Remote Presence
Supporting deictic gestures through a handheld multi-touch device

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REMOTEPRESENCE

Supporting deictic gestures through a handheld multi-touch device

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ABSTRACT

[English]
This thesis argues on the possibility of supporting deictic gestures through handheld multi-touch devices in remote presentation scenarios. In [1], Clark distinguishes indicative techniques of placing-for and directing-to, where placing-for refers to placing a referent into the addressee's attention, and directing-to refers to directing the addressee's attention towards a referent. Keynote, PowerPoint, FuzeMeeting and others support placing-for efficiently with slide transitions, and animations, but support limited to none directing-to. The traditional "pointing feature" present in some presentation tools comes as a virtual laser pointer or mouse cursor. [12, 13] have shown that the mouse cursor and laser pointer offer very little informational expressiveness and do not do justice to human communicative gestures. In this project, a prototype application was implemented for the iPad in order to explore, develop, and test the concept of pointing in remote presentations. The prototype offers visualizing and navigating the slides as well as "pointing" and zooming. To further investigate the problem and possible solutions, a theoretical framework was designed representing the relationships between the presenter's intention and gesture and the resulting visual effect (cursor) that enables the audience members to interpret the meaning of the effect and the presenter's intention.
Two studies were performed to investigate people's appreciation of different ways of presenting remotely. An initial qualitative study was performed at The Hague, followed by an online quantitative user experiment. The results indicate that subjects found pointing to be helpful in understanding and concentrating, while the detached video feed of the presenter was considered to be distracting. The positive qualities of having the video feed were the emotion and social presence that it adds to the presentations. For a number of subjects, pointing displayed some of the same social and personal qualities [2] that video affords, while less intensified.
The combination of pointing and video proved to be successful with 10-out-of-19 subjects scoring it the highest while pointing example came at a close 8-out-of-19. Video was the least preferred with only one subject preferring it.
We suggest that the research performed here could provide a basis for future research and possibly be applied in a variety of distributed collaborative settings.

Keywords: Deictic gestures; multi-touch device; pointing in presentations; remote presentations.

ABSTRACT

[Português]
Nesta tese argumenta-se a possibilidade de suportar gestos dêiticos por meio de dispositivos *multi-touch* no contexto de apresentações remotas. Em [1], Clark considera duas técnicas indicativas: 'colocar para' (*placing-for*)—o referente é colocado no campo de atenção do destinatário—e 'dirigindo a' (*directing-to*)—dirige a atenção do destinatário para o referente. Ferramentas como o *Keynote*, *PowerPoint* e *FuzeMeeting* suportam o '*placing-for*' eficientemente, contendo transições de *slides*, possibilidade de animação, entre outros, mas apresentam um suporte muito limitado da técnica indicativa '*directing-to*'. Relativamente ao recurso 'apontar', tradicionalmente disponível como ponteiro laser ou cursor de rato, artigos [12] e [13] mostram que oferecem muita pouca expressividade e não fazem justiça aos gestos comunicativos humanos. Foi desenvolvido um protótipo para iPad com o intuito de testar o conceito de 'apontar' em apresentações remotas. Este permitia a visualização e navegação pelos *slides*, assim como apontar e fazer *zoom*.
Para entender melhor o contexto de pesquisa, um *framework* teórico foi concebido para representar as relações entre a intenção do apresentador e respectivos gestos e o efeito visual resultante (cursor) que permite aos membros da audiência a possibilidade de interpretar o significado do efeito e qual a intenção do apresentador. Foi também realizado um estudo qualitativo ao qual se seguiu um estudo on-line, mas de natureza quantitativa. Os resultados revelaram que os utilizadores reconhecem a acção de apontar como útil, tanto na concentração como na compreensão do material apresentado, enquanto que, no vídeo do apresentador foi considerada uma distracção. No exemplo da apresentação contendo 'vídeo', as qualidades positivas revelaram-se ser a emoção e presença do apresentador mais facilmente perceptivas, no entanto, essas mesmas percepções foram igualmente observadas no exemplo de apresentação que continha o gesto de apontar—consistentes com outras pesquisas—contudo longe dos resultados que o vídeo expõe. Em conclusão, o exemplo que combinava o apontar e o vídeo provou ser mais bem sucedido com dez de 19 votos, enquanto que, a apresentação 'apontar' obteve oito de 19 votos. Tornando assim, a menos votada, a apresentação 'vídeo' com apenas um utilizador a preferi-la.
Argumenta-se ainda que, a pesquisa realizada poderá vir a ser base para futuras pesquisas e, possivelmente, ser aplicada a uma variedade de contextos de natureza colaborativa.

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I would like to thank Dr. ir. Dennis Dams from Bell Labs for his friendship, guidance and unique approach to complex problems. I appreciate his abstract thinking and drive for simple, usable solutions.

In addition I would like to thank Jan Bouwen, research director at Visual Communications Bell Labs, and colleagues, for their friendship and support with the project. Their expertise and drive for research and new technologies were eye opening.

I would like to express my gratitude towards António Temes, administrator of Madeira-Interactive Technologies Institute for his support in affording me the possibility of the internship.

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PREFACE

The following thesis combines research from two internships undertaken over a one-year period. The first, a 3-month summer internship with Madeira Life project, Madeira Tecnopolo, Portugal in 2010, and another 6-month internship at Bell Labs Belgium and M-ITI in 2011.

The 3-month summer internship as part of the Madeira Life project from Madeira Tecnopolo, started in July 2010 at Alcatel-Lucent Bell Labs, Belgium. For the first month I was introduced to a Bell Labs's Visual Communication's department brand new project, entitled, SlideWorld. This was an excellent opportunity for myself to be able to follow a "real-life" project right from the beginning and provide some fresh-out-of-university knowledge in Human-Computer Interaction methodologies. The project was an collaborative effort between two Bell Labs departments, Visual Communications Belgium and HyperMedia France. During this time, I applied HCI methodologies for the Belgium's part of the project. This approach and methodologies were different to how the department was used to approach new projects.

SlideWorld was ideated from the desire of creating an evolution from current slideshow presentation tools, in the sense that through different technologies (face detection and tracking) " it would be possible for remote presentations to become more engaging and less boring to the audience".
SlideWorld was divided into two scenarios: the one-to-many scenario, approached by the French team, and the many-to-many scenario, by the Belgium team.
My role within the Belgium team was to perform initial research, state-of-the-art, conceptualization and user needs analysis, as a stepping stone for Bell Labs future work.
At the end of my stay at Bell Labs, there was sufficient research to continue the internship for the next 2-months back at M-ITI, Portugal.

RemotePresence was ideated from the past Internship at M-ITI/Bell Labs Belgium. February 2011, I returned to Bell Labs for a 6-month period to continue and explore a new concept or research project for SlideWorld and to be used as my masters thesis.
On arrival at Bell Labs, the project proposal (just a formality) was discarded and a series of brainstorming sessions and meetings were devised in order to discover some new and interesting (and hopefully unexplored) research area within remote slide presentations to explore.
Findings from the past internship identified remote presentations as lacking inter-participant interaction and collaboration. We argue that the iPad—a handheld multi-touch device—has the necessary affordances to make this activity more engaging and interactive.

After defining abstractly the project, I led the project with assistance from two supervisors, Dr. Dennis Dams and Dr. Jos van Leeuwen.

This document will guide you go through the exploration phase during the 2010 internship, up to, the end of the 2011 internship at Bell Labs, describing methodologies, design decisions and findings.

1. PRE-STUDY PHASE

1.1. Introduction

Evermore, companies are opting for teleconferencing as a means for performing remote meetings. As the internet becomes evermore ubiquitous and faster, a multiplicity of high quality audio and video feeds become available. Increasingly, knowledge workers work outside the traditional office, and more and more teams are distributed over multiple physical locations. By employing distributed employees, companies do not need to pay employees travel fees, book hotels for meetings, etc. Company's may employ whoever they would like, where ever they are, this opens the doors for remote collaboration.

In collocated meetings, the chairperson, i.e. someone who leads the meetings, books the rooms, and invites participants. Participants, then reply to the invitation and attend physically the meeting at the scheduled date and time. At location, participants sit around a table (normally U-shaped) and discourse over a topic mediated by the chairperson.

As mentioned before, evermore distributed teams require distributed meetings and presentations. Participants, may now attend meetings from home, from another company, or continent. The technology for this remote communication has been available for many years now, but things get tricky when participants need to collaborate or co-author media in real-time. One of the aspects of collaboration, could be the scenario involving a slide presentation and discussion. The common tools used for these remote presentations are very basic in nature displaying solely the slides being presented, the presenter's voice, and in some cases a video feed of the presenter in a small box—except for high end and high cost dedicated systems and rooms for the occasion.
Participants tend to become easily bored during these remote presentations. Inter-participant communication is extremely limited or inexistent, managing q&a sessions during or after the presentation are difficult to synchronize and mediate.

Queue in SlideWorld. SlideWorld is Alcatel-Lucent Bell Labs approach to remote presentations with the main objective of ending boring presentations, by integrating new technologies and affording a more "natural" engaging form for presenting content remotely.

This pre-study phase chapter enumerates the approaches and contributions done towards the SlideWorld project. Throughout the project diverse methodologies, from Human-Computer Interaction, Human Computer Software Engineering and Service Design were applied. This 'mix' of methodologies afforded an interesting overview and understanding of the problem setting, and helped define the scenarios.

1.2. The SlideWorld project

SlideWorld was ideated at Alcatel-Lucent, Bell Labs, from the need of a more immersive, and engaging way of attending meetings and presenting material, to collocated, and/or remote colleagues in a simple and effective way, this without resourcing to high cost dedicated devices. By analyzing state-of-the-art presentation and teleconferencing tools (or systems), one of the key issues identified was the difficulty in understanding the cluttered user interface, the complicated participant invitation functionalities, and the long time necessary to set everything up. Another issue that was identified were that participants lacked interactivity amongst themselves, and that the shared information was dispersed. This resulted in users falling back to asynchronous communication such as sending attachments and/or invitations through email.

Some higher end dedicated systems, afford a more immersive and engaging experience, but they require specific rooms with high cost equipment that offer no scalability.

SlideWorld is a new project ideated from an identified undesirable issue that occurs in presentations especially remote distributed presentations: people get bored.
Initially, there was no defined user target demography, thus required a broad exploration of the problem context in pursue of an interesting feasible scenario. During initial research into presentations in combination with discussions with Visual Communication department colleagues, two interesting but somewhat different scenarios where identified in which SlideWorld could positively make a difference:

One of the scenarios was nominated the one-to-many. This scenario was identified from the need that a single presenter could have while presenting to a local or remote audience. How could viewing the presentation remotely be more engaging and exciting than what is offered by current presentation tools? This scenario would be approached by the Bell Labs Villarceaux, France, Hypermedia team.

The second scenario was nominated many-to-many. This scenario considers group meetings. A collocated group presenting and discoursing with another remotely collocated group of colleagues. This scenario tends to be more interactive and engaging for the participants. Our interest resides in bringing these two groups together in a way that affords them to collaborate in real time, contribute, and share information easily. This is the scenario being elaborated in this pre-study phase, being approached by myself and the Bell Labs Visual Communications Team, Antwerp, Belgium.

1.3. Initial research and exploration

The initial research consisted of closed set of semi-structured interviews with Alcatel-Lucent employees, consultation of relevant literature on public presentations, public speakers, good practices in presenting, presenter's needs, live audiences, remote audiences, video-conferencing issues and relevant tools. Further research were performed as live observations —including a full day observation of a live remote meeting between Villarceaux and Antwerp.

User needs, goals and expectations

The presenter's main goal, is to successfully transmit his message to an audience in a simple and effective manner. Identified presenter needs include: controlling the presentation, navigation through the media; being heard and seen with enough quality to be understood; as well as, necessary feedback (time and audience engagement). The feedback that the presenter receives from the audience is important to him. Looking at the audience and assessing their interest through facial expressions, body language, and gestures, provide him with the necessary feedback to be able to adjust his presentation and regain audience attention.

The audience members also have needs, goals and expectations. They attend presentations to learn more about a certain topic, to listen to an expert in a certain area transmitting his message, and to be somewhat "entertained."

Below, Figure 1 demonstrates abstractly, the context of these presentations. A presenter or speaker, has some visual aids (our scenario requires a digital slide presentation) and is directing his message, the information that he wants to transmit, to a group of local participants or/and remotely located participants through, telephone, video conferencing tools, etc. These simple diagrams help focus on the essential before looking into chaotic world of features and new technologies.

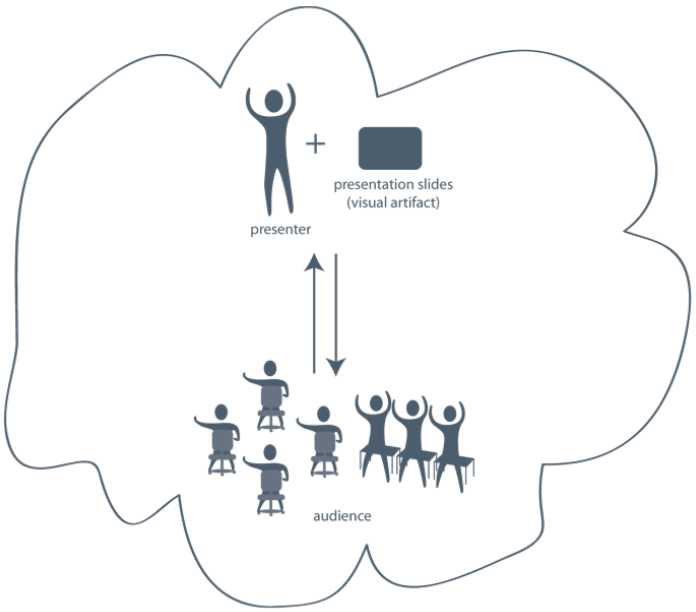


Figure 1. Abstraction of a slide presentation containing a presenter and audience.

Figures 2 and 3, identify some key user needs and goals as well as how participants interact amongst themselves. Benefits that occur in one context and not the other are highlighted in green.

Figure 2 features a summary of interactions, tools, user roles and goals for a collocated slide presentation. The presenter uses some common artifacts to transmit his message. He traverses through a preparation phase and is able to use himself as a medium for communication (deictic gestures, etc). The presenter has his own set of goals (as participants have their). At the bottom of figure 2, we are able to see the flow of information (feedback from the audience (A) to the presenter (P), the presenter then reacts accordingly).

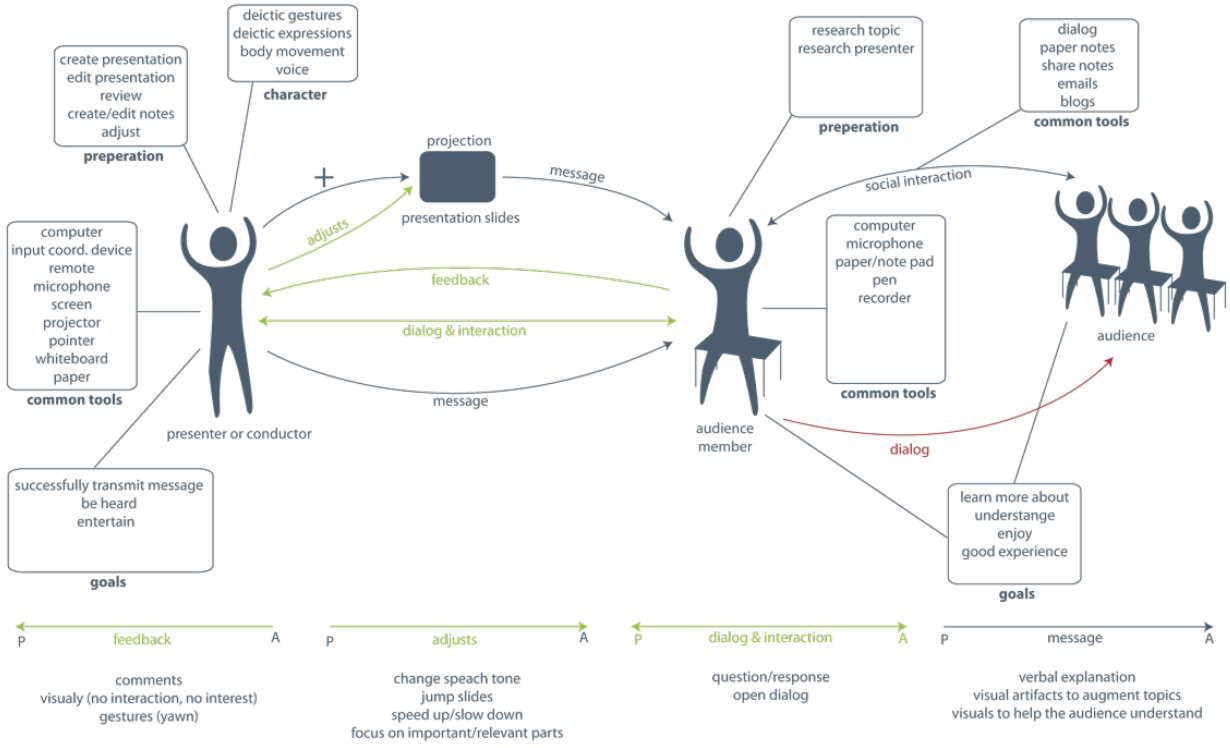


Figure 2. High-level diagram of a live presentation representing interactions, goals and artifacts.

Figure 3 tries to replicate the meaning of Figure 2 this time for remote presentations. It is possible to identify the differences among them especially, when it comes to communication and feedback. Current systems or tools that support remote presentations do not offer any natural means of audience feedback. I.e. the presenter does not have an overview of every participant (for larger groups) and their interactions (personal or with other participants). Mostly, the audio channel is unidirectional, therefore it is increasingly difficult for the presenter to get feedback from his audience about the presentation thus he does not perceive if the audience if following the presentation and allow him to perform the necessary repairs to help them understand or regain their attention.

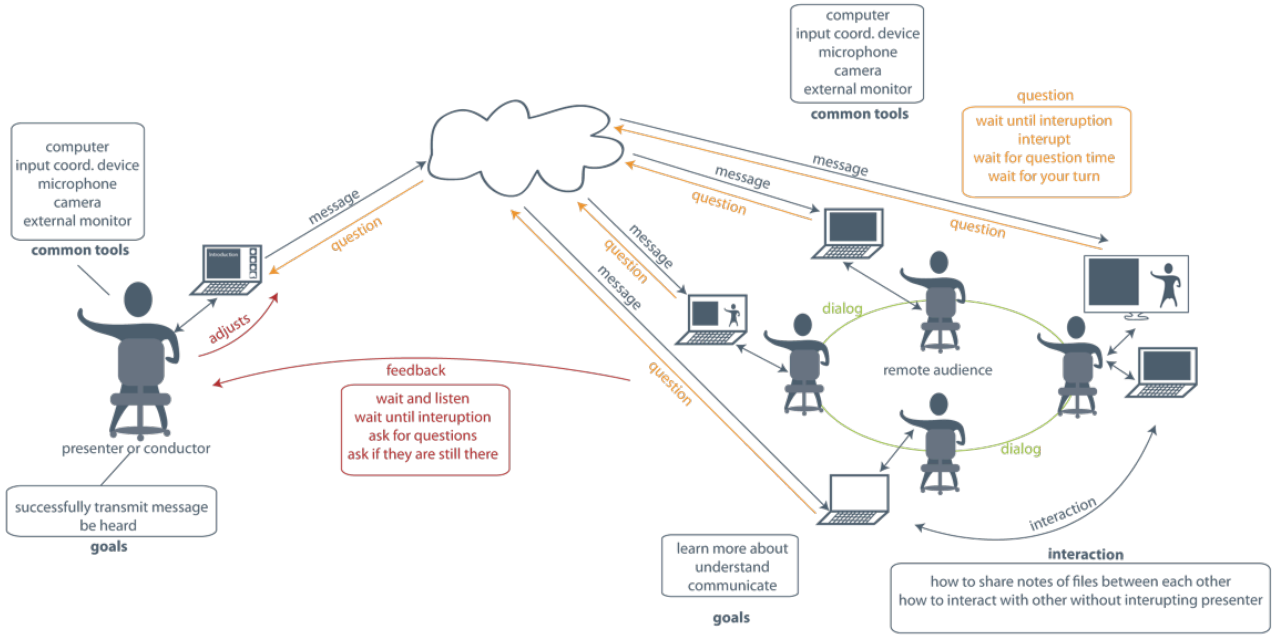


Figure 3. High-level diagram of a remote presentation (video-conferencing) representing goals and communication channels.

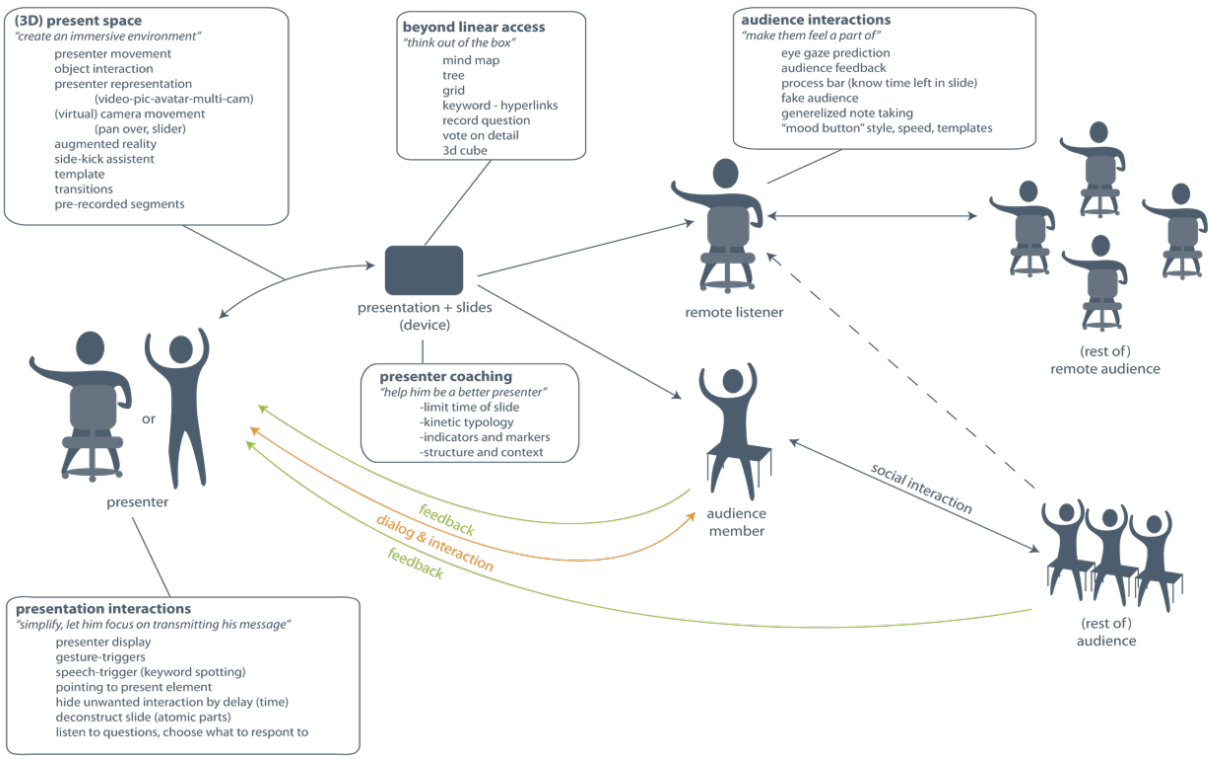


Figure 4. Diagram displaying early brainstorming results relating to user roles.

