **60 Minuten**. Um das Interview in dieser Zeit durchzuführen, ist ein **plangemässiger Fortschritt** notwendig. Bitte begründen Sie jeweils **kurz** Ihre Aussagen.

Aufbau des Interviewleitfadens

1. Allgemeines

2. Intraorganisationale Zusammenarbeit

3. Einsatz von Kooperationssystemen in Projekten und dessen Wirkungen

1. Allgemeines

1.1 Name	
1.2 Unternehmen	
1.3 Bereich	
1.4 Funktion	
1.5 Telefon	
1.6 E-Mail	

2. Intraorganisationale Zusammenarbeit (10 min)

2.1 Aus wievielen Personen besteht Ihr Projektteam? (Anzahl)

2.2 Ist Ihr Projektteam auf mehrere Standorte verteilt?

JA	NEIN

2.2.1 Wie stark überschneiden sich die Hauptarbeits-zeiten zwischen den geographisch verteilten Projektteammitgliedern? (in Stunden)

0 - 2	2 - 4	4 - 8	voll-ständig

2.3 Die Zusammenarbeit innerhalb meines Projektteams ist sehr intensiv.

ich stimme überhaupt nicht zu						ich stimme vollständig zu
1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

2.4 Der Dienstweg hindert an der Zusammenarbeit mit anderen Mitarbeitenden im Unternehmen.

ich stimme überhaupt nicht zu						ich stimme vollständig zu
1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

2.5 Die Zusammenarbeit zwischen den Unternehmensbereichen ist sehr intensiv.

ich stimme überhaupt nicht zu						ich stimme vollständig zu
1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

2.6 Wer bestimmt welche Mittel zur Unterstützung der Zusammenarbeit eingesetzt werden?

2.6.1 Wie wird entschieden? (Entscheidungsprozess gesucht)

2.6.2 Werden diese Mittel nach der Einführung wieder einmal auf deren Nutzen hin überprüft?

JA	NEIN

3. Einsatz von Kooperationssystemen in Projekten und dessen Wirkungen (45 min)

3.1 Aus welchen Phasen besteht Ihr Projektmanagement-Prozess?

Bitte schreiben Sie Ihre internen Bezeichnungen in die grau markierten Felder.

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Ihre internen Bezeichnungen:					

3.1.1 In welche(r/n) Projektphase(n) ist Ihr Projektteam zur Zeit tätig?

3.1.2 Die auf der linken Seite stehenden generischen Gruppenaufgaben verstehen sich als gemeinsam im Projektteam ausgeübte Tätigkeiten. Diese Aufgaben werden je Projektphase wie folgt ausgeübt:
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Gemeinsames Erfüllen von Meilensteinen (Leistungsorientierte Aufgaben ausführen)						Total 10 Punkte

3.2 Welche Kooperationssysteme werden in welcher Gruppenaufgabe eingesetzt?

3.2.1 Gibt es Kooperationssysteme, die Sie im Projekt bewusst nicht einsetzen? | **JA** | **NEIN** |

3.2.1.1 Warum nicht?

3.2.2 Welche Kooperationssysteme würden Sie gerne im Projekt einsetzen?

3.2.2.1 Weshalb?

3.3 Welche Wirkungen (Nutzen, Einflüsse, Konsequenzen, usw.) resultieren aus dem Einsatz der Kooperationssysteme in bestimmten Gruppenaufgaben?

3.3.1 Wie stark treffen diese Wirkungen ein?

3.4 Wie wichtig ist die Nutzung der Kooperationssysteme in diesen Gruppenaufgaben?

C Inputs from Pretests

- At first the conduction of impacts was intended to link task execution and tool impacts with project phases. This required to much cognitive effort at once. The new way to collect data happened in following combinations: project phases > tasks, task > tools > impacs and task > tool > tool use. The combination project phases > tasks was conducted by allocating 10 points for the execution of a tasks in project phases.
- Before the development of a software tool to conduct impacts, a paper based version was used which worked in analogous. A configuration of task, tools and impact was photographed and later analyzed. Due to impracticability a software tool was the preferred alternative.
- The guideline was adopted. Question 2.6 changed from “Which means helping project teams to collaborate are supported?” to “Who decides which means supporting collaboration are supported? How is this done?”. The focus lies therefore on the responsibility and decision process and not on the current inventory. The question “Do groups of employees exist, who do not have access to certain CIT tools?” was only listed on the guideline of the head of CIT, because project manager’s didn’t possess this knowledge.
- Interview partners (especially the heads of CIT) had difficulties to determine the usage of a tool related to a given task, especially because they had to state the usage CIT tools themselves. After discussions with several doctoral students, the variable was changed from usage to importance. Therefore which tool is most important for a given task. This facilitated the determination and allowed to compare the collected answers.
- The time for an interview is limited to 60 minutes. Some changes in the software tool (e.g. asking the head of CIT about the expected impacts and the view of users) lengthened the interview by about 15 minutes. Thus, later interview partners were encouraged to work through the questions of the guideline in advance. During the interview only the argumentation for a given answer was conducted.

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