Figure 4 features the results of a brainstorming session perform by the Visual Communications department—performed a week before my arrival—that was refined, filtered and mapped accordingly to the role or artifact in the diagram.

Interviews and Questionnaires

The semi-structured interview and questionnaire's objective was to build a persona and revise scenarios, that could help the communication between both teams (Belgium and French) and focus the research to specific users and settings.

Seven participants with ages between 21-49 working at Bell Labs as researchers responded the questionnaire:

- Demographics
- Background
- Current activity
- Attending presentation
- Presenting material

Research results:

A typical collocated presentation was considered to be a small group of individuals were a presenter uses a laptop and projector to display a slide presentation. A "U" shaped sitting layout was the most common result, where audience members remained seated facing the presenter standing next to the screen (projection).

Most of the interviewed individuals preferred a more interactive role where they where audience members of a presentation. They disliked slide presentations that contain too much text, an inexperienced speaker or a speaker that does not interact with his presentation or audience. What they liked about presentations was the presenter's interaction with the local audience, the presentation's appearance, its content and the possibility to interaction with colleagues (more in small groups, less in larger groups and less with remote colleagues).

When questioned about taking on a presenter role, the interviewees showed notions of good presenters practices such as: presentation story should be fluent; well practiced; reviewing; and interaction with the audience that consists on looking more towards the audience than the screen. Using gestures to enhance presentation, adapt presentation according to feedback, Q&A, approach the person who is asking the question and pointing are key practices.
Some issues identified such as, slide synchronization with remote viewers, the need to edit on the fly and the difficulty in setting up devices and connections.

This initial research study helped identify the essential aspects of presentations providing a more concrete understanding of the ground level that we could build on.

1.4. Project constraints and initial design

Project Constraints

The following project constraints were defined by upper Bell Labs management:

- Presentation can be formal (CEO presentation) or informal (remote group meetings)
- Presentation is live (not recorded and seen offline)
- Should be broadcasted over a network to remote audience

- Maximal inscription and minimal subscription (with minimal cultural/social interference)
- Showcase the contribution of the project in the defined context, as a more efficient and effective, bigger, faster, better, greener technology.
- Benefits of the project as compared to existing solutions are shown through scenarios.
- Aim at showcasing a working prototype, focusing on the user experience.
- Target the development for everyday devices.
- Instead of changing the user's devices, change the way they interact with them to afford a more natural and intuitive support to their activity.

Persona

"Bert," our persona was based on the information obtained during the previous interviews. This would allow for a more "credible" archetype for the individuals who are working on SlideWorld and see Bert (the persona) as a possible user and design for the persona. E.g. Would Bert benefit more from feature A or B?

More information of the persona Bert can be found in the appendix.

Scenarios

The two following scenarios (1-to-many and many-to-many), Figure 5 and 6, were refined into these easy to read maps. These two maps were shared with the French Bell Labs team, and from them, both team were able to understand their roles and chosen scenario to work on. These maps representative of the scenarios focus more on the potential users and are still being used by Bell Labs today[1]. *The first two scenarios (1-to-many and many-to-many) based on the initial research and incorporate the persona can be found in the appendix*

The first scenario (see Figure 5) represents a formal presentation as if a CEO of a large company were to present to stakeholders while the many-to-many scenario represents a more informal, interactive, inter-group meeting. This is the scenario that was addressed during the M-ITI internship (see Figure 6).

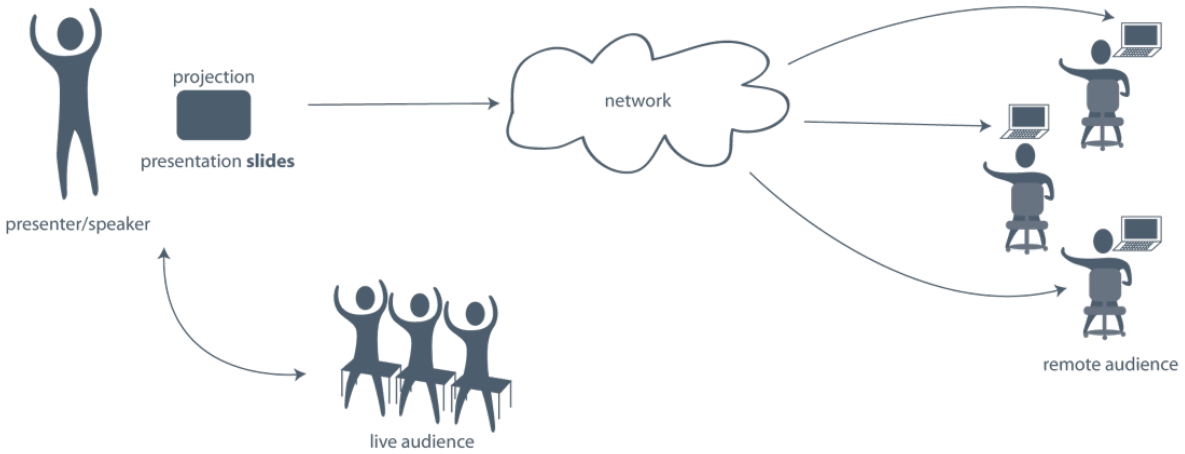


Figure 5. One-to-many scenario devised for SlideWorld approached by the French team.

[1] Bell Labs Villarceaux uses the 1-to-many map several times in their presentations including the Bell Labs open days France 2011

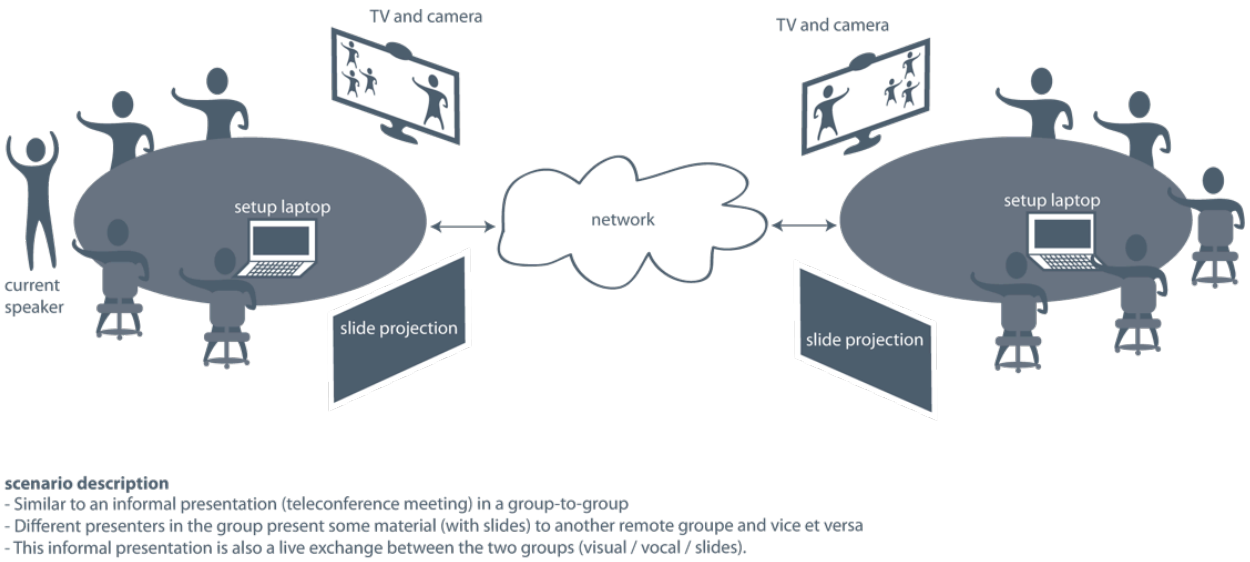


Figure 6. Many-to-many scenario devised for SlideWorld approached by the Belgium team.

1.5. Activity Modeling

For a deeper understanding of the research context and scenarios, a Human Computer Software Engineering methodology was used, the activity modeling. Within Activity Modeling, a role map of possible SlideWorld users and their relationships can be seen in Figure 7. Users who interact with the system are referred to as actors (Participant and Staff). An Actor can subsequently play a role (or multiple roles) in multiple activities. A user role (Chairperson, Technical Facilitator, and others) is an abstraction representing a relationship between user and system. Roles represent the user-participant perspective within activities: needs, interests, expectations and behaviors. A role may be played by more than one actor.

A typical application involves distinct roles representing the various relationships a user can assume in interaction with the application. As seen in Figure 7, a Participant (actor) may have a multiplicity of distinct roles. He may take on the role of a Collocated participant, Remote participant, Isolated participant or Reader. Each of these roles take on different activities within the system's context (and subsequently different Tasks). E.g. a Collocated participant may perform activities through different artifacts that differ from those performed by an Isolated participant.

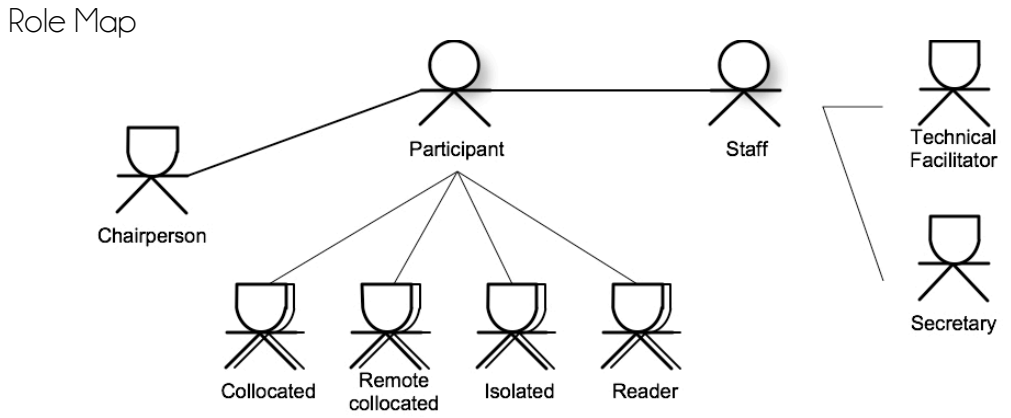


Figure 7. Role map for SlideWorld representing the three identified actors and their roles.

Role Profiles

User Roles are played by Actors within activities. User Profiles include extra information about the activities. The content of this revised Role Profile is organized under three headings: Activity, Background and Characteristics.

An Activity refers to the activity within the role is played. It is described in terms of: purpose; physical and social context; and participation (including salient artifacts).

Background refers to the background characteristics of the performers of the role. Experience, training, education, system knowledge and domain knowledge are some of the characteristics described.

Characteristics refers to performance characteristics, such as frequency, regularity, intensity, complexity and predictability of performance.

Design (the forth rubric), serves as a container for evident design implications considering the first three rubrics to effectively support the role.

Below is the designed user profile for the "Chairperson" role—*for the remaining role profiles please consult the appendix.*

Chairperson

Activity: The person who organizes a meeting to discuss project updates, inform colleagues, collaboration sessions, etc. He invites the participants, books the room and manages the meeting's topics. During the meeting it is he who keeps the order—of discussion—by deciding who should speak and managing the decision making process (e.g. deciding when to vote, how to vote). The Chairperson assigns tasks to the participants, decides what topic should be emphasized, how it should be approached (e.g. Brainstorming session, group activities) and what to do during the meeting.

Background: An individual with experience in the discussed topic and at managing meetings and participants. The chairperson is comfortable with the technologies needed to perform his activities.

Place/Time: Takes place before the meeting: E.g. at his office he might decide about the meeting, organizing the invites, booking the video conferencing room, gathering the initial information about the topic and during the meeting: e.g. in the meeting room where he manages the participants and tasks.

Participation: The chairperson normally decides on the need to hold a meeting or is informed of that need. Before the meeting, it is he who books a video-conferencing room and will take care of scheduling, inviting and informing participants of time and date as well as the topic to be discussed during that meeting. He might also provide some initial information—documents (physical or digital)—as the background or introduction to the topics. During the meeting it is he who will manage discussions, keep track of the agenda and tasks to be assigned.

Characteristics/Performance: Depending on the type of meeting or presentation the Chairperson may play his role during the entire meeting or change to a participant role.

Product Design Implications: Centralized information and access to a shared repository where files and information can be shared easily and remotely with participants—who can be easily notified on these meetings and know were the information is located. The system during the meeting should support different tasks and activities as well as an easy form of transition between them. The system should assist the Chairperson during the decision

making process by providing tools that can efficiently transition between states (e.g. voting, polling, collaborative work, presentation, etc).

Meeting Journey Map

A User Journey Map provides designers with a visual map of the user's intents from the initial moment they need to interact with the system or service until the end of the interaction. A journey map is a timeline augmented with user activities and possible touch-points (points in time where the user might interact with the system or service).

SlideWorld's journey map (see Figure 8) displays the distinct user roles taking part in activities that occur at different moments in time (phases). This journey map allows us to identify four main phases in the 'journey' of holding a meeting and to visually relate user roles to key activities that are taking place during a meeting as well as in what phase these activities are being performed.

As shown in Figure 8, the Chairperson role takes part in phase 1 of the meeting, while the other roles do not. The Reader role, which may be played by various actors, interacts with the system in phase 4. These roles perform different activities and have different needs and interactions related to them.

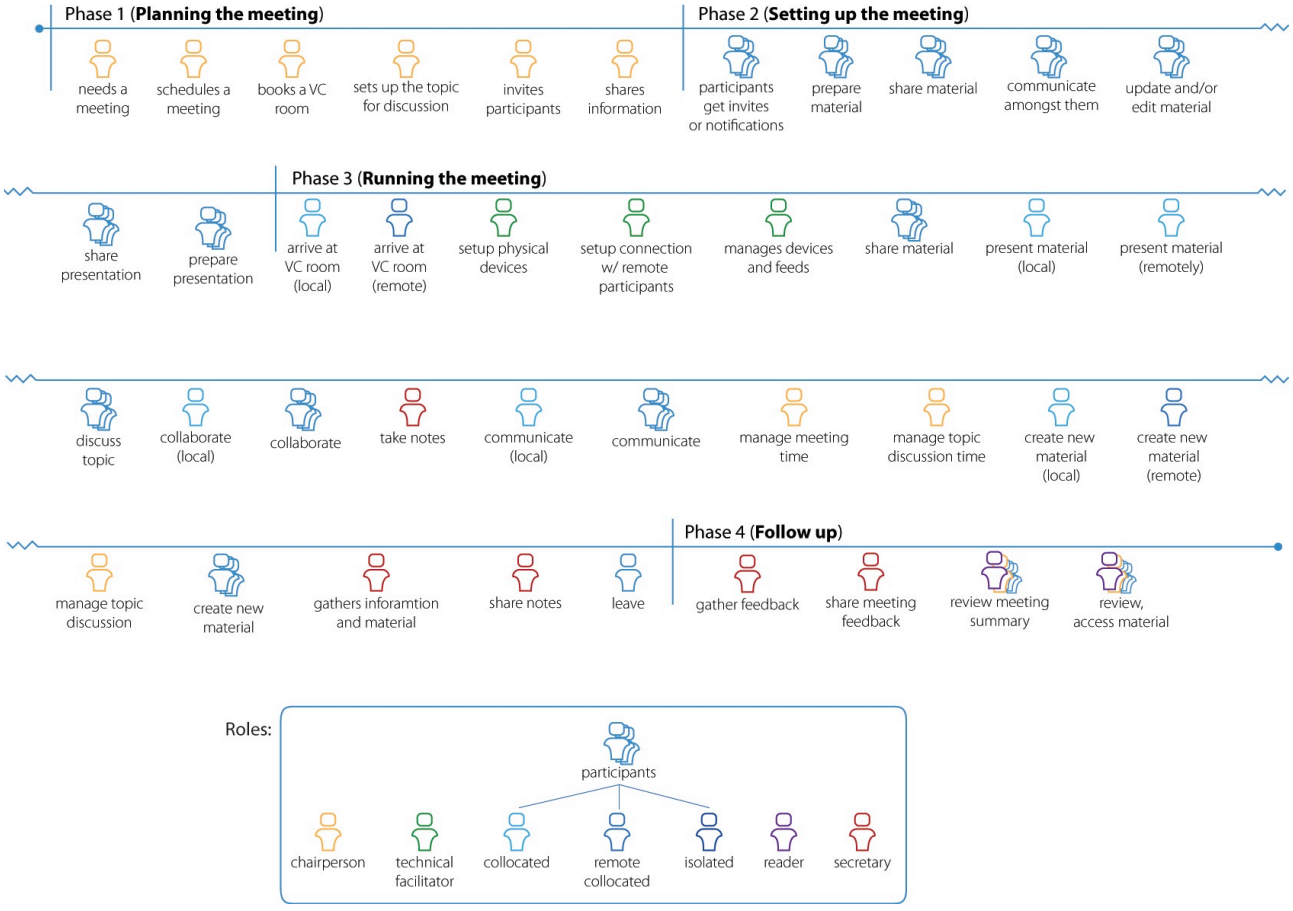


Figure 8. Journey map of a presentation divided into phases, displaying the activities that each user role undertakes within each phase.

Meeting phases

The identified meeting phases are as follows:

- Phase 1: Planning the meeting

During this phase the Chairperson decides on the need for a meeting or presentation. He checks schedules; books a room to hold the meeting, invites participants and staff and shares the meeting topic and initial information.

- Phase 2: Setting up the meeting

During this phase the participants have received their invite or notification to the meeting/ presentation. They, if requested, prepare material for the meeting, research about the topic, contribute, and collaborate with colleagues.

- Phase 3: Running the meeting

During this phase the meeting is ongoing. Participants collaborate and discourse over the meetings topic, the devices have been setup for remote collaboration and communication, new materials are being created and interesting ideas registered.

- Phase 4: Follow up

During this phase (that can last indefinitely) participants can review, access and manage the information generated and shared during the passed meeting. The information can be structured as a document to be shared with others.

1.6. Conceptual Architecture Map

Figure 9, represents conceptually how user roles could be associated to certain artifacts due to the nature of their inter-role interactions.

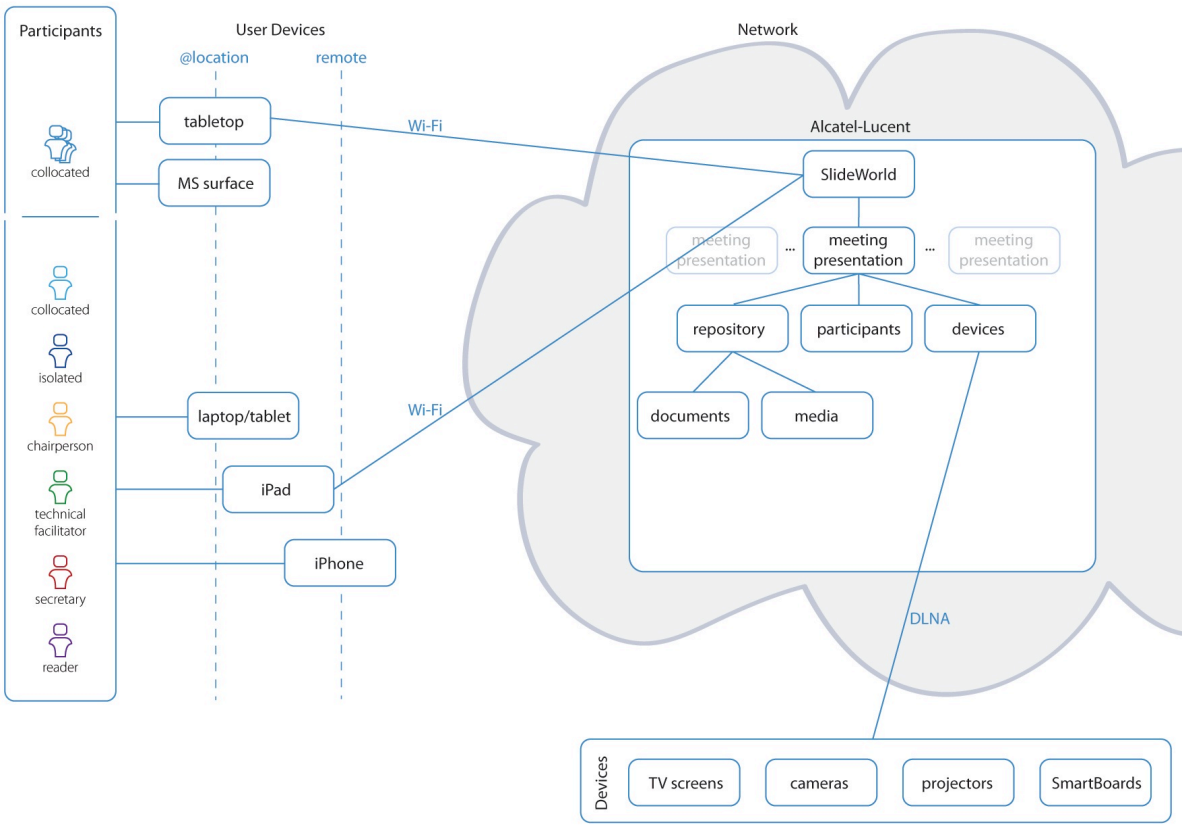


Figure 9. Abstract architecture for the centralized repository concept for SlideWorld

The concept was based on a centralized repository of information for meetings and presentations. This would allow for local and distributed audience members and participants, to access a central repository where all the information relevant to a meeting or presentation

would be located. The information we consider is everything from slide sets, documents, multimedia, too room location, time and date of the event. One of the motivations for this was to try to minimize the usage of email (asynchronous communication) in organizing and sharing information—before and after the event.

More concretely (as seen in Figure 9, right) the central repository would be divided into meetings or presentations (events in time). For each of these events there would the a repository, list of participants and devices (depending on the room). DLNA was the technology of choice for the connection of new devices due to is wireless nature, easing the setup phase of the devices—versus the traditional: this cable is damaged! Or: Is there a cable for "device A"?

1.7. Ideal scenario

An ideal scenario was ideated and designed. This scenario includes some initial concepts and brainstorming results into a story. The above user roles and stages (Figure 8) are present as well as the design concept from Figure 9.
The Ideal Scenario is located in the appendix.

1.8. Activity mapping and descriptions

The above scenario, role map and the journey map, helped revise more concretely the activities and tasks performed by the user roles. This was helpful when approaching the Activity, Performance and Activity Modeling maps.

Activity map

An Activity is a collection of actions or tasks undertaken for some purpose.
An Activity Inventory identifies the focal activities (involving the system) as well as related activities.
An Activity Map shows the interrelationships among focal and related activities.

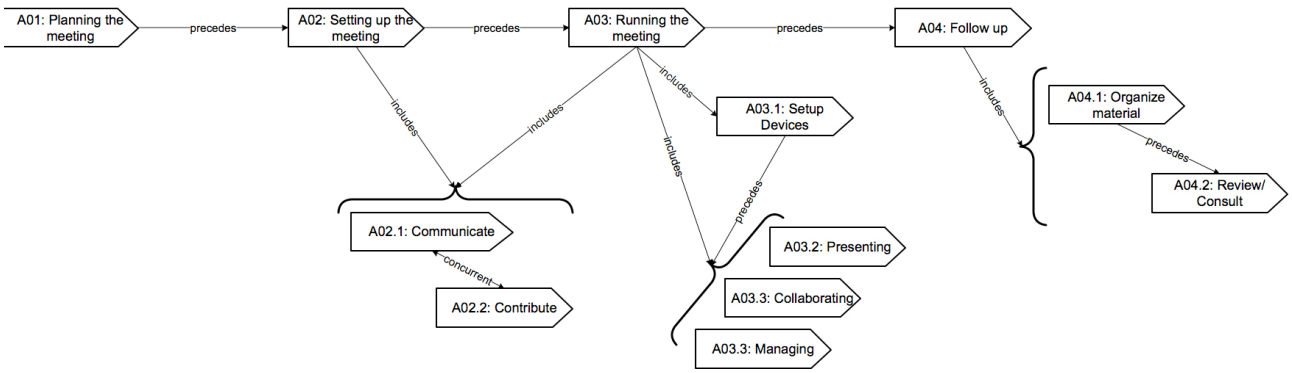


Figure 10. Activity map for SlideWorld showing the activities that take place during a meeting.

Performance map

A Task is an action performed by an actor in interaction with the system of reference, for some goal within an activity.
A Performance map models the aggregation of Tasks within activities.

Figure 11. Performance map for SlideWorld displaying the tasks associated to activities.

Activity Modeling

This model displays the performance model with the related roles associated to each task or activity. This provides us with an easy way to perceive which user roles are associated with which activities and subsequently with which tasks.

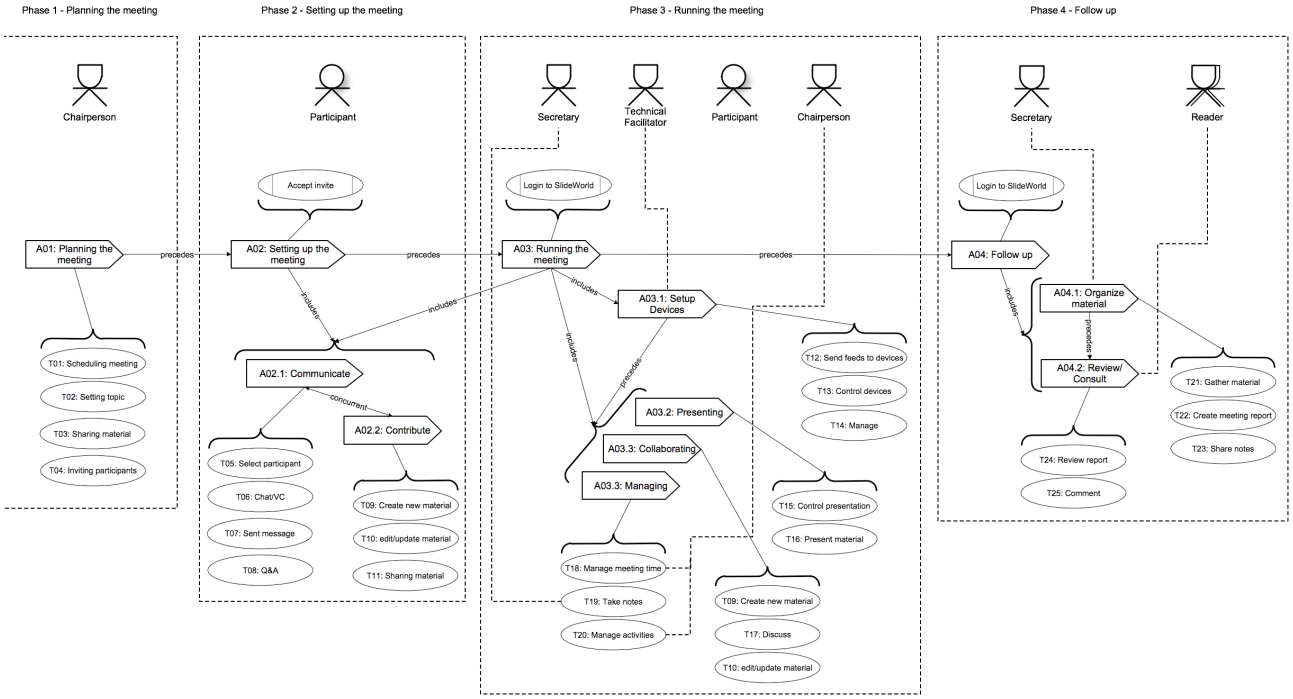


Figure 12. Activity Model for SlideWorld relating tasks to activites and activities to user roles, all divided into the four phases of a presentation.

1.9. State-of-the-art

Introduction

The internship with Alcatel-Lucent Bell Labs allowed for context and problem setting exploration of the 'SlideWorld' project. During this exploration phase the project's usage context and user demography were narrowed down, thus performing initial user needs, research and initial ideation. This exploration phase refined the problem setting, the project approaches and possible methodologies.

Furthermore, the internship provided valuable insight into Bell Labs technologies and technological possibilities, thus introducing the first project constraints and overall goals.

State-of-the-art research on software applications and web-based services

As a first approach, a broad analysis of popular state-of-the-art software and web-based services were analyzed. During this initial phase the aim was to identify potential positive characteristics approached by the state-of-the-art, while learning and identifying undesirable features or interactions or un implemented needs.

Approach

We chose to approach the state-of-the-art research by identifying popular communication platforms, project and team management, productivity suites, collaborative environments, sharing and synchronization tools and web-based versions of the above. Through this research we intend to understand and identify what makes these applications and services popular and consequently most used and liked by users.
This was done due to the unforeseeable future directions of the project. I.e. we did not know how, when, or if we would be approaching the many-to-many scenario as part of a larger project. The state-of-the-art research was based on experimentation, consultation of expert application reviewer websites and by consulting written user reviews and opinions. The intent was to obtain a global knowledge of what "others" are developing and providing to users and identify why, which parts and which features or collection of features, make these applications and services popular.

This state-of-the-art research will also allow us to perceive which areas are not fully explored, or that lack functionalities that might enhance the overall user experience. By exploring within this global context, we should be able to identify where (if so) these applications and services achieve our set goal of inter-participant interaction, real-time collocated and remote collaboration and immersive remote presence.

From the internship and Bell Labs interests, the research will provide more accentuation to the affordances of these application on the iPhone and new iPad devices and cross-platform web-based applications and collaborative web-services.

From here onward we shall dub the ongoing project 'RemotePresence.' At this point, RemotePresence was approaching a remote CSCW context. It might seem very general but it was a good eye opener, in the sense of looking at what has been done within the CSCW community.

Research Method

For this state-of-the-art research we defined our research methodology as following:

- Small introduction to the software or web-service with some wireframes and screen shots
- A pros (+) and cons (-) analysis in context to RemotePresence's goals
- A SWOT analysis highlighting interesting key features and weaknesses
- A brief conclusion and a 7-point star feature overview map representing the overall score of the software or service related to RemotePresence's focus areas

The studied features that were identified and focused on, do not reflect the complete array of features that the chosen software applications or web-services have to offer, but are the most relevant features and characteristics for the RemotePresence project and research context.

The pros (+) and cons (-) section, SWOT analysis and 7-point star feature overview map, features and characteristics analysis where relating RemotePresence's research focus and future direction.

We consider this selection of features, key for focusing on the project's context and not get sidetracked by a vast number of interesting features that do not fall into RemotePresence's problem setting. For comparison and an easy visualization of information a 7-point star feature overview map (see Figure 13) was designed for each studied case.

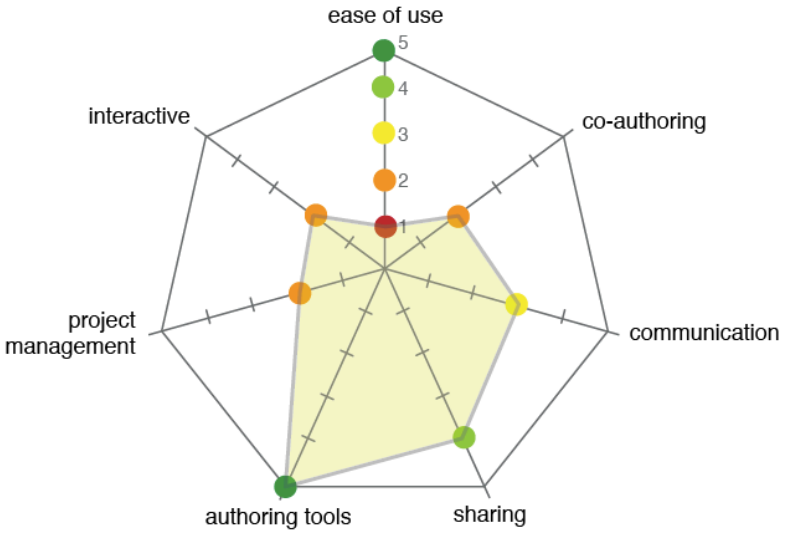


Figure 13. Example of the 7-point star feature overview map used for each analyzed state-of-the-art.

An example of the 7-point star feature overview map (see Figure 13) displays the 7-axis key features and the specific value that the studied application or service was provided with for each axis. An overall rating, provided by the size and color on the polygon is created by joining the specific value point of each axis and the polygon's color reflects the overall rating color similar to the specific score on each axis.

The axis values represent key characteristics that RemotePresence has targeted. Rating is provided related to which features and characteristics are offered and available to users and what number of implemented features coexist and integrate.

Ease of use: How easy is it for users to perform and navigate their desired task?

1. Bad. Over complicated to use, cluttered interface, no understandable navigation
2. Poor. Unintuitive, complicated navigation, and interface cluttered
3. Fair. Simple to use, but not well organized
4. Good. Simple to use and easy to navigate
5. Excellent. Everything is well designed, organized, and works as expected

Interactive: How interactive is it for users?

1. Little. Just me, the mouse, and clickable buttons
2. Poor. The normal interaction you would expect from a GUI interface
3. Fair. The application allows me to do more than just type, point and click
4. Good. I can interact with another users or the interface itself is interactive
5. Excellent. I interact and communicate with other participates in joint tasks, in a visual interactive application

Project management: Does it provide the necessary tools and features to support project and product management?

1. None.
2. Poor. I just get a calendar and a message board
3. Fair. A number of features, can manage schedules, invite users
4. Good. Complete number features to support the activity
5. Excellent. Supports all the possible tasks needed for the activity

Authoring tools: Does it provide tools for content creation?

1. None.
2. Poor. Provides a basic text editor
3. Fair. Provides a complete writing tool, or features that support the context
4. Good. I can create text documents, presentations, spreadsheets
5. Excellent. I can create almost anything needed to support my activity

Co-authoring: Do the applications or services provide users with the possibility to simultaneously author content?

1. None.
2. Poor. I can create some basic text files for others to view
3. Fair. I can create a variety of different files, other may edit asynchronously
4. Good. I can create text documents, presentations, spreadsheets and collaborate
5. Excellent. Create almost anything needed to support my activity and collaborate in real time with live feedback

Communication: What is the level of communication support?

1. None.
2. Poor. Just instant messaging or email
3. Fair. A combination of messages, instant messaging and email facilities
4. Good. Synchronous communication (audio/video) with email or instant messaging
5. Excellent. I can host multi-user video conferences, send emails, instant messaging chat rooms, send or post messages

Sharing: Does the application allow users to share information with other users, synchronize multiple devices and centralize access?

1. No.
2. Poor. I can share documents and files via email
3. Fair. I can upload document to a web-based storage, and send emails
4. Good. I specifically share to a user, synchronize my information or share my screen
5. Excellent. I can share through a number of different ways, synchronize all information even on other devices, backup with version revision, send URLs pointing to files, and have a centralized repository.

For the state-of-the-art device research, the products and solutions offered by one of the world' leader in unified communication solution provider, Polycom were taken into account.

Below (see Figure 14) a comparison map will be designed for each solution and system range offered by Polycom that fall into RemotePresence many-to-many scenario context.

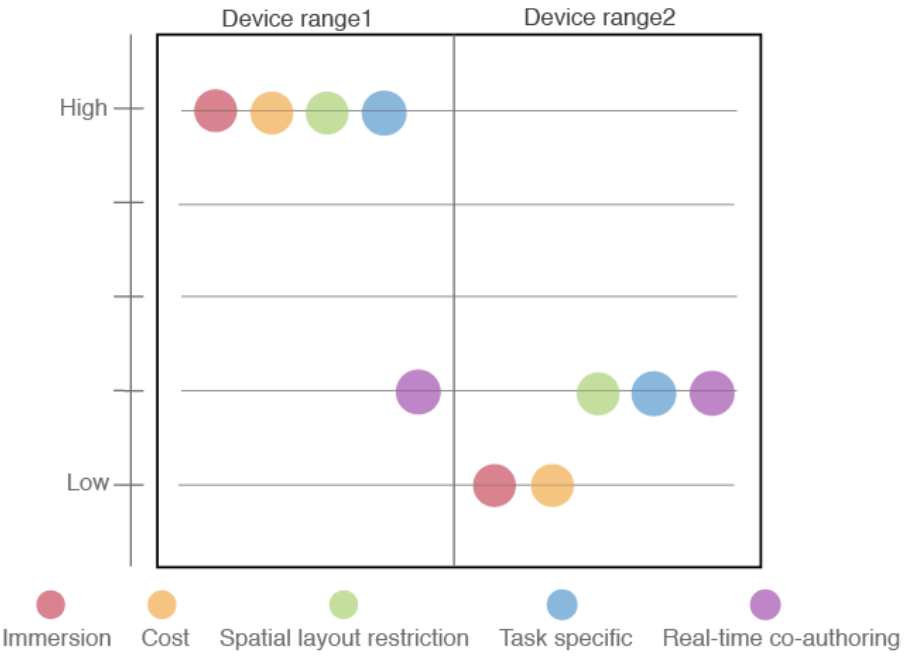


Figure 14. Example diagram representing feature and characteristic comparison of two devices ranges

This comparison map will afford an easy overview of specific features and characteristics that define these provided solutions and systems. Below are represented the characteristics that were chosen to participate in the comparison.

Immersion: How immersive is the communication and collaboration to users?
Cost: How expensive are these solutions?
Spatial layout restriction: Do these solution need specially prepared rooms and devices? Can these spaces be rearranged?
Task specific: Are these solutions only valid for a specific context or activity?
Real-time co-authoring: Do these solution afford real-time creation and collaboration on documents and other information?

State-of-the-art analysis

The state-of-the-art analysis of the individual applications (tools, and services) is located in the appendix.

State-of-the-art conclusion

This state-of-the-art application and web-service research phase, allowed for a deep insight into possible RemotePresence competitors and their offerings, approaches and focuses. Many of the mentioned applications and services are specific to a certain context, area, focus, demography and domain. RemotePresence focuses on providing an immersive and interactive platform to support meeting and presentations, thus researching communication specific, meeting specific, project management application and services provide an in-depth understanding of these specific tasks and how we might combine them seamlessly.

Discoveries

The state-of-the-art research provided valuable information relevant to how to approach the problem setting.

Figure 15 displays an overlay of all the studied applications, software and web-services, all superimposed on the 7-point star map. The darker the highlighted are the more application overlay occurred and more popular features and characteristics are implemented.

One surprising discovery was that most of these popular and well known applications and services are simple to use and easy to perform the desired tasks.

None of these applications or services really focus on designing highly interactive experiences or focus on real-time collaboration confirms our initial premiss that collaborative tools are dismissing a key interactive feature.

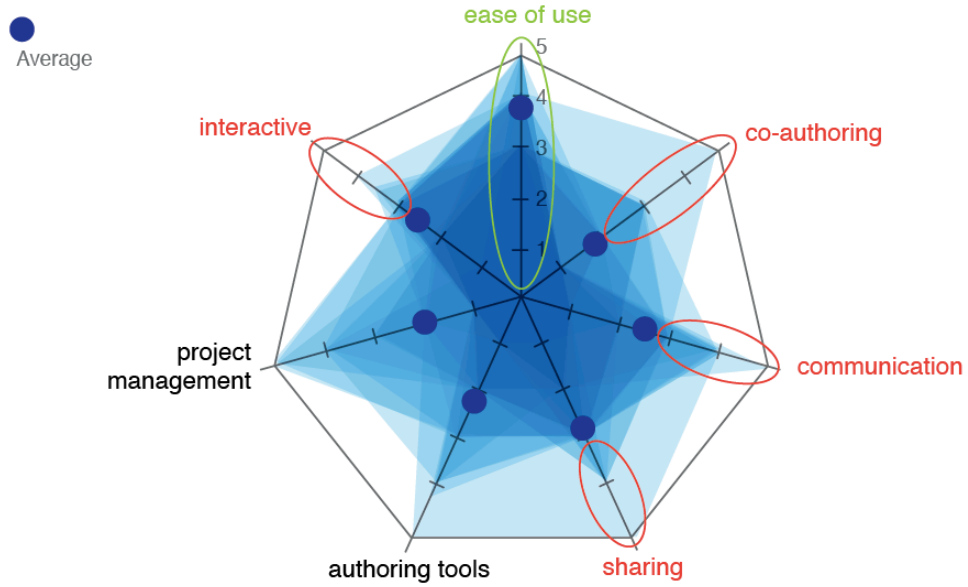


Figure 15. Superimposing of all the analyzed state-of-the-art applications and services.

By analyzing the Figure 15 overview result map it is possible to identify some key points:

- Many applications and services do not provide meaningful interaction between participants and do not offer visually interactive interfaces.
- There is very little interaction with the content (web-conferencing tools).
- Popular services and applications tend to be easy-to-use (valid for individual to mid-size organization usage).
- Few applications or web-based services afford real-time document or activity collaboration integrated with natural communication (video communication).
- Despite very good activity specific software and web-based services (e.g. Dropbox, SkyDrive, iDisk) not many of them can seamlessly integrate with other applications or services.

RemotePresence's problem setting is the so-called many-to-many scenario. This scenario describes a typical group-to-group meeting or presentation. If we take a look at RemotePresence most feature complete and direct competitors (see Figure 16) we are able to identify their strengths and weaknesses.

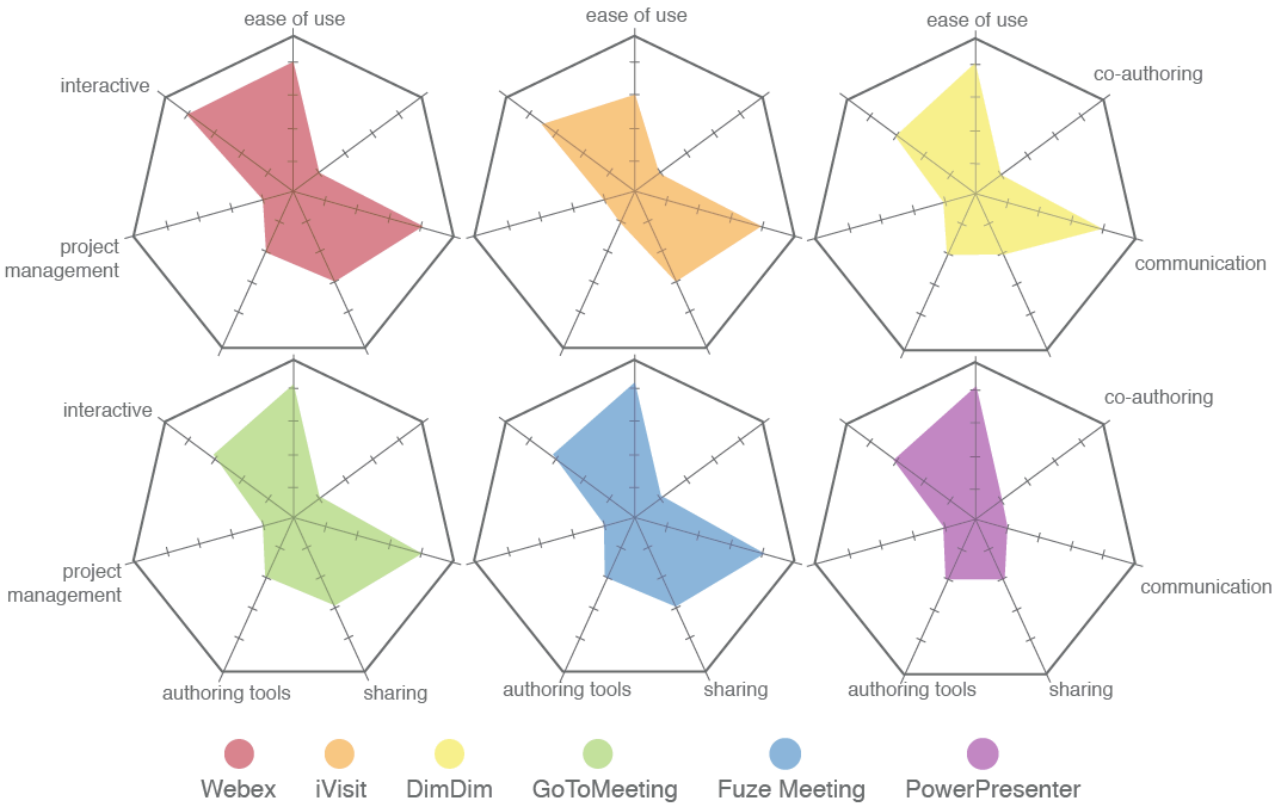


Figure 16. Most direct RemotePresence competitor's overview score, side-by-side.

Many of these meeting and presentation specific web-based applications support some complete communication tools (instant messaging and video conferencing) and are very easy to use and setup, but none on them support real-time collaboration in content creation or editing. Also, neither of the web-based meeting and conferencing applications are highly interactive, opting for traditional GUI looking interfaces. Interaction with the presentation content was minimal to inexistent (some annotation and note taking features were available).

This state-of-the-art research afforded an in-depth look-and-feel of the main features and characteristics these services and software applications have to offer. A Word Cloud map (see Figure 17) was generated, giving prominence to words that appear more frequently in the source text, in this case, the generalized features and characteristics that appear most in the studied cases.

Figure17. Word Cloud map of the most prominent features and characteristics within the studied cases.

These Word Clouds display the most predominate words within a large amounts of information in an easy to understand output. As seen in Figure 17 is was possible to quickly identify that the studied application and services are easy-to-use web-base application that provide users with a simple and familiar interface and navigation on a multiplicity of different devices and platforms. Most of these application support some type of communication (asynchronous or synchronous), some level of integration with popular document types and a small level of collaboration.

Project opportunities

This state-of-the-art allows us to validate our initial supposition that there are not many fully interactive and immersive collaborative environments available for personal devices such as computers and tablets.

The Word Cloud (see Figure 17) afforded an easy way of identifying less approached or implemented features and characteristics. Central-repository, interactivity, synchronization, real-time collaboration and interaction are less prominent within this study. RemotePresence looks to approach those by researching and conceptualizing usable features and characteristics that support user needs in those areas.

The state-of-the-art research uncovered interesting features and characteristics that deserve to be pursued and explored in more detail for the RemotePresence project. Some of these features and characteristics include:

- Central repository for sharing, synchronization, and backup of files and information
- Support co-authoring and real-time document collaboration
- Support multimodal communication and interaction
- Manage and organize information (e.g. notebooks with notes and tags)
- Support file revision and reviewing
- Allow for mutual control in presentation settings
- Support active reading activities
- Support a multiplicity of devices and work with their affordances
- Support meeting and presentation recording and playback
- Provide a secure and reliable medium for communication and sharing
- Easy to invite participant by emailing a URL (pointer) to a meeting/presentation
- Provide shared whiteboards for inter-participant ideation sharing

Some more complex features included:

- Anoto Pen synchronization of annotations and markups between paper drawings and digital copies.
- Text recognition from images and photos with OCR algorithm
- Scheduling appointments in natural language (e.g. Meet John at 3:00PM Wednesday at the Pestana Hotel)

The RemotePresence project will not focus on the development of new hardware solutions, but there might be advantages in integrating with popular Polycom (and others) solutions. Many of the meeting setting already provide Polycom's video conferencing systems. RemotePresence focuses on adding real-time co-authoring and interaction through the iPad to enhance these settings and user experience.

1.10. User needs study

Introduction

During this next pre-study research phase of RemotePresence an additional User Needs study was performed that complements the previous study. Here, given the problem setting, project usage context and user demography, the previous User Needs study was refined and focus on specific user needs and the required features and characteristics needed to support their activities within our defined many-to-many scenario.

Why perform a User Needs study?

At this point RemotePresence was focusing on being a part of the CSCW community and integrate seamlessly into meeting and presentation group-to-group settings. These User Needs studies help designers obtain an in-depth view of the users perspective as well as technical parameters, key features and characteristics needed to support their activities, thus providing a complete experience and usable product to the end user.

Project setting and usage context

As stated before, this project will focus on the problem setting of inter-group and participant co-authoring and interactive real-time collaboration. We imagine RemotePresence to be used along with existing teleconference and video conferencing systems.

During the previous phase—State-of-the-art research and literature reviewing—we identified that the current web-conferencing, productivity suites and communication tools lack user-to-interface and inter-user interactivity, real-time collaboration and more engaging communication features that we argue to be key in supporting the key activities identified within our project context.

RemotePresences's problem setting and usage context incorporates a diverse and tightly integrated inter-participant interaction and communication (see Figure 18). From small, almost private communication and collaboration to inter-group and participant communication and multi-tasking collaboration (groups of individuals working collaboratively on different parts or scenarios).

Figure18, presents usage contexts—the swim-lanes—for RemotePresence. Each swim-lane represents a level of possible inter-participant interactions, while also possibly interact with other swim-lanes. Interactions, artifacts and activities, vary throughout the swim-lanes. Grouping users to a single context (swim-lane) affords identifying key activities, constraints, user needs and interactions.

1 - Collocated collaborative work:

This natural collaboration between two (up to 3) people includes reviewing papers, drawings, consulting emails, viewing information on a device, creating new content, writing papers and reports, etc. This type of collaboration requires less technology (due to proximity) and affordances of the physical environment and artifacts. When technology is required, e.g. a laptop, it is easily usable and viewable by the individuals.

2 - Collocated collaborative group work:

This type of collaboration is common is academic and business environments. A group of individuals working with one or more contents or materials for a common goal. This may include presenting material to others, working on a project, etc. Technology is used to create and manage information as well as for visualization.

3 - Inter-group collaborative work:

In our state-of-the-art study we encountered some web-based tools that approach this swim-lane context. Two groups of individuals presenting materials and working for a common goal. Technology is essential in this context for remote communication, sharing of material, etc.

4 - Inter-participant collaborative work:

This swim-lane focuses on two individuals that are remotely located working on the same content and communicating. Sometimes the individual who is at the meeting acts as an intermediary for the remote individual. E.g. an external consultant or a remote colleague.

5 - Multi-participant and group collaborative work:

This is the whole (sum) of all the previous swim-lanes. Here different usage contexts need to seamlessly integrate and communicate if needed to be a usable and efficient collaborative environment. Supporting all the above swim-lanes may over-complicate a single application interface.

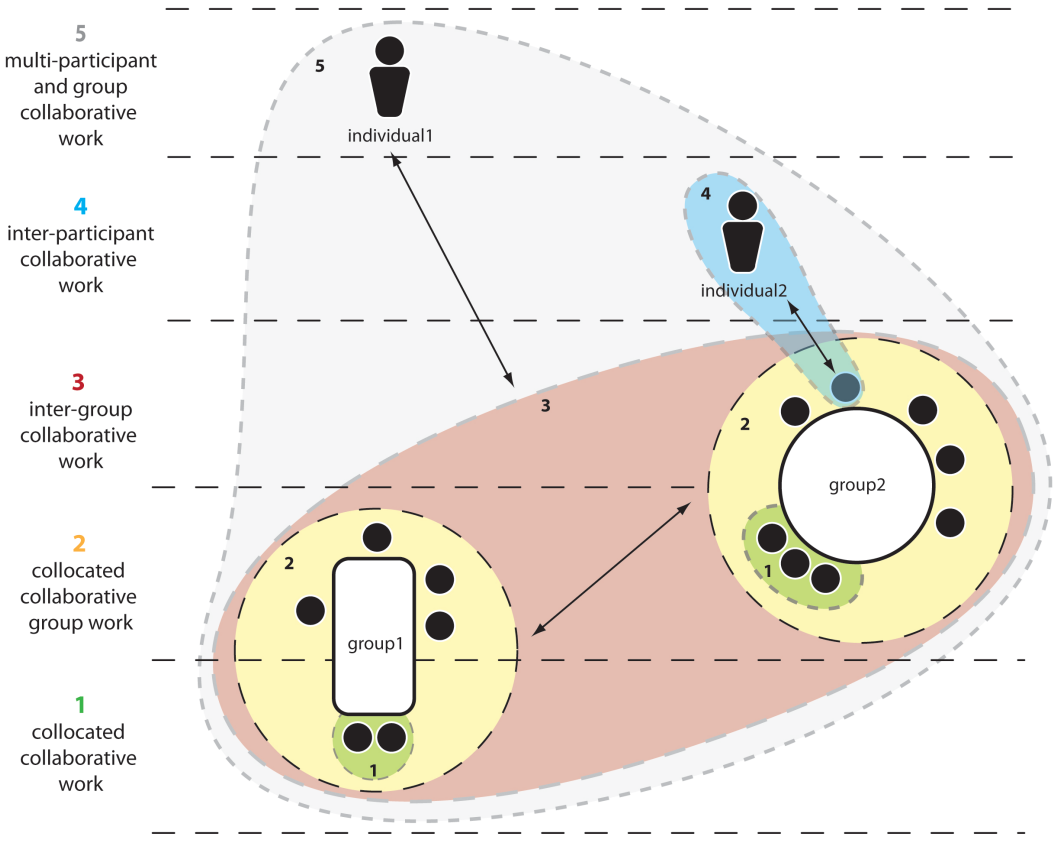


Figure 18. RemotePresence usage context and problem setting mapping.

This document contains a User Needs analysis[2] that will complement the previous state-of-the-art research with more concrete usage requirements and adding a user's perspective in approach to RemotePresence project.

[2] The user need analysis uses a priority system. This priority system is a relation between the identified user needs and its importance (1-5) within RemotePresence context.

User Needs analysis

The following user needs are a result of different phases and analysis. The first being from the past internship at Alcatel-Lucent Bell Labs Belgium (observations and semi-structured interviews), the second from analysis of current state-of-the-art and literature review.

The User Needs analysis can be found in the appendix

User Needs Conclusion

Figure 20 displays the user needs approached by current state-of-the-art divided into general categories. Due to the nature of RemotePresence and its focus as a CSCW tool, RemotePresence focuses on user needs that fall into its environmental and demography context. More importance is given to co-authoring, sharing, and interactive needs. We argue that the iPads affordances support these categories best. Communication and authoring tools are best handled by specific task devices (Polycom systems and laptops). RemotePresence looks to enhance the existing many-to-many scenario focusing on more social and collaborative needs that users require or would benefit from having supported by a multi-touch mobile device.

To better understand figure 19 we consider the following:

- Co-authoring: creation and manipulation in real-time of documents and multimedia
- Sharing: diversity of ways to share information and files to individuals or groups
- Communication: Multi-modal communication, asynchronous, synchronous, etc
- Interaction: Inter-user interaction, GUI, command based, etc

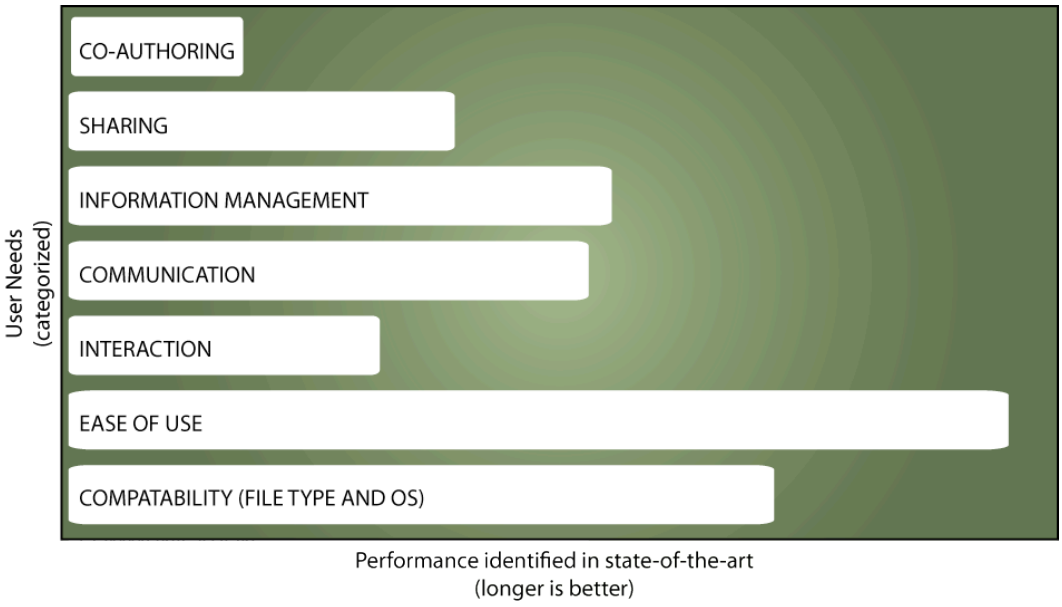


Figure 19. State-of-the-art's approach to some identified user needs.

1.11. Conclusion

This pre-study proved to be a successful exploration phase. During the three month internship, a scenario (many-to-many) was defined and explored, some initial research demonstrated that individuals whom have been placed in the remote presentation setting acknowledge the lack of interaction and boredom. The persona, Bert, and the two scenarios, along side the journey map and activity modeling maps, helped gain some valuable insight into the roles that individuals may perform within the context, as well as, when is what role more predominant and which are the activities, tasks and artifacts needed to support efficiently that role.

By ideating the central-repository concept, these different user roles have a unified access point to their relevant information. From the research and observations, one of the key issues identified within this context of remote meeting and presentation was the difficulty in organizing, collaborating and keeping all the information (media) up to date and synchronized with all the relevant participants.

The generalized state-of-the-art analysis now proved to be an interesting approach. Looking into the different areas of CSCW, specifically (communication tools) or globally (groupware tools) it was easy to identify that the most popular tools used, are indeed very easy to use and perform the intended task.

The user needs analysis showed that some key aspects have been overseen by current state-of-the-art remote presentation tools. Key aspects that are inherent in collocated live presentations and that are natural for “us” in human communication. Real time collaboration, co-authoring, sharing information and group communication are difficult and too costly to achieve well.

An interesting aspect, is indeed the lack of expressiveness. Moreover, other modalities of presentation such as the presenter's body language and hand gestures are missing, making it more difficult for the audience to understand the intended message.

2. INTRODUCTION

In concluding the pre-study phase, an interesting research opportunity was identified: There is indeed a lack of expressiveness and other modalities of presentation, such as, the presenter's body language and hand gestures [2] within teleconferencing, distributed collaboration teams and remote presentations.

[3], identified that around 30 million people give presentations with PowerPoint everyday (2001). These PowerPoint presentations are by nature collocated events with a presenter (speaker) and a group of people who are participating in the discussion or merely attending (see Figure 2 in the pre-study phase for a visual summary).

When performing this activity—presenting or collaborating—remotely/distributed (over a network), [4] argued that the relative weakness of many of these systems in supporting synchronous remote working, comes from their inability to assist individual's work flexibly and with a variety of workspace objects.
As seen in the pre-study phase, Polycom's Immersive Telepresence Rooms offer completely equipped rooms with the latest in telepresence and telecommunication technology to help perform distributed (and collaborative) meetings (and presentations) in a way to offer users the best experience and performance as if every participant were collocated.

If the aim of RemotePresence is to support these remote collaborative activities with our everyday devices (and not fully equipped dedicated rooms). Understanding of the basis for human communication, social interactions, deictic gesturing and analysis of the affordances of these "everyday devices" and what is the best design that a user needs to achieve a good user experience and performance.

Studies [4] have demonstrated how communication and collaboration are dependent upon the ability of personnel, to invoke and refer to features of their immediate environment. It has been found that many activities within collocated working environments, rely upon the participants talking with each other and monitoring each other's conduct, whilst looking at some workspace artifact and have another see in a particular way what themselves are looking at.
While at the linguistic level this, "talking with each other" or, "shared understanding" is concerned with the understanding of a sentence, or even, a word in a sentence, while at the cognitive level it is concerned with the understanding of a problem and its solution or with the understanding of a domain [5].

Communication isn't only about understanding sentences and words. Communication is a collective activity of the first order. When A speaks to B, A must do more than merely plan and issue utterances and B do more than just listen and understand. A, must speak only when A acknowledges B is attending, hearing and trying to understand what A is saying, and B must guide A by giving A evidence that B is doing just this [6].
This mutual acknowledgment of understanding between A and B is called Grounding in communication.
Grounding (or social grounding) is the collective process by which the participants try to reach a mutual belief that the contributor and his or hers partner, have understood what the contributor meant to a criterion, sufficient for the current purpose—converse, explain, transmit a message, etc.
Grounding employs mechanisms that vary according to the task and according to the medium [6] and has two main factors that shape it: Purpose, what the two people are trying to

accomplish in their communication; and Medium of Communication, the techniques available in that medium for accomplishing that purpose and what are the costs in using them [5].
During a conversation people tend to utter back-channel responders such as “uh huh”, “yeah”. This activity in grounding is named Evidence in Grounding. Once a conversation has initiated and one utters something, one might suppose that all we need to look for is for a negative evidence, some feedback that lets one know if the other person is not understanding. As importantly as a negative evidence, the positive evidence (“uh huh”) is even more noticeable while conversing over a telephone or teleconferencing device. In this type of communication medium we are not able to view the other persons body language, facial expressions, etc, thus, we rely solely on these positive and negative evidences (utterances) as a mean to repair (to better explain, change wording, speak louder, etc).

Commonly, people do not like to work harder than they have to [6]. In language (communication) the same principle also applies. People conversing do not expect to spend more effort then they need to get their addressees to understand. Deictic gesturing (pointing and referencing) is one of these Least Collaborative Effort Mechanisms for grounding in communication. It is easier and less costly to point at someone and utter ‘him’ or point somewhere and utter “there” rather than referencing something spatially by words. Clark and Brenan [6] argue that deictic gestures combined with communicative statements help establish common understanding and that an appropriate gestures that are easily interpreted are preferable over complex sentence constructions.

Speakers frequently indicate objects by pointing gestures that support selections from the shared visual context and are connected to an explicit deictic term (“this”, “here”, “that”) hence deictic gestures [7].
In a previous study by [5] they observed that 87% of the numerous gestures performed during their experiment were simple deictic gestures. Speaker B utters the pronoun <u>you</u> three times, each time referring to a different participant. This use of gestures allows the listeners to interpret the speaker’s intent unambiguously [8]. Gesturing will only be beneficial if the speaker and the addressee have a mutual awareness of their eye gaze—the first stage in deictic referencing, Mutual orientation. I.e., the speaker should not gesture if he acknowledges that the addressee will not see him performing or holding the gesture.

Looking into these communication modalities, body language, gestures, sign language, in this thesis we chose to approach the modality of deictic gesturing (pointing) as a research project. By analyzing the prototypical pointing gesture, it is a communicative bodily movement that projects a vector from a body part (for this thesis we are only considering the arm, hand and finger). This vector indicates a certain direction, location, or object. Pointing is a deictic gesture used to reorient the attention of another person so that an object becomes the shared focus of attention.

The pointing gesture is a foundational building block of human communication in four respects: Its ubiquitous in our day-to-day interactions with others. When communicating about referents locatable in the speech situation, pointing is almost inevitable; Pointing is uniquely a human behavior. Pointing is a primordial in ontology (people learn to point before they learn to speak) [9].
Pointing is also a way of declaring, making a point, or asking for something. It always draws someone else’s attention to an object or event of interest and the gesture never conveys information that is completely redundant with the information conveyed in speech—is always adds something meaningful.

Gestures and speech are more connected than people might think. They stem from the same mental process and tend to be both temporally and semantically related [10]. People utter

almost simultaneously with the extension of the gesture.
Deictic pointing allows for verbal communication to be much more efficient. There are four important stages in performing a successful pointing gesture: Mutual orientation; Preparation and staging; Production of the gesture; and Holding (provides best information) [11].

When looking into collaborative environments, [12] identified "Fractured Ecologies" as being a mismatch of perspectives. When collaborators are not side-by-side they have different perspectives on the task depending on the medium of communication between the remote sides. Experimental studies indicated that just by linking spaces through audio-video links does not improve performance to the levels observed between side-by-side collaborators. We recon the same is true for remote presentation settings due to the inherent nature of referencing object and content from the media being shared between the individuals.
On this last note, we intend to approach deictic gesturing within these remote presentations by means of a handheld multi-touch device. By researching and studying the psychological aspect of pointing, allied to affordances of a multi-touch device, we argue that it is possible to add meaningful information that is lost by only having audio and a video feed (small box with the medium close up) of the speaker.

The remainder of this thesis will follow a structure as follows: In chapter 3 state-of-the-art, we will look with greater detail into literature review on human communication, grounding in communication, pointing gestures and the psychological aspect of pointing. More so, we will look into and analyze the strengths and weaknesses of the current state-of-the-art devices and tools that afford this "remote pointing." In chapter 4, the research question will be presented and described. Chapter 5 will present the theoretical framework designed to help approach the research question. Chapter 6 will describe the methodology, how, when and why of the decisions and techniques performed. Chapter 7 introduces the all the research activities chronologically, describing findings and design decisions. Chapter 8, design iterations presents the final designed cursors and prototypical integration with Bell Lab's SlideWorld project. Chapter 9, 10 and 11, discuss, present future work, and conclude the thesis.

3. STATE-OF-THE-ART

3.1. Literature review

Introduction to Grounding in Communication and Least Collaborative Effort Mechanisms

In [5], the authors identified a large difference of scale between grounding an utterance and sharing a solution through hundreds of interactions. To approach this issue they identified three factors that described how utterance grounding mechanisms vary, according to task criteria and according to the medium used for communication: The degree of sharedness of the information (e.g. CO-presence decreases the cost of grounding); degree of mutual knowledge; and the persistency of information.
The author's study was based on a shared whiteboard (with no audio channel) as a grounding instrument to solve an enigma. While the need for the test subjects to perform deictic gestures was present, the authors did not observe any due to the users knowledge of them not being able to see each others cursors and to the impossibility of simultaneously marking an object and typing an utterance 'he.' Similar studies, Delhom (1998), observed that a shared whiteboard served as a shared memory and that the acknowledgment rate (evidence in grounding) was lower in comparison to the same context without a whiteboard. [5] discriminated the persistency of display from the persistency of validity. While the display persistency on a whiteboard is high, the persistency of a strategic knowledge is low (within their enigma solving context), i.e. the information on the whiteboard may persist for a long amount of time, but the same information is slowly updated.
A similar notion concerning remote presentations can be identified. While the slide presentation has a somewhat longer persistency (tens of minutes), each slide is less persistent, and the logical (story) path within the content (slide) being discussed is even less.

In contributing to a conversation the contributor (speaker) presents an utterance to his addressee in two phases: The Presentation phase, where A (speaker) presents an utterance u for B (addressee) to consider and waits for B to provide any evidence; and the Acceptance phase, where B accepts the utterance u by providing evidence that he or she understands what A means by u [6].

The Principle of Least Collaborative Effort that demonstrates that in a conversation, the participants try to minimize the work that both do, from the initiation of each contribution to its mutual acceptance—namely collaborative effort. When people communicate its is natural that some repairs need to be made in order to get the addressee to understand. Studies have shown that speakers have two preferences about repairs: Speakers prefer to repair their own utterances; and Speakers prefer to initiate their own repairs.
By the addressees providing a quick grounding evidence (feedback) the speakers can repair (and utter that repair) quickly enough to not break the communication flow. In the present remote presentation tools there is a very limited (if not inexistent) feedback channel from the addressees to the presenter (speaker). In many cases the speaker does not have any evidence feedback from his addresses and performs no repairs, or sometimes the feedback comes too late and the repair subsequently comes out of time and disrupts the communication.
During the pre-study phase, in many live remote presentations it could be observed that the addresses preferred not to interrupt the speaker (provide negative or positive evidence) due to the latency of the communication channel and due to its interruption—the speaker had no idea of the negative evidence of his addresses at the immediate time, so, when the negative

evidence arrived, it was slightly delayed to where the presenter was in his story, thus interrupting him and making him need to recall and repair his previous utterances.

When discussing or presenting some content (slides, a product, etc) it is important that the involved participants can identify the objects quickly and securely. This grounding reference has several common techniques to establish this crucial mutual belief. One of the techniques is done by providing alternative descriptions. Here speakers, in referring to objects they typically use one or more referring expressions such as: definite or indefinite description, proper noun, demonstrative or pronouns. In trial references (another technique), speakers use "try markers" (e.g. a question intonation on a normal phrase) to initiate the grounding process.

For RemotePresence's research context, indicative gestures is the most interesting technique presented. Speakers refer to a nearby object, the partners have the possibility to provide positive evidence that they have identified it by pointing, looking or touching.
Commonly, in the slide presentation context there is a question and answering phase. During this phase addressees become speakers and the slides may still be the common ground—if discussing something about a slide. Currently tools are limited for that interaction. Participants, may ask the presenter to go to slide "s" where there was a diagram "d" that mentioned "m" and then try to indicate the object by uttering spatial coordinates ("the upper right image next to the …") but it comes at a high grounding cost.

Grounding changes with the medium and has its owns constraints and costs. Co-presence, visibility, audibility, co-temporality, simultaneity, sequentiality, reviewability, and revisability are 8 constraints that a medium might impose on communication between two people. Looking at the current mediums that fit in the remote presentation context we can identify co-presence, visibility, and simultaneity as their main constraints. Similarly, when a medium lacks one of these characteristics it generally forces people to use alternative grounding techniques that come with different costs such as: Formulations costs; production costs; receptions costs; faults costs; and others.

In [13], the authors conceptualized Media Spaces, a computer-controlled teleconferencing system, in which audio and video communications are used to overcome the barriers of physical separation. They defined Media Spaces in the context of telepresence as the establishment of a sense of presence over distance—whether in space, time or both—and came across a key concern. They identified three distinct dimensions to how telepresence could be established: Person space: a space that lets you know it is me, my mood, my personality—most often supported; Task space: a shared space of the domain of interest—source around a document, whiteboard, shared drawings, etc; and the most neglected of the classes of shared spaces—that are a requisite for a rich sense of presence—the Shared Reference space. The shared reference space defines the superimposition of one's physical presence (e.g. presenters gestures) on the shared task space (e.g. the slides during a presentation). This is what lets the remote person anticipate the presenters next action and maintain a situational awareness of what he is doing and to what.
In nearly all shared drawing, writing and whiteboard examples the remote person's reference space is defined by a moving point, such as a screen cursor. "This gives them the gestural and referential capability of a fruit fly"
Similarly, [12] agues that "laser pointers have lower bandwidth for the expression of gestural information than the direct presentation of hand gestured or sketches."

The psychology behind the pointing gesture

In order to approach the issue of lack of physical expressiveness offered by current telepresence, telecommunication and remote presentation tools a deeper understanding into the psychology of deictic gesturing (pointing) was required. What does it mean to point? What are our intentions? How do we point? These are only some of many question that we wish to approach with the literature review.

Communication is ordinarily anchored to the material world—people, artifacts, objects. One way it gets anchored is through pointing.
Pointing, in its essence is a communicative bodily movement, that project a vector from a body part in order to reorient the attention of another person towards an object of shared attention. Pointing is a foundational building block in human communication, and different forms of pointing may correlate with particular types of referents and intentions.

In [9], Rolfe (1996) offers three criteria for deictic pointing: Its dialogic in that it requires and audience; The gesture's objective is to single something out which the addressee comprehends to be the referent; while the direction of what is being pointed at is seen away from the pointing hand (pointing vector).
The pointing gesture acquires a metacognitive aspect, i.e. the aspect that the person performing the gesture knows that for the gesture to be successfully communicating, he needs the attention of others. This tight connection between gesture and speech form an integrated system. The gesture conveys information (identical or not) within the utterance, if in the case that it does not convey identical information, the gesture nevertheless has systematic temporal relation with the speech it accompanies. In fact, [8] notes that psycholinguistic studies have shown that the onset of the gesture generally precedes the onset of the expression (utterance) 1/3 second before.

One might think that every person performs a pointing gesture in different ways. [9] demonstrates a compiled list of some of the most common physical pointing gestures (using hands) and identified them as:

- Index-finger palm down: refers to an individual object as something to be considered directly.
- Index-finger palm vertical (side): the object being indicated has relevance is the conversation but is not the focus. The object could be relevant to the conversation in terms of attributes, spatial settings, placed in some kind of relationship.
- Thumb-pointing (the enumerator gesture): refers to a last index-pointing gesture or placing objects or locations in some kind of symbolic context.
- Open-hand oblique: indicated a relationship between the speaker and the object and is used to when making a comment about the object.
- Open-hand palm down (the beggar gesture): commonly used to indicate source of something that the speaker is now saying.

Index-finger pointing is socially transmitted and is a natural form of referencing and indicating single objects in space.
Commonly, pointing gestures may trace the shape of what is being pointed at—namely Tracing. Within a singular gesture it is possible to superimposing an iconic display. If the act of tracing leaves behind a mark (e.g. pointing and dragging your finger on sand) it is identified as an Inscription.

Pointing is an indicative act. Indicating is fundamentally creating indexes for things, while indexes are one of the three basic types of Signs. An index designates its object because its a

dynamical connection between the object and with the person to whom the index serves as a sign. Symbols are another type of signs that are associated with their objects by rules (e.g. traffic signs). Finally, icons, bear a perceptual resemblance to their objects.
Signs are part of a three-placement relation, a sign addresses an object for an interpretant. In conclusion, anything that draws attention is considered to be an index.

Directing-to and placing-for, two basic techniques for indicating (pointing)

In pointing, speakers try to direct their addressees' attention to the object they are indicating —directing-to, one of the two techniques for indicating.
Placing, the second technique for indicating, allows speakers to place the object they are indicating so that it falls within the addressees' focus of attention.

Directing-to tends to be a transitory signal. A speaker can use his voice as an attention-directing device, thus indicating themselves as speakers, their present location as *here*, or the time of the utterance as *now.*

In Placing-for, people tend to place two types of things: themselves (e.g. in a queue); and material things other than themselves (e.g. a 10euro bill on a counter in the supermarket).
Placing happens within an indexing site (site exploring), while directing-to tends to create a new site. I.e., in placing, absolute placement sites impose particular interpretation on objects from well developed conventions (e.g. checkouts, cash registers), while relative placement sites take in account the relative positioning of the speaker, address, or landmarks (e.g. person in a queue). Placing goes through a three phase lifespan: Initiation, where one places the object per se; Maintenance, maintaining the object in place (focus of attention); and Termination, replacing, removing or abandoning the object.
Placing-for is optimum for maintaining a continuing signal and has certain advantages over directing-to as:

- Joint accessibility of signal: The object is located and accessible to everyone in a conversation for an extended amount of time
- Clarity of signal: The continuum presence of an object makes it easier to resolve disputes about what is being indicated
- Removal of signal: Placement is easier to revoke than directing
- Memory aid: The continuing presence of the object is an effective memory aid
- Preparation of the next joint action: Placement leaves an object in an optimal place for a next step in the collaborative action

Directing-to has more practical advantages over placing-for. It is quicker, easier to indicate objects that are difficult or immovable, easier to indicate objects one-by-one that are spread over a wide area, indicates direction, indicates complex referents (e.g. point at a shampoo bottle and say: "that company") and precision timing (gesture and utterance).

Directing-to and placing-for work well together. E.g. An individual witnesses a robbery. The police place individuals in a "line up" The witness points to an individual and says "that man". By being in a police station, behind a tinted glass, individuals being placed in a line (site exploring), the witness creates a perceptually conspicuous site in that common ground by pointing to the individual (site creation) so that the action is understandable by others.

Markers are an extension of placement. E.g. an individual leaves his coat on a chair in class. Instead of placing himself in the chair he leaves a marker of himself (an artificial index), indicating that, the seat has been taken by the owner of the coat.

Graphical user interfaces in computers demonstrate the extended notions of the basic indicating techniques, placing-for, and directing-to. A click is a virtual form of pointing, and dragging is a virtual form of placement.
In revising the context of remote presentations, current presentation software tools such as PowerPoint and Keynote offer ample support for placing—slide transition, highlight, progressive disclosure of list items, animations, etc. Prezi, offers a more extended notion of placement with zoomable areas and "flight paths" through content. However, directing-to has a very limited support mainly (if any) as a virtual laser pointer or mouse cursor.

RemotePresence is not focusing on placing-for. We acknowledge that current presentation tools cover the user needs sufficiently, however, directing-to is our main research direction. Perhaps, the combination of the notions of placing and pointing could be very interesting in adjusting pointing granularity, i.e., the difference between pointing at a UML class in a diagram, or, at an attribute within a class in the same diagram.

Focusing on directing-to (deictic gestures or pointing as now referred), [11] divided a deictic gesture into four stages.

- Mutual orientation: the producer of the gesture must acknowledge that the observer can see both the gesture as the referenced target (object)
- Preparation and staging: the producer makes a preparatory action (e.g. raising arm slowly), indicating to the observer that a gesture is going to be produced (feedforward)
- Production of the gesture: physical pointing gestures are not immediate and the gradual production of the action allows people to predict the general direction of the referent
- Holding: this phase provides the best information, by holding the action until there is a mutual understanding of the referent has been achieved (most communicative gesture) [8]

Similar to [9], the authors observed that when indicating a plain-visible object the producers of the gesture performed an extended arm gesture, while when the objects was obscured (or partially visible) the producers performed a circular open hand gesture, indicating a region of interest.

This literature review on deictic pointing and human communication helped narrow down the scope for RemotePresence to supporting deictic gestures within a remote presentation context. We understand that the nature of a touch screen (*is touching yes/no*) will be difficult to support some identified deictic stages such as preparation and staging, and mutual orientation due to the distributed nature of all participants.
Nevertheless, we shall continue to some state-of-the-art analysis in the next subtopic.

3.2. State-of-the-art

Funky wall

In [2], the authors describe an interactive wall-mounted display tool named Funky Wall, to support designers in easily conveying messages or ideas in the form of a asynchronous visual presentation. This interactive tool allows for presenters to easily record their presentations while capturing the presenter's individual gestures.
The authors designed four different proximity regions to act as individual interactive triggers. The closest region allowed for highlighting or interacting with content from the presentation. This allows users to record their gestures by augmenting them onto the content in the form of a white translucent (25-30% alfa) streaks (see Figure 20).

Figure 20. Replaying: visual feedback displaying all gestures made in the presentation semitransparent on the mood board [An Interactive Support Tool to Convey the Intended Message in Asynchronous Presentations]

Evaluations undertaken by professional designers, showed that they were able to use the tool without any prior training. Viewers, commented that seeing the gestures with the audio of the presenter, helped better explain the pictures being presented, enriching the experience, making the presentation more "alive", and perceiving the designers gesture made it more "human".

Discussion

The authors approach in recording, replaying, gesturing, and contemplating interactions in different proximity regions, fit well within their asynchronous presentation setting. The same might not be true for RemotePresence's real time distributed presentation context where gestures may be used to perform repairs in real time.

A system that explores a multimodal fusion of pen, speech and 3D gestures

In [14], the authors designed a system allows participants at remote sites to collaborate by sketching on multiple distributed whiteboards while displaying how participants could be made aware of naturally occurring pointing gestures. The authors argued that the technological affordances should support meetings as they run normally, and not constrain the users into adapting their meetings and communication towards the technology.

Telepointers have been explored as a means to provide a sense of embodiment to remote users of such shared artifacts. In an attempt to bridge distributed meetings with a stronger sense of co-presence, video has been the key media of choice, but this creates some issues such as actions conveys via video are framed within local contexts and become hard or impossible to re-construct from an outside context.
Pointing gestures made towards a display (e.g. slide projection) are in general not retrievable at remote sites and participants are unable to tell what object is been pointed at. The authors identified some state-of-the-art video manipulation software were used to attenuate this problem.

Finally, the authors argue that multimodal disambiguation is indeed required to correctly select a target in most cases and that humans pointing to difficult targets (distance or size) by moving closer to the target or by adding complementary information via utterances.

Discussion

Here we have a better understanding in how video alone is limiting, when it cannot successfully capture the presenters gestural actions and the referent in the same frame (detachment). Interestingly, the notion of adjusting the pointing gesture in relation to the difficulty of referencing your target (distance or size) by altering the pointers distance to the target, could be interesting to research for a remote presentation context. E.g. pointing at the slide verses, pointing at a bullet point within a slide.

The Effects of Remote Gesturing on Distance Instruction

In [12], the authors investigated remote instruction using an object assembly task where two subjects (and instructor and a student) had to communicate to complete the task. The study consisted in comparing a remote gesturing system (see Figure 21) to audio only communication. The instructor's task was to instruct the student on how to assemble a object, for this he was provided with a TV screen (view the test subjects work area) and a video camera. The instructor could perform assembly gestures with his hands knowing that the student was able to view his gestures on his workspace by a video projector. The authors demonstrated that with the remote gesture system the assemble tasks were completes faster and with less need to verbal communicative assembly instructions.

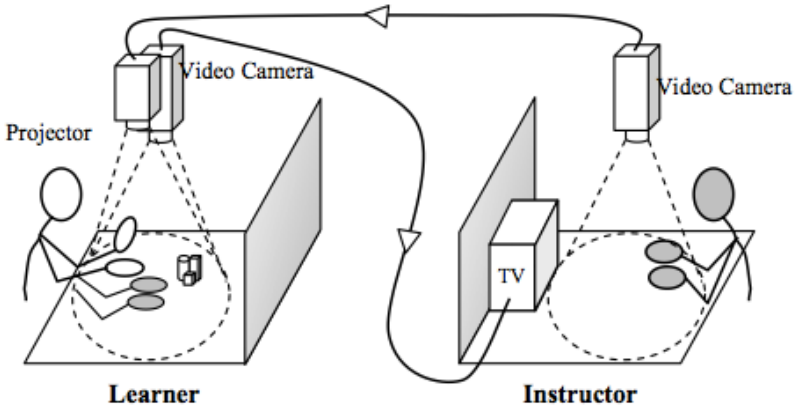


Figure 21. Schematic of the gesture projection system [The Effects of Remote Gesturing on Distance Instruction]

Discussion

Telepointing is a visible embodiment of the gesture (mediated gesture system) but in this case the addressee was viewing the instructors gestures augmented as video projection on his

workspace (linked gesture system). This allowed the addressee to conclude his assemble task faster, perhaps due to the fact explaining certain artifacts or describing assembly actions verbally were too complicated and time consuming.

For the context of RemotePresence we shall adopt a mediated gesture system that uses an artificial representation of the remote gesture, similar to virtual laser pointers (presented in this state-of-the-art chapter).

Magnification for Distance Pointing

In [15], the authors tested three types of magnification (linear circular magnification, fish eye, and widget) for visualization of large screens that display web page content and computer applications—where the content was to be seen from a distance (see Figure 22).
The authors encountered related research, where researchers were conducting research on the usage of laser pointer for distance interactions and their encountered issues and design guidelines. Jitter and the difficulty for cameras to track the laser pointer where two of the main issues encountered.
In an attempt to minimize such unsteadiness and tracking difficulties the authors focused on three types of magnification. The fish eye magnification had the advantage of enhancing localized details while preserving the continuity of transition to the global context. However the continuous distortion mislead the orientation of the focus. In the order to decide which type of magnification was best, the authors applied Fitt's Law technique, and observed that without magnifier, users had a 123% higher error rate than with any other magnifier (for small objects). The authors ultimately concluded in offering several magnifiers and let the users choose the one they preferred most—since it was based on personal preference.

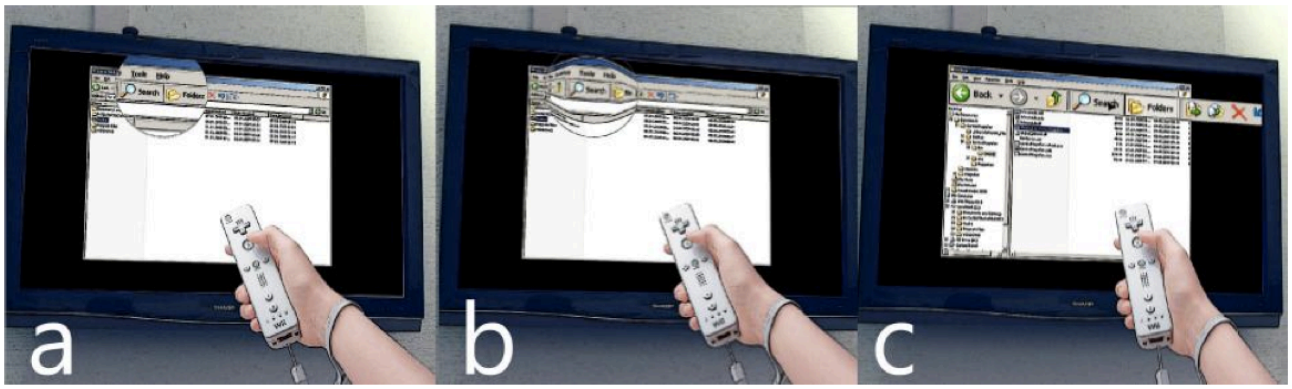


Figure 22. a) Linear circular magnification; b) Fish eye magnification; c) Widget magnification [Magnification for Distance Pointing]

Discussion

An interesting aspect of physical pointing was mentioned here. Jitter, unsteadiness, difficulty in acquiring the target, are all issues that interacting through a multi-touch device could avoid.

Gaze Awareness and Interaction Support in Presentations

In [16], the authors approached the scenario of a collocated live presentation where the presenter uses as a visual aid, a large slide projection located high above for all the attendees in the room to see. This combination of large and distant canvas does not allow the presenter to interact with it (e.g. pointing or to what part of the slide is the presenter looking at). The authors designed a see-through display (see Figure 23) in which the presenter interacts with the presentation, gesturing and gazing. A camera captures a video stream of the presenter and

the system digitally combines the slides and the presenter to create a coherent view for the audience (see Figure 23, right) on the large display.

The authors argue that it is easy for the local and remote audience to see where the presenter is looking at and what he is pointing to.

Figure 23. Left, presenter view. Right, audience view [Gaze Awareness and Interaction Support in Presentations]

Discussion

The authors approach the detachment of the presenter and his content by merging them both and projecting the resulting media on a large projection screen. The overlay may become too confusing and distracting from the content due to the presenters persistency within the slide canvas during the presentation.

Direct interaction with large-scale displays from a distance

In [17], the authors take a different approach to the somewhat mediated gesture system proposed as a semi-translucent display [16]. Here the authors propose extending the reach of the performer of the gesture with a physical laser pointer, not only for indicative purposes but also, as a direct interaction device. The authors argue that by tracking the laser pointer on the projection canvas with a camera (instead of interacting with the presentation using a mouse) this form of interaction will thereby reduce the cognitive load of the user and improve their mobility while interacting and performing actions.

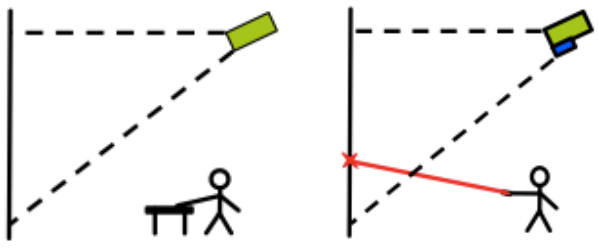


Figure 24. Left, a schematic of existing large display interactive systems. Right, an example of direct interaction [Direct interaction with large-scale displays using infrared laser tracking devices]

Discussion

This is a common scenario. A presenter relies on a physical laser pointer to be able to perform indicative gestures to content and objects that are out of reach. While the authors focus was on interacting and performing action by tracking the laser pointer, other ideas such as

tracking the laser pointer and then augmenting it (via a projection) on to the slides in a more predominant fashion, or record the "pointing" to add to an offline version of the presentation are interesting in helping the addressees understand and follow the presenters deictic utterances.

Pointing Gesture Recognition based on 3D-Tracking of Face, Hands and Head Orientation

In [18], the authors present a system capable of visually detecting pointing gestures and estimating the 3D pointing direction in real-time (see Figure 25). By integrating Hidden Markov Models the authors track the pointing gestures of a persons' face and hand on image sequences provided by a stereo-camera and magnetic sensors (for head tracking).

Figure 25. Different approaches for estimating the pointing direction [Pointing Gesture Recognition based on 3D-Tracking of Face, Hands and Head Orientation]

Discussion

While an interesting approach to support natural deictic gesturing, the system had at best a 88% detection rate and a 75% precision. Presenter movement would be restricted to the view angle of the camera while the environment needs to be well lit.

Pointer Remote for PowerPoint and Keynote

Power Pointer is an iPhone application that allows presenters to control their slide presentations (PowerPoint or Keynote) on their Mac from the iOS device.
Power Pointer offers a variety of pointing cursors (see Figure 26) and markup features. One points by touching the screen at the location of the referent or by moving the device (moves the cursor) through its gyroscopic and accelerometer features.

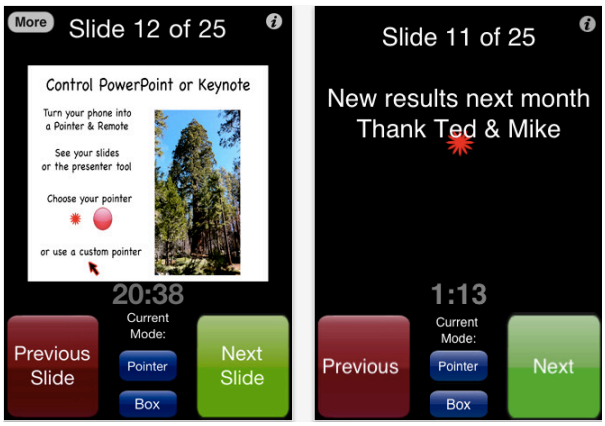


Figure 26. Left instruction screen and pointing cursor selection. Right, a slide being pointed at by the presenter (red shape) [http://www.zentropysoftware.com/ZS/Pointer.html]

Discussion

While Power Pointer falls within RemotePresence's context, we argue that the iPhone interactive area is too small to afford a more natural pointing gesture. Adapting one's pointing granularity on a small device requires attention, not easy while speaking to an audience.

Keynote for iPad

Keynote is Apple's presentation application. The iPad version allows presenters to mirror their presentation to an external display (or projection screen) and offers the feature to pointing with a virtual laser pointer. The presenter presses the screen until the red dot appears enabling the usage of this pointing feature.

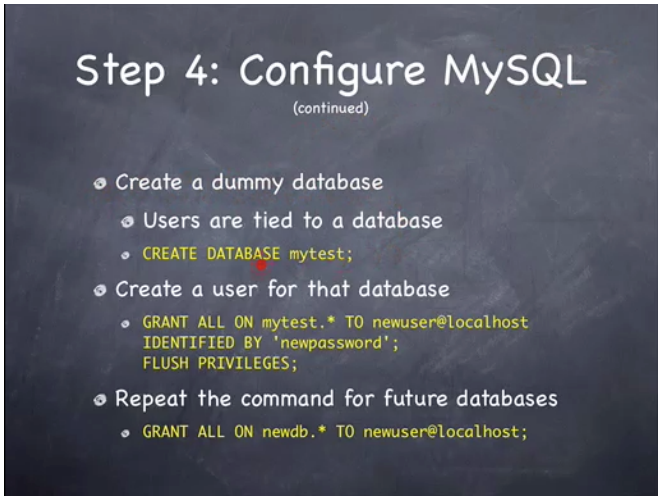


Figure 27. A slide demonstrating Keynotes pointing feature [http://www.macworld.com/article/151359/2011/05/ipadkeynote.html]

Fuse Meeting for iPad

Fuse Meeting differs from keynote in the aspect that it is a web-conferencing tool. Allowing for presentations and meetings with distributed participants on a variety of cross-platform devices. Similar to Keynote, Fuse Meeting offers a virtual laser pointer to direct participants attention, requiring the presenter to press a "pointer" button (see Figure 28) then touching where he would like to indicate the referent.

Figure 28. A slide demonstrating Fuse Meeting's pointing feature [screen shot from Youtube video: Fuze Meeting with Multi-Party HD Video Conferencing]

Discussion

Keynote and Fuse Meeting (and others) offer great placing-for features (slide transitions, etc) but are very limiting in the directing-to indicative technique. Needing to press a button to enable pointing sounds counter intuitive. From humans' rich repertory of deictic gestures one one of them is represented in these state-of-the-art applications, the indicative gesture.

3.3. Two representative scenarios

Two scenarios were chosen to demonstrate two how people understand the need to perform deictic gesture to help addressees understand what is being discussed in the common ground.

The first scenario perfectly demonstrates how the individuals tried to repair some known issues in viewing a (video) recorded presentation and how sometimes pointing is really necessary to understand a presentation.
As seen above in the state-of-the-art, the video frame does not capture the whole physical context of the presentation. In order for remote attendees to view the presenter speaking and the slide presentation simultaneously, the slides had to be augmented digitally over the video feed (see Figure 29). This augmentation of the slides attends the issue of the video frame, but also the issue of the presenter and the slide projecting being at different light exposures. If both were to be recorded simultaneously by the same video camera, one would appear much darker than the other. Another issue of video recording slide presentations if the quality of the video many times is not sufficient to comfortably read and identify small objects.

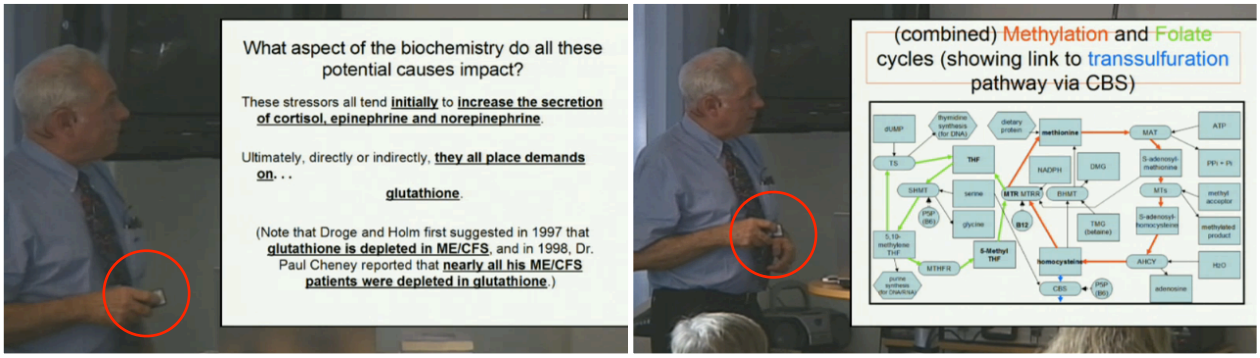


Figure 29. Left, presenter hold a physical laser pointer. Right, presenter is now required to point out individual referent and uses the laser pointer [screenshots from a reordered video presentation: http://iaomt.media.fnf.nu/2/skovde_2011_me_kroniskt_trotthetssyndrom]

By augmenting the video frame with the slides we encounter a new issue. Now, the presenter is detached from his referent. If he gestures towards the slide presentation his location of the referent is in reality much different to the remote viewers'. In Figure 29 right, the presenter hold a physical laser pointer. As he reaches a complex slide he uses the laser pointer to extend his indicative gesture towards the slide, thus helping local views to focus their attention on the referent being discussed. Due to the detachment of the presenter and his slide presentation, the remote viewers are not able to view the laser pointer. As a repair, the augmented slide is removed from the video frame and the camera man places the slide into frame (see Figure 30). Now, remote viewers are able to see (barely) the laser pointer, and the presenters deictic utterances such as "here" "this one" start to make sense.

In performing this repair, the people involved in the recording of the video know of the need to maintain a rapport between gesturing and utterances even if the quality of the slide becomes worse, the presenter's mental model through the diagram is more important in helping attendees understand.

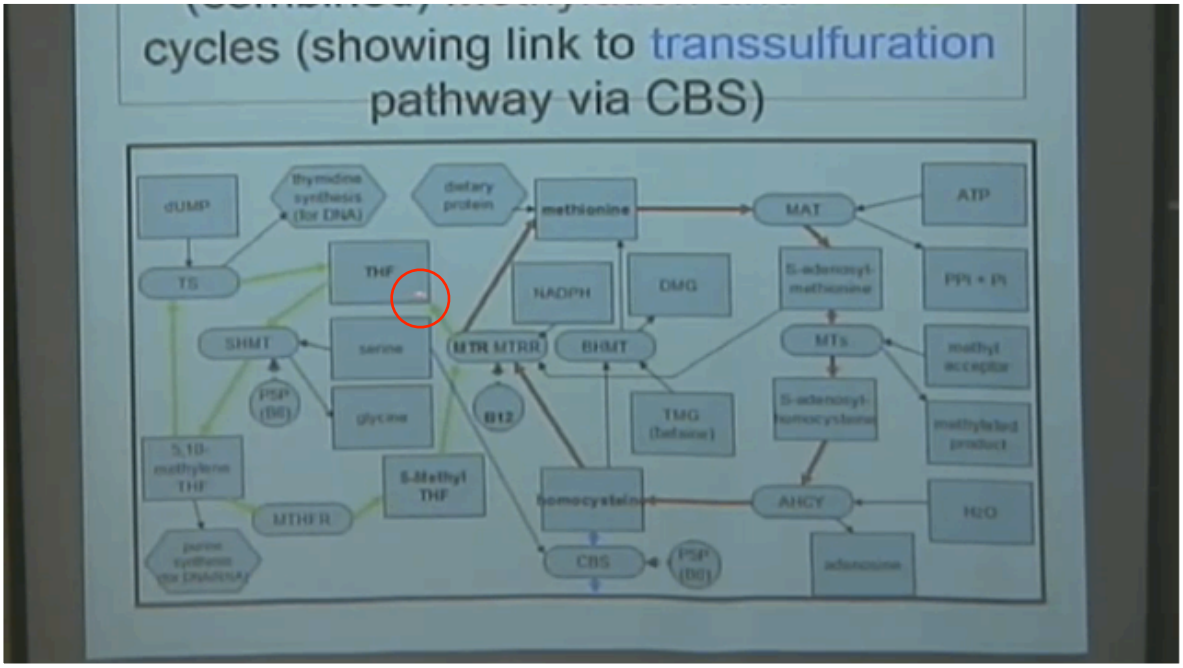


Figure 30. A closeup to the real slide projection and presenter's laser pointer being captured by a video camera [screenshots from a reordered video presentation: http://iaomt.media.fnf.nu/2/skovde_2011_me_kroniskt_trotthetssyndrom]

The second scenario was taken from a live CNN presentation. In figure 31, the presenter and his referent (slide presentation) are captured within the same video frame and present no detachment. The speaker interacts with his content through a large multi-touch display. He is able to use his natural deictic gestures and be able to trace (tracing) and interact with the content (placing by swiping to a next slide).

The angled positioning of the display and the speaker creates a rapport. The speaker knows that the remote audience is able to view his gesture and actions, and view where he is pointing to. The presenter can highlight words or trace to create a more persistent mark—rather than holding an indicating gesture. We consider this high cost approach to be RemotePresence's ideal comparable scenario.

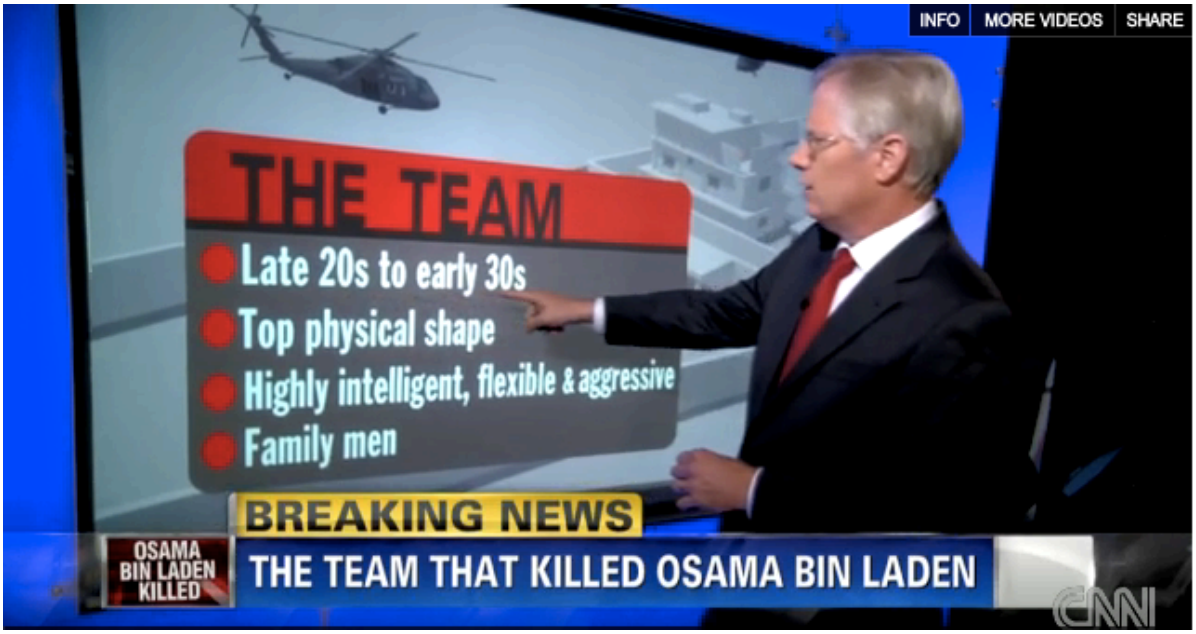


Figure 31. Speaker interacts directly with his content in a large multi-touch screen display [screenshot of a video presentation: http://edition.cnn.com/video/#/video/bestoftv/2011/05/03/ac.foreman.inside.seals.cnn?iref=allsearch]

3.4. Discussion

In the previously analyzed state-of-the-art some supported deictic gesturing at its most basic form, pointing. As seen in [9] pointing has different gestures for different intents as tracing, palm pointing and inscription amongst others.

In [18], the authors were able to identify and track the pointing gesture of a person with cameras and gesture tracking technology, and perhaps supports best the presenters natural pointing gestures.

In [2] and [19] the authors designed similar experiments to test how people performance in interacting with objects projected onto a screen at variable distances. Both identified that people are not able to hold a laser pointer absolutely steady, the average jitter (hand unsteadiness) or wiggle is around 8-12 pixels, and the mean target acquiring time is around 1 to 1.4 seconds (5 to 10 feet). Similarly, the users start and end points are typically not close to the target hence the start and end paths of the laser pointer are not good indicators of the user's intentions.

In [19] the authors measured the performance of laser pointers in comparison to other similar devices such as mouse and smart boards. The experiment with smart boards obtained the best results in terms of speed (16% faster) and errors (50% less). The participants rated the smart board the highest. This might suggest that direct tapping interfaces can perform better than indirect devices such as mouses. This is a great indication for RemotePresence's handheld multi-touch deictic gesture support.

3.5. Conclusions

Research [20] has been done to address some of common problems with accuracy and unsteadiness when using absolute pointing devices, obtaining some significative improvements. A direct tapping interface was identified as preferable for indicative pointing [19] and should address some (if not all) of the common laser pointer interaction issues. More so, cursors (pointer representations) should display a minimum persistency of 1.4 to 3 seconds in order for viewers to acquire the cursor and relate the referent to the presenters utterances.
When a rapport between presenter (speaker) and his presentation content (e.g. slide presentation) can not be achieved, the detached video feed with the augmented or framed slide presentation should contain minimally a "virtual laser pointer" to help addressees understand the chain of thought of the speaker and connect his deictic utterances to the correct referents.

Two important issues arose from this state-of-the-art study. First, the physical laser pointers (as seen in scenario Figure 29-30) present themselves with some issues. Both [12] and [13] argue that laser pointers do not make any justice to the expressiveness of human gesturing. Second, the higher cost solution does not have a 100% recognition and tracking rate. While, the individuals perform their natural bodily gestures there is too much technology involved.

In the context of RemotePresence, a "low cost" approach is preferred in order to try and answer the research question.

4. RESEARCH QUESTION

"Is it possible to support deictic gestures through a handheld multi-touch device?"

The above research question builds on previous state-of-the-art analysis and literature review where devices and tools support one indicative gesture—pointing.
Our research project's goal is to approach a broader group of gestures, deictic gestures. Deictic gestures are indicative gestures that are semantically connected to utterances (deictic or not). E.g. Pointing at an individual in a group and uttering "him."

The previous analysis of state-of-the-art and literature review, offer little to no support for deictic gestures, especially through handheld multi-touch devices. The first representative scenario (see Figures 30-31) the individuals editing the presentation for offline viewing seem to acknowledge the need for a rapport between the presenters utterances and pointing gestures. More so, they recognize the difficulty in readability and legibility that the addresses have in attending these remote presentation where a single video camera cannot capture the presenter and the slide projection at the same light exposure. Furthermore, the quality of the video camera led them to augment the image of the slides on the presentation, thus making it more legible. Finally, the presenter was holding a laser pointer that he used in combination with deictic utterances to explain diagrams and images within the slides. The editors tried to capture the laser pointer at the cost of taking the presenter out of the video frame and focusing on the slide projection, where a barely noticeable red dot could be seen. Still this helped in following the presenter's story and relate utterances to referents.

Our research, analyzes the affordances of handheld multi-touch devices (e.g. iPad) as an interface to support these gestures—perform the gestures on the device.
The research question focuses on a remote slide presentation context. E.g., a presenter through a computer connected to the internet and a tool that allows for slide sharing, presents his material and transmits his message, verbally, to a distributed participants. These participants, also have a computer, tablet, or other device that could support the visualization of the presentation.
We argue that these handheld multi-touch devices will reduce the need for these "video editing hacks" as seen in the first scenario, while not barring the same issues as the physical laser pointer's jitter, time to acquire referent, and low visibility in large screens.

We intend for RemotePresence to support more deictic gestures that it is currently possible through a laser pointer or mouse cursor.

5. THEORETICAL FRAMEWORK

5.1. Introduction

In this chapter we propose a theoretical framework (see Figure 32) that represents the research context specific to the remote presentation setting.
The framework was defined over multiple iterations. Literature review, observations, and abstraction of the research context, shaped the theoretical framework into a simple, essential, map that represents the key components and their relationships. The framework helps associate possible user studies to specific research components, thus providing a tool to acquire more exact findings for each component, rather than performing global studies that possibly could not be associated to any component.

This chapter shall explain the overall theoretical framework, what methodologies where used and how each research component—intent, gesture, effect and perception—was approached.

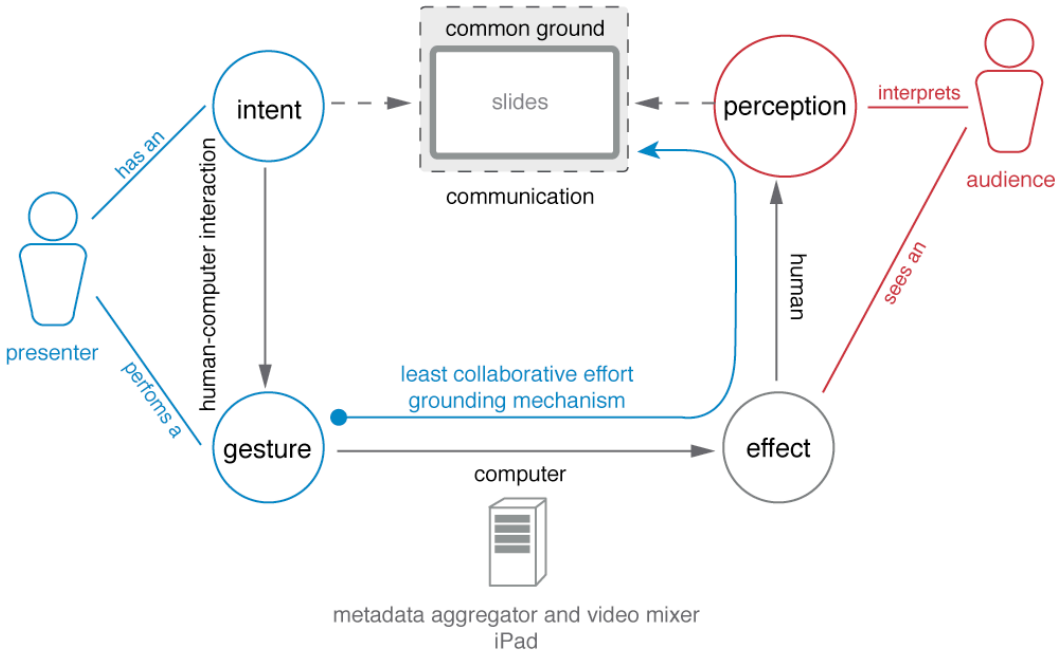


Figure 32. Theoretical framework for RemotePresence that represents the relationship between a presenter and the audience within a remote presentation

5.2. Overview

Conceptually, the theoretical framework involves two entities, a presenter and the audience to whom he is presenting.
The slides are considered the common ground, the thing being discoursed about, while the gestures performed on the multi-touch device are considered a least collaborative effort mechanism.
Besides the presenter's primary intention of transmitting his message to the audience, the gestures he performs, similarly has intentions, for example: directing the audience's members attention to a particular section of the slides. These intents, in the framework are exteriorized through gestures (and utterances) that the presenter performs on the multi-touch device. The device (or computer) then identifies the gesture and attributes an abstract representation of that gesture (namely the intention behind it) as an effect for the audience member to visualize. The audience then interprets their perception of the effect and create their own mental models of the what the presenters intentions could possibly be.

The overall objective relates to the audience members mental model of the presenters's intentions being the same or similar to the presenters'. If this is the case, then the gestural communication was successful, helpful and is a valid, least collaborative effort technique.

5.3. Intent: *Presenter*

Summary

This research node defines a high level meaning for the performed gesture. The presenter has an intention and externalizes that intent by performing a gesture. E.g. directing audience members focus of attention or point of interest P to content A. Ideally, this intent should be easily perceived and understood by the addressees.

Approach

In order to understand what intent relates to which gesture, literature review into natural human communicative gestures, common grounding in communication, and deictic gesture literature were consulted. In field observations and discussions performed throughout the project helped revise and specify the possible intents and gestures.
A user study was set up at Alcatel-Lucent to understand the relationship between intents and gestures through a multi-touch device.

5.4. Gesture: *Presenter*

Summary

This research node defines the interaction (or sequence of interactions) gestured by the presenter based on his intentions and captured through a handheld multi-touch device. These gestures may be triggers for events (actions and interacting with content and application) or to perform deictic gestures.

Approach

Literature review lead to interesting compilations of "natural gestures" performed on a multi-touch surface (see Figure 37). A compilation of standardized gestures for the iPad (and other handheld multi-touch devices) was created (see Table 3). This allowed for a broader understanding of the gestures performed by individuals to perform certain actions. Observations of slide presentations and the gestures performed by the presenters towards the common ground where analyzed and helped in understanding the contexts of the presenters intentions.
A user study was designed to understand the relation between deictic gesture intents and the subsequent natural gestures. Users were provided a list containing intentions, their task was to perform the gestures they felt represented the intention on an iPad. The iPad was running a drawing application with slides loaded. The users gestures were recorded and later analyzed (see Evaluation Activities 9.2 e).

The complete user experiment can be found in the Evaluation chapter of this document under Intent to Gesture User Study.

5.5. Effect: *Computer designed*

Summary

This research node defines how the gestures performed by the presenter on the multi-touch device are represented and displayed to the viewers (audience). Different effects are associated to different gestures and subsequently different intents, thus influencing audience interpretation of the effect and presenter's intents.

Approach

Literature review into virtual gesture representation and state-of-the-art analysis for tools supporting virtual pointing features defined a baseline standard effect—the virtual laser pointer. While RemotePresence's cursor concepts were designed taking into account the research gathered from user studies and literature, no user study was performed in order to identify which where the best designs for the intents. The importance of a user study here was recognized but there was little time to perform one.

5.6. Perception: *Audience*

Summary

This research node directly relates to the effect (how the gesture is represented) and how the viewer (audience) interprets how he perceives that effect and creates his own mental model of the presenter's intention.

Approach

This research node had the most user studies performed, in order to understand if pointing added any meaningful information to the presentation. Literature review provided some valuable insights into past experiments and findings in for similar contexts.
A user study involving 13 subjects was performed at Haagse Hogeschool, Netherlands, as a qualitative user study. Using the Repertory Grid technique we were able to elicit 190 user constructs that then where analyzed. Refinements to the user experiment were performed and an online version was designed as a quantitative user study. The online user study focused on the qualitative data elicited from the previous user study in Haagse Hogeschool.

The complete user experiments can be found in the Research Activities chapter of this document under 8.2.9) Haagse Hogeschool User Experiment and 8.2.10) RemotePresence Online Web Experiment.

5.7. Conclusion

The theoretical framework was useful for understanding the research context and in focusing research activities. This abstraction helped identify where the problems were, were humans and computers played their roles, and in explaining and describing the project to others.
Experiments, observations, literature review, and state-of-the-art analysis were easily related to their respective research nodes, thus organizing and focusing research was helpful in designing and the necessary user studies.

While the overall goal of the framework was not addressed in a user study—does the audience members interpretation of the effect match the presenters intention?—we are confident that these handheld multi-touch devices are capable of supporting more than simple indicative pointing gestures and could be used to enhance communication or be used as feedback mechanisms for audience members.

While the theoretical framework was designed for a specific context, presentations, we argue that if the roles where inverted, the audience members have a questions and use RemotePresence to point towards the slide, the framework will still be valid. Furthermore, the abstraction that the theoretical framework offers, could allow for it to be used for other contexts such as: remote collaboration; co-authoring; tele-lecturing, etc.

6. METHODOLOGY

RemotePresence followed an unconventional (for University of Madeira, Computer Science masters thesis) process, due to the nature of how it was defined and the context in which it was approached.
This chapter shall introduce the methodologies used for each stage of the project with short justifications and descriptions. Any techniques, methods used, and decisions shall be briefly described while findings, discussions and detailed disruptions of the methods and techniques will be detailed in the research activity chapter.

The Visual Communications department (now forth "Viscomm") from Bell Labs, Belgium, functions (sort of) as a research and development department. In Alcatel-Lucent, Viscomm is the first stepping stone in research and the birth place of concepts, projects and technology. In reality, Viscomm does not contribute with new physical technologies. They research new technologies and conceptualize new and interesting applications (or application enablement software to be more precise) that if are accepted by upper Bell Labs management, they are sent to another department (Business Division). The Business division than performs the ethnography studies and approach the concepts (and the technical demos) as a product for an end customer.
In summary, the role of Viscomm is to quickly perform some research into technology and state-of-the-art and create technical demonstrations of their concepts—to be shown to others'—and perform some user testing as initial feedback.

Figure 33 displays the methodology's timeline for approaching the RemotePresence project.
The project was divided into 5 main checkpoints (excluding the writing of this document). The end of each checkpoint represents a change in the project, i.e. new direction, different approach, different activity, etc.

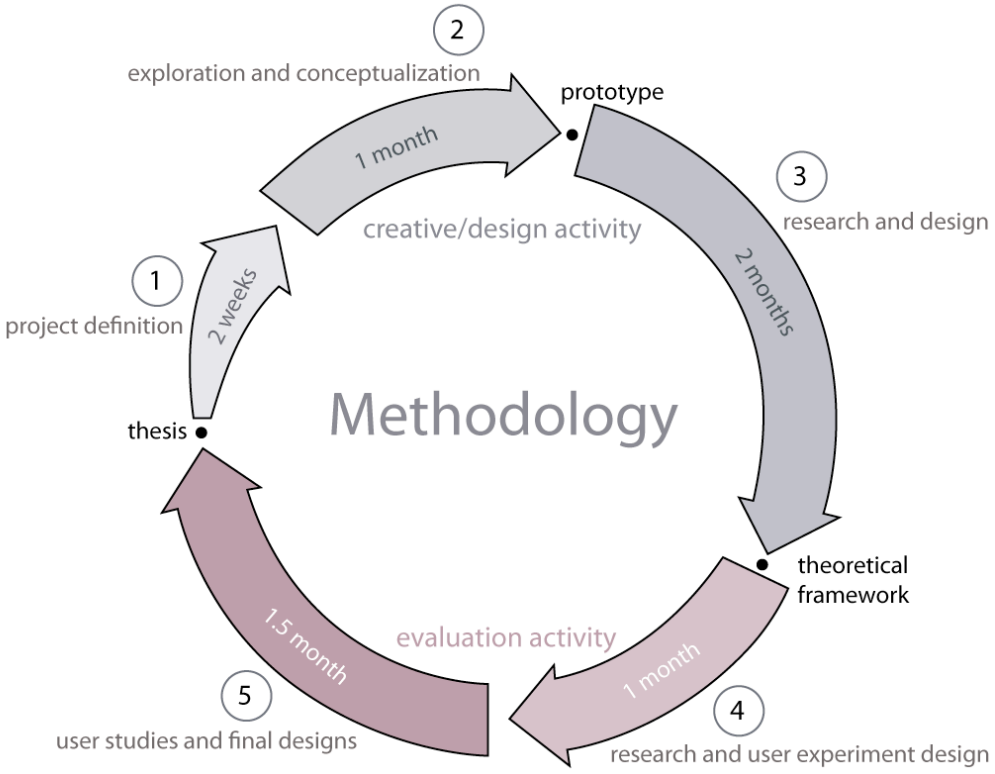


Figure 33. RemotePresence's 6-month methodology timeline

The two week lifespan of stage (1) began upon arrival at Bell Labs and consisted of meetings and discussions with thesis supervisors and Viscomm colleagues, in order to find an interesting new research area that could be used for a Masters thesis and be useful to Bell Labs in the future. It was during this stage that the notion of RemotePresence as "pointing with the iPad in presentations" came together.

The beginning of the one month stage (2) RemotePresence entered an exploratory, creative/ design activity. Initial literature review into the new research context was performed, initial observations and research, initial ideation and designs. Revisiting the pre-study phase helped refine the scenario as well as the user roles and activities. An implementation of a working prototype was used in a real life collocated presentation setting, this provided some valuable insights for the researchers on the affordances of the device and the essence of pointing with it during a presentation.

During the 2 month stage (3) RemotePresence's scenario was revised. More context specific iteration over literature review helped define the theoretical framework. The theoretical framework helped focus research activities and provide a useful perception into what research and user studies would be needed in the future. Specific research and more objective observations allowed for a second iteration over the initial cursor designs and concepts, while providing some new material for ideation and discussions.

The beginning of stage (4) initiated the evaluation activity for RemotePresence. The prototype was well received by the addressees of the presentation, but none of the researchers knew what that meant, thus the 1 month stage involved specific literature review and research into the psychology of pointing gestures, deictic gestures and grounding in communication. This new information provided details needed for an iteration and revising of the theoretical framework. The framework now including common ground, least collaborative effort mechanisms. The research allowed for further definition of intentions and gestures, that could possibly be supported by RemotePresence. A research spectrum diagram was designed, and initial ideation for user studies led to literature review into possible experimental techniques for dedicated research nodes focused in the theoretical framework.

During the final 1.5 month stage (5) a refined user experiment was designed using a Repertory Grid Technique. A pilot user study was performed in order to test and get aquatinted with the technique for future implementation in a larger setting. A smaller more specific user experiment was designed and performed at Alcatel-Lucent in order to further understand and relate gestural intents, to the performed gestures on an iPad displaying slides. A user study performed at The Hague using the Repertory Grid Technique was intended as a qualitative experiment for gathering users perceptions of different visualizations of remote presentations, including a presentation displaying a laser pointer. A final user study was designed as a quantitative online user experiment. This user study would build on the The Hague user study in order to obtain more results that could possibly be quantified.
A continuous literature reviewing and state-of-the-art analysis helped along these steps in defining and revising variables to test as well as provide new information.

7. RESEARCH ACTIVITIES

The project was approached with two main activities in mind: a creative/design activity where initial exploration, ideation, conceptualization, design, prototype and research took place; and a evaluation activity, where more in-depth research, theoretical literature review, observations, specific user experiments were performed.

This chapter will describe each activity chronologically, explaining the methods used, why they were, the decisions taken and the steps used, as well as research results from user studies.

7.1. The creative/design activity

After the project was defined—at the end of the initial two weeks—the creative/design activity began. During the first couple of weeks, a broad exploration of literature review and state-of-the-art research took place due to RemotePresence's initial project definition: "Let's support pointing with the iPad in remote presentations for the presenter as well as for the audience members—during the question and answering phase"

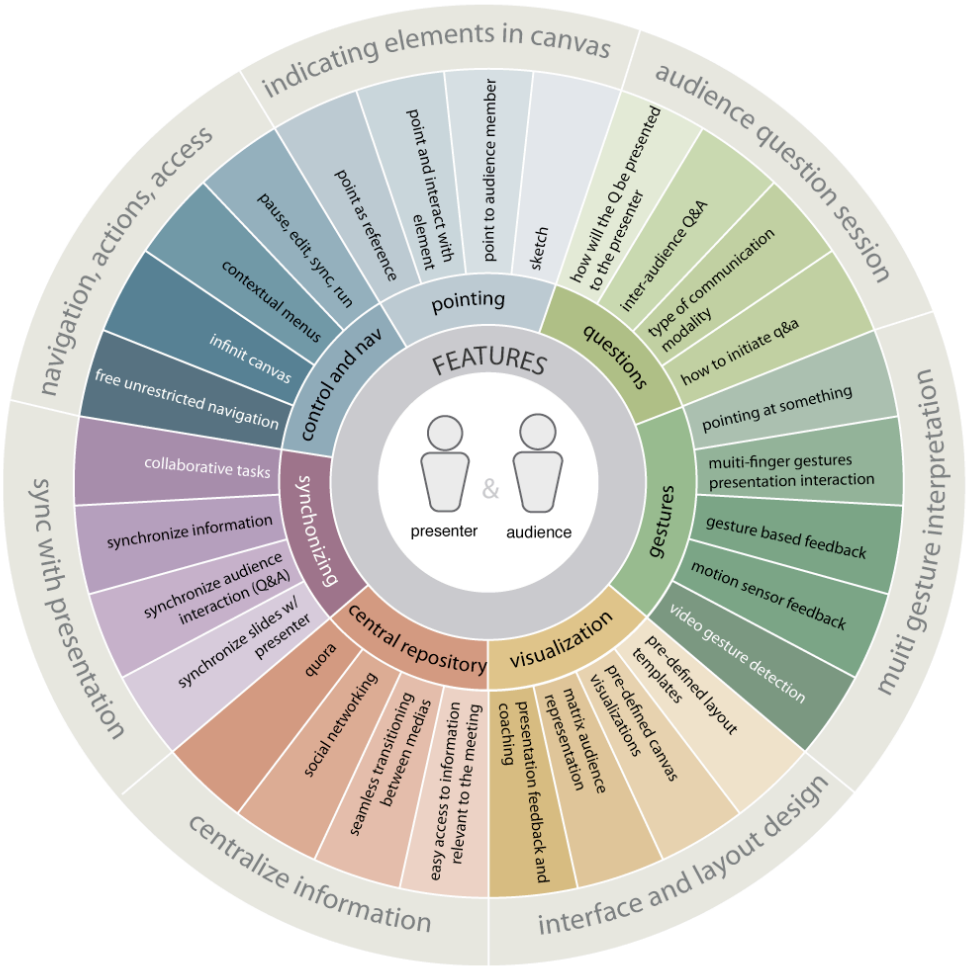


Figure 34. Initial broad scope of features, concepts and ideas, that could have been pursued by RemotePresence.

Due to the broadness of the projects definition (see Figure 34) and lack of a focused research context, RemotePresence could be used as a new technology for Bell Labs, or to integrate with Bell Labs SlideWorld project. Initial research and designs were exploratory, and served greatly in communicating ideas to others and in refining the research question and project definition.

Initial research into literature review and state-of-the-art led to the first sketches (see Figures 35-36) of RemotePresence supported within SlideWorld—the chosen scenario to better communicate the designs to colleagues.
Figure 36 left, represents the presenter interacting with the iPad and the sketches to the right the subsequent remote audience visualization of those gestures within SlideWorld. Figure 36 demonstrates a similar concept, different, in the ability of the pointing action to trigger an event. E.g. zoom into the pointed section of the diagram or show an attention catching effect.

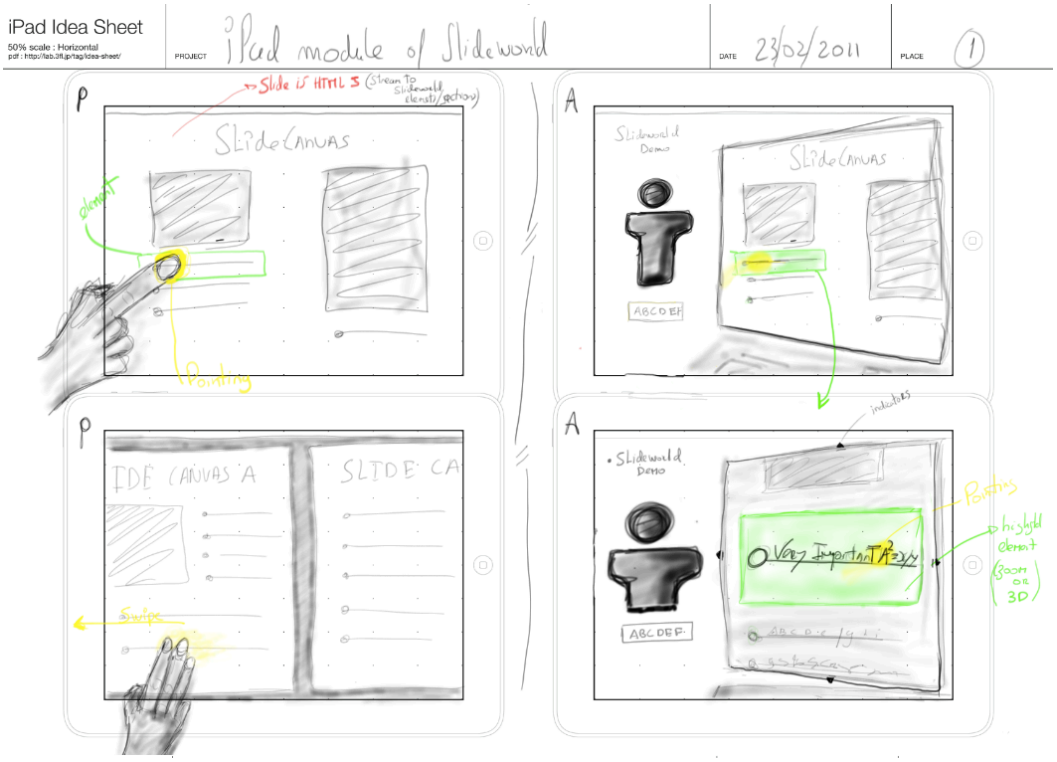


Figure 35. Pointing in SlideWorld, triggering attentional focusing events (e.g. enlarging bullet points).

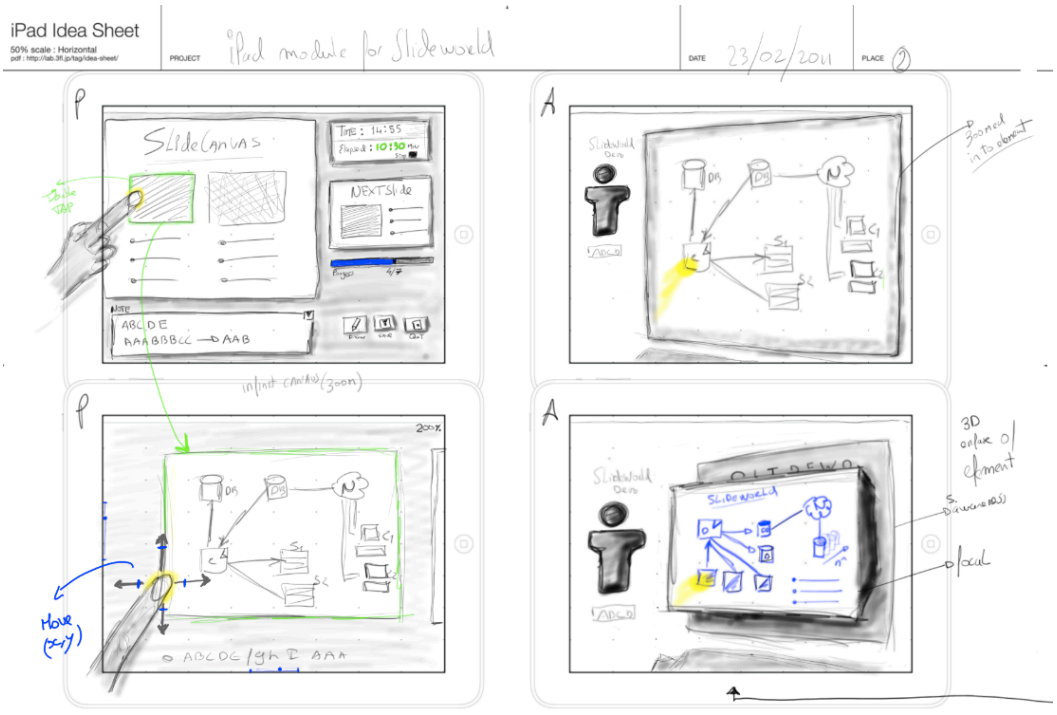


Figure 36. Pointing in SlideWorld as a presenter's tool for interacting and performing actions on content.

The initial sketches for the iPad based pointing application, were a mean for an end: Initialize ideation and discussions, while continuously focusing the research context and identifying needs—research and user.

7.1.1. iPad's affordances study

To achieve good user experience and user performance, certain standards and user expectations (familiarities) should be present and clear in the design decisions. It is only logical that when creating an iPad application some gesture meanings should not be changed —if presented within the same context. E.g. 3-finger swipe to go Back or Forward in Safari and in our document viewing application would change font size or some other unexpected reaction.

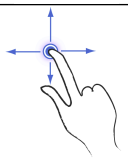
In order to better understand the iPad's affordances a table listing the most used and "standard" gestures was created and later on compared to some literature review on gesturing on multi-touch tabletops. The objectives were: Identify and understand which are considered to be well implemented and standard gestures (within what contexts); Identify new interesting gestures to be supported cohesively and meaningfully within our application.

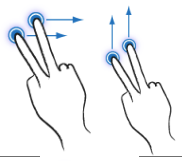
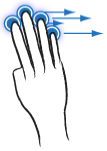
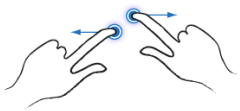
In [21], the authors contributed with a framework proposal to formalize multi-touch gestures and created a table (see Table 1) with the overview of semiotics for multi-touch gestures. Semiotics describe all the phenomena associated with the production and interpretation of signs and symbols and syntactics, describe these symbols and their combinations. Semantics addresses meanings and pragmatics, is concerned with the users mental models.

	Syntactics	**Semantics**	**Pragmatics**
Scope	Symbols	Meaning	Interpretation
Formalization	Formal grammars	Ontologies	User model
Implementation	Recognition engines	Application commands	Metaphors with feedback and feed-forward
Multi-touch	Performed gesture	Semantic dimensions	Intuitive interface concepts

Table 1. Overview of semiotics for multi-touch gestures

Table 2, displays the standardized gestures identified for the iPad, the actions, and some popular applications where the gesture triggers the described action.

Gesture	Description	Action(s)	Supported by
Touch down (1-finger)		Action trigger Select object	Application interfaces
Touch up (1-finger)		Action trigger (Touch up inside)	Application interfaces
Touch move (1-finger)		Move canvas Move object (in canvas)	iPad Google Maps
Drag (1-finger)		Drag movable object	iPad/iPhone unlock screen

Tap (1-finger)		Select Trigger action Open Zoom in	Most applications Google Maps (zoom)
Double Tap (1-finger)		Edit Expand Call Keyboard Zoom in	Most applications Google Maps iPad
Tap (2-finger)		(right click) Expand options Zoom out	Google Maps iPad
Double Tap (2-finger)		Zoom out	Google Maps iPad
Scroll (2-finger)		Pan/scroll up/down left/ right	iPad Safari iPad PDF reader Mac OS scroll
Swipe Left/Right (3-finger)		Go back/forward Switch between full screen applications	Safari Mac PDF reader Mac OS Lion
Swipe Up/Down (3-finger)		Launch Mission Control	Mac OS Lion
Swipe Up/Down (4-finger)		Show desktop (exposé) Show multi-tasking bar	Mac OS Snow Leopard iPad (4.3)
Swipe Left/Right (4-finger)		Open application switcher Switch open applications	Mac OS Snow Leopard iPad (4.3)
Flick (1-finger)		Page turn	iPad iBooks
Zoom (2-finger)		Zoom in/out	Almost any application that supports zoom
Pinch Zoom (2-finger)		Zoom in/out	Almost any application that supports zoom

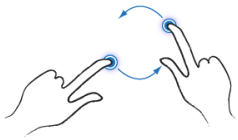
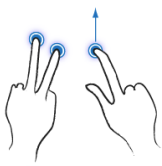
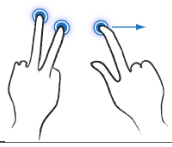
Rotate (2-finger)		Rotate view or object	iPad Photos Mac OS preview
Pinch Rotate (2-finger)		Rotate view or object	iPad Photos Mac OS preview
Pinch (2-finger)		Zoom in Make object smaller Exit full screen	Almost any application that supports zoom
Expand (2-finger)		Zoom out Make object bigger Enter full screen	Almost any application that supports zoom
Pinch (5-finger)		Launch Launchpad Show home screen	Mac OS Lion iPad (4.3)
Expand (5-finger)		N/A	N/A
Swipe up (5-finger)		N/A	N/A
Swipe down (5-finger)		N/A	N/A
Pitch		Control with slider object pitch	Adobe
Yaw		Control with slider object yaw	Adobe
Shake		Reset data Erase	iBrainstoming iPad app

Table 2. Overview of standardized gestures for the iPad

In creating table 2, it became much easier before hand to identify which gestures should be avoided or used for certain actions. Still, these gestures were defined by software engineers and interactions designers. In order to further understand if the iPad could support natural deictic gestures a user study needed to be performed.

During some literature review into multi-touch gesturing, [22] performed such an experiment —not exactly on deictic gestures. The authors conducted a study involving 20 non-technical users to do a set of 28 gestures with 1-hand and with 2-hands. None of the users had ever

used a table top or multi-touch device (e.g. iPhone). The authors objective was too have an understanding of users mental models for gestures on a surface. Figure 37, displays the resulting gestures from their user study.

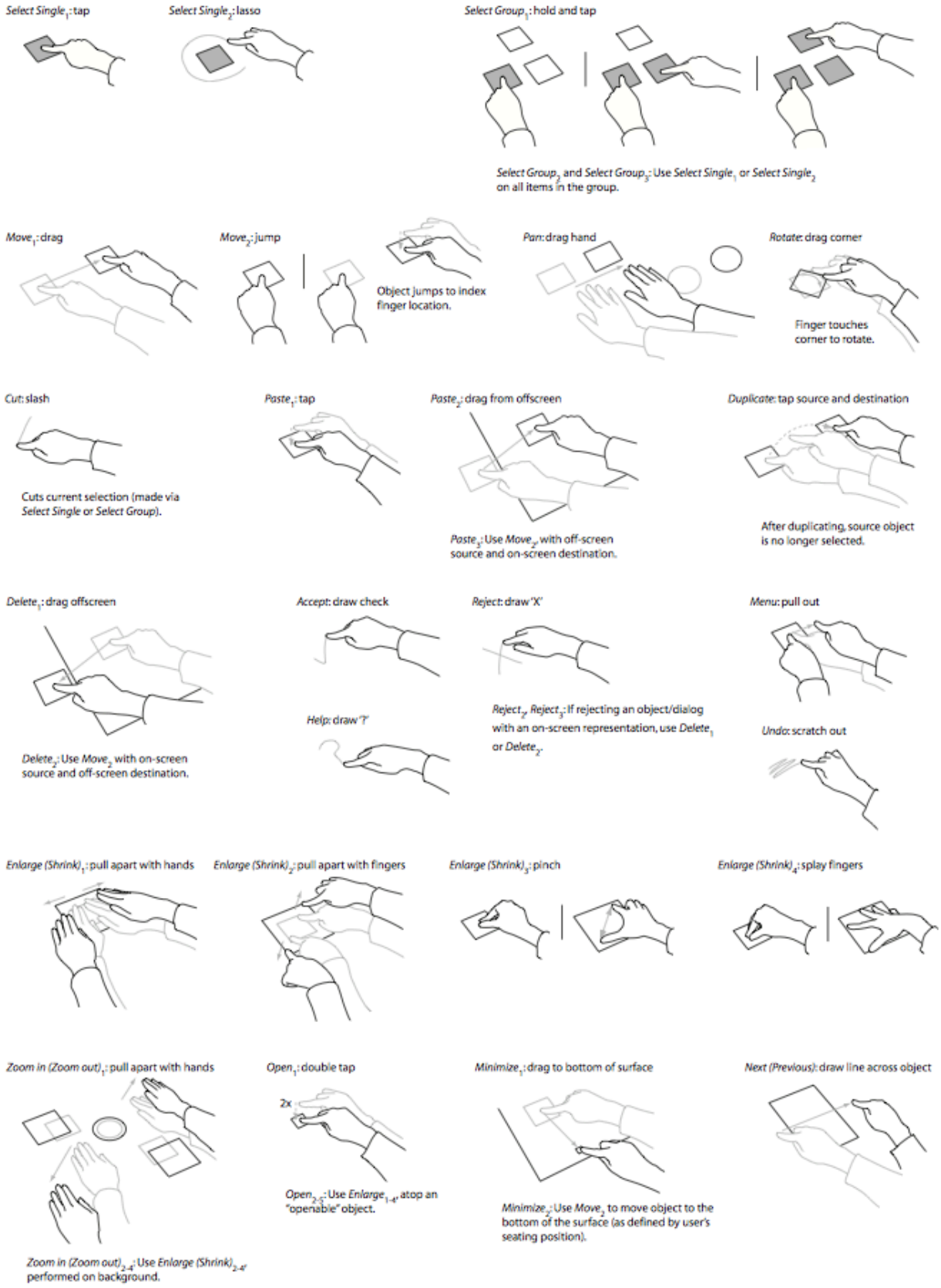


Figure 37. The user-defined gesture set. Gestures depicted as using one finger could be performed with 1-3 fingers. Gestures not depicted as occurring on top of an object are performed on the background region of the surface or full-screen object [An Interactive Support Tool to Convey the Intended Message in Asynchronous Presentations]

The authors identified that simple commands more often resulted in physical gestures, while more complex commands resulted in metaphorical or symbolic gestures. They argue that gesture reuse is important to increase learnability and memorability.

The gestures identified from [22] and the compilation of standardized gestures for the iPad are surprisingly similar—taking into account that the iPad is not a table top. Some interesting gestures arose from their research such as the cut, accept, reject and help gestures. This information was found to be helpful in supporting gestures for audience feedback towards the presentation. Additional literature review into pointing and deictic gesturing helped revise and focus RemotePresences attention in supporting and designing interaction for deictic gestures.

In order to further understand the iPads affordances for supporting deictic gesturing within a presentation, a iPad was connected to a Philips 37" LCD TV screen located on the wall in the department and two colleagues were given the task of presenting one to two slides while standing. Most interesting comments were on how heavy and bulky the iPad was for stand up presentations (limiting movement), and how the finger covers the content being pointed at. Still, the users felt that pointing on the iPad was an easy interaction to perform even while standing. The display affordances of the iPad allowed for complete legibility of the content on the slides, diminishing the need for the presenters to turn their backs to the audience in order to see the slides on the screen or slide projection.

A Bell Labs workshop in April required myself perform a presentation on RemotePresence project progress. French Bell Labs Villarceaux colleagues would be present and it would be a great opportunity to brainstorm on RemotePresence. Since there was still a month to the workshop I decided to implement a working prototype of the concept of RemotePresence—easier to show something work than verbally explain it.
Three weeks of literature review on iOS and Xcode programming provided me enough basis to quickly implement an iPad prototype application).

7.1.2. RemotePresence Prototype

The prototype (see Figure 38) loaded slides (in png format) and allowed users to swipe to change slide, touch on slide to point (draw abstract virtual pointer, 1 out of 4 effects) and pinch to zoom—feature included in order to adjust the pointing's granularity. A slide presentation was created taking into account the need to point and zoom, thus, a slide with a large diagram (see Figure 38 left) the journey map from pre-study phase, and a cluttered slide showing multiple visual representations of different gestures (see Figure 38 right) were included along other information describing RemotePresence.

During the workshop four colleagues presented material—two colleagues where department directors and the remaining two researchers. This presented itself as a great opportunity for a two day field observation of RemotePresence's setting.

The two research directors followed a somewhat formal presentations style. They chose to stand to one side of the slide projection with their backs towards the slides. They commonly pointed to the slides using index-finger gestures and open hand gestures—depending on their intention. The two researchers presented somewhat more informally. A lot of body movement with occasional back-towards-audience postures (looking at slides). Similar pointing gestures as the directors were identified.

Figure 38. Left, RemotePresence prototype zoomed in slide. Right, slide displaying visual gesture representations

Instead of adopting the presentation posture as the before presenters, I opted to present from the iPad using the prototype application. I remained seated, not visible by all attendees (was my intention) and began my presentation. When reaching the slide on figure 38 left, I could hear comments on how the content was too small to be readable, when I zoomed in to further explain the slide, utterances "ohhh" and "ahhh" where heard. When reaching the slide on figure 38 right, while explaining which gesture we had chosen to pursue with RemotePresence with deictic expressions ("there" "that one"), no participant was able to identify the correct gesture representation until "I pointed to it" through the prototype. From here onwards the pointing feature was used whenever it felt necessary to explain something, always maintaining eye contact with the present participants.

Initial feedback from the presentation include:

- iPad is comfortable to present in an informal meeting on the presenters lap
- The fingerprint pointing representation (more persistent pointing cursor) triggered a user to focus his attention on the presenter and not the content (more personal)
- Successfully directed audiences attention to the content that was allied to the deictic utterances

The workshop was a great opportunity to gather some initial feedback on the small handheld multi-touch device in supporting deictic gesturing within a presentation setting and in communicating the notion of RemotePresence.

After the workshop, specific state-of-the-art research identified presentation tools that support a virtual laser (pointing) by pressing a "point" button, then interacting with the screen. This was not the goal for the RemotePresence prototype. We argue that in order to support natural deictic gesturing we should not activate the deictic gesture support. The system itself should recognize that gesture as a deictic one and perform the correct effect (pointing representation).

RemotePresence prototype supported the pinch and swipe gestures. When detecting a touch:began event the iOS gesture recognition method would try to identify that touch event as a pinch or swipe, if not, a pointing cursor would be drawn on location. This sometimes brought some false positive event triggers, e.g., user wanting to point and moves his finger and triggers a swipe event. The addition of a "if failed" clause to the gesture recognizes resolves this issue but it still requires some time to detect (if not a swipe). I.e. quick moving pointing gestures still triggered the swipe event (change slide).
In order to approach this issue the in-frame and out-frame concept (see Figure 39) was

idealized—but not implemented. Within the in-frame interaction area the slides would be shown, deictic gesturing would be supported as well as interacting with content. The out-frame area would be where notifications (audience feedback), presentation control, other content (e.g. other slide sets or videos) and etc would be contained. This would allow the presenter quick access to the artifacts needed for the activity, while for the audience the transition between medias would be seamless.

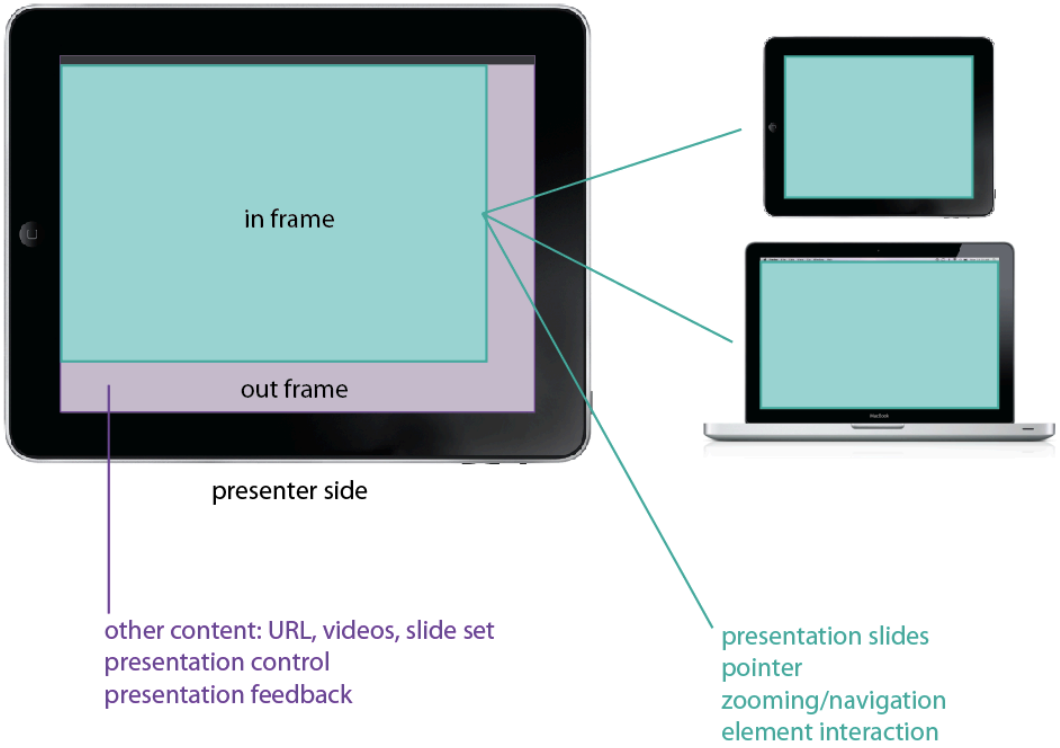


Figure 39. RemotePresence's in-frame and out-frame interaction areas

Other concepts such as HTML5 based slides where discussed. The nature of HTML would allow for easy interaction with the individual elements that the slide is composed of, possibly providing the presenter with yet another interaction: Interacting with the content[3].

7.1.3. Second Design Iteration: Designing the cursors

The next step was to iterate over the initial sketches. Further conceptualization was performed and the first notions of sticky cursors and contextual menus for choosing different pointing cursors were designed (see Figure 40).

The concept of the sticky pointer (fingerprint as a representation) was based on deictic expression literature. The fourth stage of deictic gesturing is the entitled "holding". The holding stage is the stage that conveys most information. It is when the performer of the gesture holds his pointing gesture until he confirms that the viewers understand what is the referent. As an interaction, the notion of a user keeping his finger immobile (for some time) while presenting does not make much sense, thus the wiggle gesture was designed. The wiggle gesture is a simple touch and wiggle similar to recording our finger print on an ID card. This would allow presenters to continually point at something while not needing to continuously interaction with the device. The objective was not for the device to take up too much of the presenters attention and cognitive load.

[3] The concept of HTML5 based slides and interaction with content went to become a Visual Communications Bell Labs project and was presented at the Bell Labs Open Days, October 2011.

Figure 40. Second iteration over RemotePresence pointing cursors

7.1.4. Understanding gestures and effects

In an attempt to better explain RemotePresence and the key research directions. Table 3 the decoupled key areas for the presenter and the audience member.

The presenter performs a gesture. The gesture had an inherent meaning (meaning for performing that gesture), that then is attributed an effect for the audience to visualize. This decoupling allowed for more specific design decisions taking in account each touchpoint and for more focused user testing.

Presenter		Audience
Gesture	**Abstract Meaning**	**Effect of Visual Representation**
e.g. Long touch	e.g. "look here"	e.g. fingerprint visualization

Table 3. Relating intentions to gestures and effects

The continuous research into literature review and state-of-the-art helped in identifying our "ideal" scenario (see Figure 32).

8. Initial Research Spectrum

When decoupling and abstracting RemotePresence research project down to the essential, the same was thought of for the effects—abstract pointing representation for the audience.

Figure 41 shows a timeline (transient to persistent) and the possible augmentable information for a presentation context—our research spectrum.

The very left of the spectrum the laser pointer (red dot) has been used in many cases and is still very much the only cursor available (see Keynote and Fuze Meeting). Studies have shown

that it does not convey enough or as much information as seeing the presenter gesture locally. At the very end of the spectrum, the annotation and highlighting features are available in many applications and presentation tools.

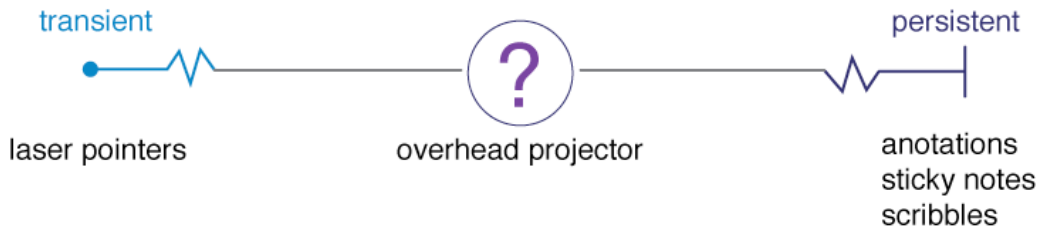


Figure 41. The research spectrum.

Very little to no research was found for the middle of the spectrum. The best example identified was the old overhead projectors that were used in classrooms and presentations. The speaker would place a transparent sheet of plastic with printed text and images on the overhead projector and then use a pen (different colors) to circle, sketch, draw, or relate content together. The speaker could also use the pen as a pointing device or any other objects (e.g. coins) as tokens. Hiding and revealing parts of content where also possible by laying a sheet of paper or any other opaque object.
These interactions helped the addressees to focus their attention towards the content being discoursed, easily supporting deictic expressions.

Building on the concept of overhead projectors led to performing a simple user test. Myself and Dennis Dams had a remote meeting with screen sharing through Skype. We had the task of through the mouse cursor explain the context while uttering deictic expressions.
We found pointing with the mouse to be unnatural—consistent with other studies. The mouse's relative positioning meant most of the time the mouse was not at the correct location. To counter this, circular gestures or quick horizontal movements were perform to help enhance the importance of some content. While discoursing over shared content we did not feel a need for a video feed since it could distract us from the content being discussed and shared.

8.1.1. SlideWorld integration and Metadata Aggregator

RemotePresence by now was well defined and research goals were set. Alcatel-Lucent's Applications Domain head, was keen to have RemotePresence integrated into their SlideWorld presentation tool as a technical demonstrator. This required a more detailed gesture and effect definition and arose some questions: What about late gazes? For how long does a cursor need to be remain visual for up to 90% audience members can see it;

We felt a need to better understand the psychology of pointing and what goes on behind it. A more evaluational activity for the project was now defined.

8.2. The evaluation activity

The evaluation stage of the project began by researching literature on pointing and gesturing in language and communication. This lead to a specialized book on the subject: *Pointing: Where Language, Culture, and Cognition meet* [9] which helped revise the overall view of RemotePresence (see Figure 42) by identifying and refining the performer's intentions and gestures—this overall view of the project is now the theoretical framework.

Two noteworthy indicative techniques were introduced into the project: Directing-to and placing-for. These different techniques serve a mutual purpose, to direct and focus addressees attention to a referent.

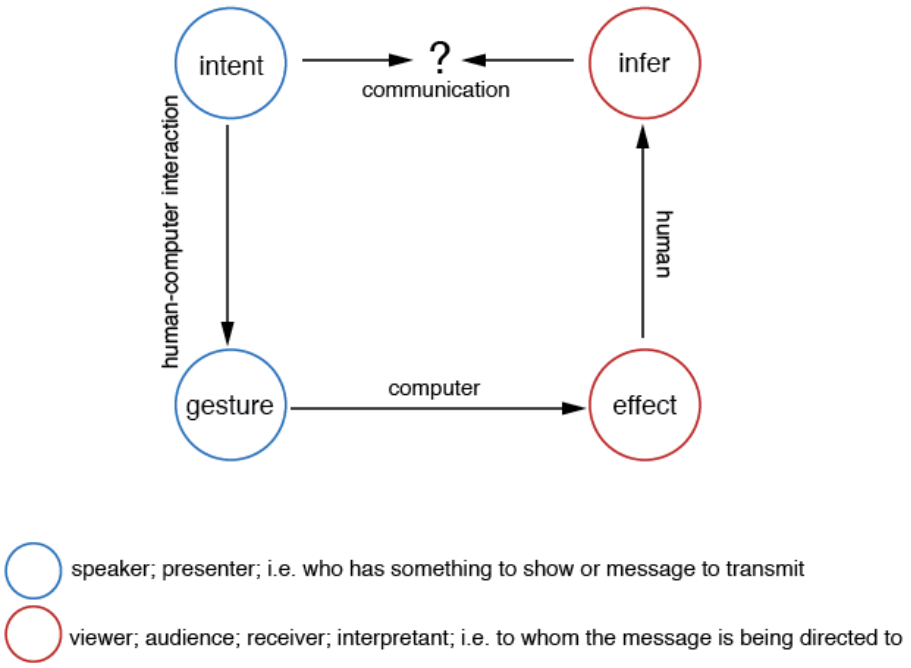


Figure 42. RemotePresence's initial theoretical framework

Figure 42 iterates over table 3, by adding the addressee's ability to interpret their perception of the effect (infer node) and compare that mental model, against the presenter's intention. This initial theoretical framework was an interesting method for dividing and focussing the research and identify specific user studies.

8.2.1. User Needs

RemotePresence consists of an interface in which the user, through it, may perform deictic gestures during a presentation. The user's needs were taken into account in designing the gestures and effects.

State-of-the-art and literature review, identify and argue a need for supporting deictic gesturing in telecommunication and distributed collaborative contexts. A tool that can quickly and easily allow users to indicate referents in conjunction with audio is valuable in helping addressees focus and understand.

A handheld multi-touch device as a gesture input interface, will minimize the issues identified by using physical pointing devices from a distance (e.g. laser pointer). Furthermore, the possibility of viewing the common ground on the multi-touch device while gesturing may help the presenter with his discourse. I.e., he will simply point at the referent (by touching it) while uttering. This close interaction with content can perhaps add more expressiveness to the gesturing while lowering the cognitive load needed for reference.

While presenting, especially live presentation with collocated attendees, presenters need a tool that does not distract them, or take up too much cognitive load to use, thus detaching

them from the audience. The presenter needs to maintain eye contact and a continued interaction with the audience members—this makes the audience feel engaged and helps communication.

The tool should be robust in detecting the deictic gestures while keeping "standard" gestures and actions recognizable and not counter intuitive.

8.2.2. Research

Literature review, observations and interviews into pointing and gesturing in communication helped identify presenter's gestural intentions. A user study involving the aforementioned intentions, in order to compile what are the most natural gestures that the presenters perform that represents their mental model of the provided intents, was performed.

Performing studies on the designed pointing cursors was necessary in order to understand if the designs (effects) were representative of their intentions, but before performing user testing on RemotePresence designs, a baseline for comparison was needed. An ideation phase began in order to design a user experiment to understand what the most basic of pointing support (virtual laser pointer) added to a presentation.

The first main issue that arose was: what does "adding to a presentation, and more meaningful" mean? There were many different variables that were interesting to test for during the experiment, such as: presenter social presence; performance; memory aiding; understanding and comprehension; engagement, etc.
The baseline study was to compare: audio and slide presentation; with video, audio and slides; and pointing with audio and slides. The objective of the study was to identify what did pointing add to the presentation that the other two examples did not.

Literature review into a method to perform a user experiment that could support our needs was not found. On a trip to the Technical University of Eindhoven Dennis Dams introduced me to Saskia, a PhD student familiar with psychological user studies. Saskia mentioned a technique that eliminates researcher bias as well as eliciting personal insights into how and what the test subjects perceive from a collection of examples.

8.2.3. Revising the Research Spectrum

Reviewing, *Pointing: Where Language, Culture, and Cognition meet* [9], provided valuable insights into how a person's intent alters the gesture. This information was used to update our initial research spectrum map (see Figure 41) to figure 43's map. The map now displays the new indicating gestures and signs on the persistency timeline, including two user triggered events in time: user cancel; and slide exposure;

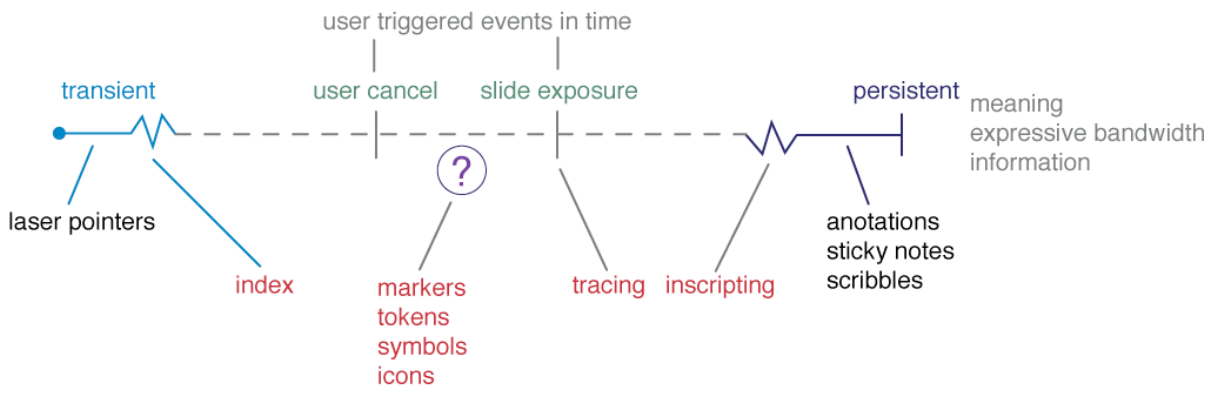


Figure 43. RemotePresence's research spectrum displaying indicative gestures and two new user triggered events.

Further discussions and ideation over the research spectrum revised the above map (see Figure 43) to a bi-dimensional map (see Figure 44), displaying the indicative signs (types of pointing) on the map relating the complexity and amount of information to the amount of time that same information is exposed.

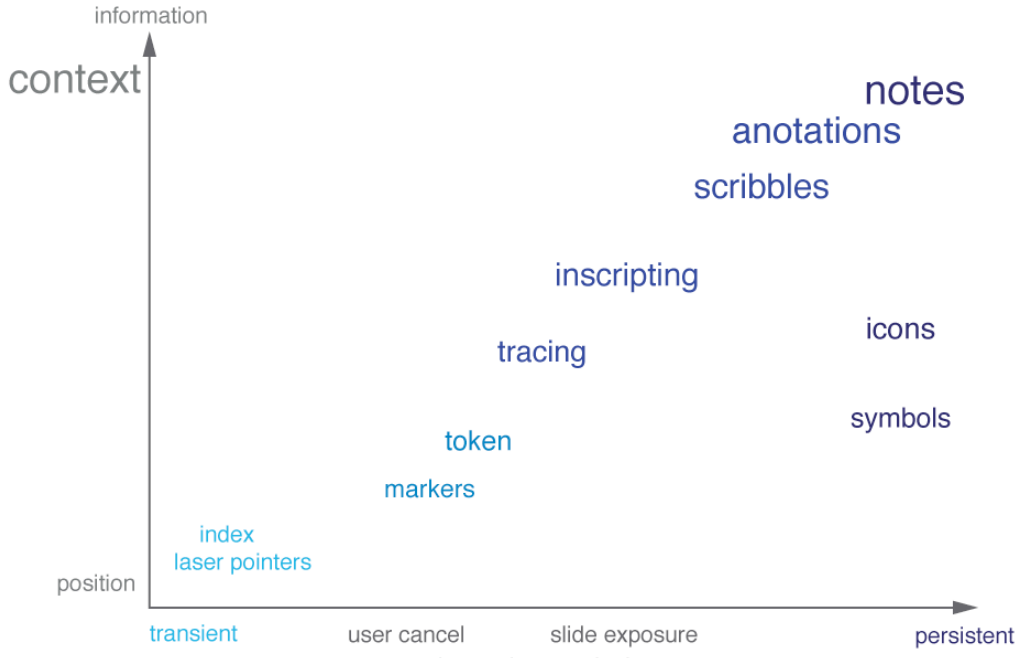


Figure 44. RemotePresence's research spectrum, relating the exposure of information to the amount of meaningful information transmitted.

At this point RemotePresence was focusing on supporting gestures that would be exposed to the maximum until the slide exposure event.

The second iteration on designing the user experiment led to a dead end due to an immense amount of interesting variables to test for: immersion; engagement; understanding; social presence; mental models of the presentation; memory, etc. Immersion was an interesting research topic for Bell Labs—Visual Communication being part of the Immersion at Distance project. A compilation of literature review by Jan Bowen demonstrated one aspect of immersion, Attentional Immersion.

Testing for Attentional Immersion was too general. Identifying its composing factors would help select an key factor (variable) to research on in the user study. Narrative engagement, story telling, task, social presence and common ground are some of the factors that compose attentional immersion.
Common ground was identified to best fit RemotePresence's context. This lead to literature review on common grounds and grounding in communication. Within the literature, least collaborative effort mechanisms were an interesting topic. Pointing and gesturing are considered least collaborative effort mechanisms within the common ground—we consider the slides to the common ground in a presentation. The possibility of justifying pointing as an added grounding mechanism that helps audience members construct better mental models, was now funded in research.

A continuous search for state-of-the-art lead to Power Pointer and Fuse Meeting, both tools supported virtual laser pointers for slide presentations. These tools were analyzed and user reviews were consulted.

The RemotePresence prototype was refined. The placing-for technique was implemented (pointing while zoomed in) and some architectural design revised. The prototype did not see

implementation of new features due to the decision of using recorded videos of a presentations to conduct in the user experiment.

8.2.4. Second Design Iteration of the User Study

Further work into designing the user experiment to understand if pointing added any meaning to a presentation lead us to revise and refine our experiment (see Figure 45). Three examples would be shown to test subjects: slides and the audio of the presenter; video and audio of the presenter and slides; and slides with the pointing from the presenter and audio. What content to display on each examples was still a complicated decision. It should not be domain specific, thus introducing bias with test subject from that same domain—they would pay more attention or understand better than others. If the content where boring or complicated, test subjects would just be bored or uninterested and not pay attention.

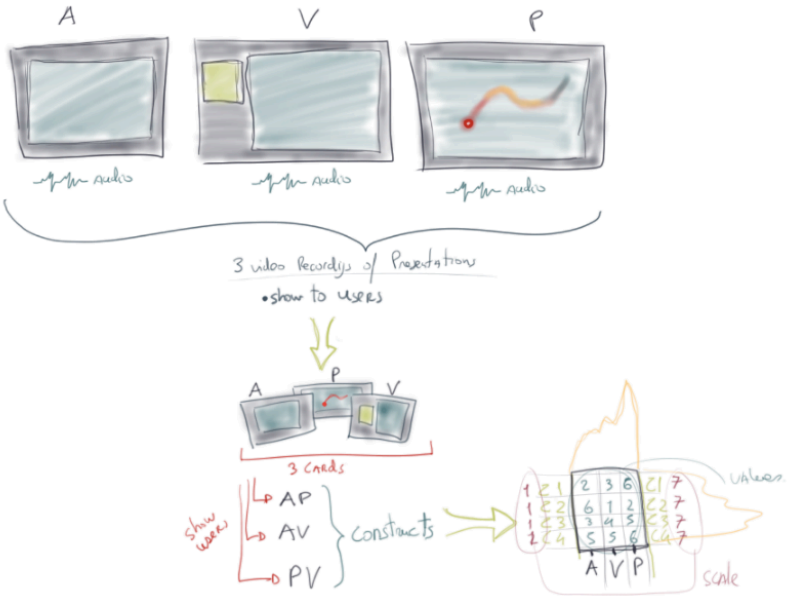


Figure 45. Initial sketch demonstrating the design of the user experiment, the three examples and viewing orders.

Initially, three distinct presentations were going to be used for each example, but in order to simplify the experiment and to avoid the content influencing the experiment, I decided to use one longer presentation. This longer presentation would be cut down into three logical parts. These parts should not require the other to be understandable. Each example should show the three parts of the presentation (see Figure 46) randomly to the user. E.g. user A would view a random example with a random topic, not repeating topics or examples.

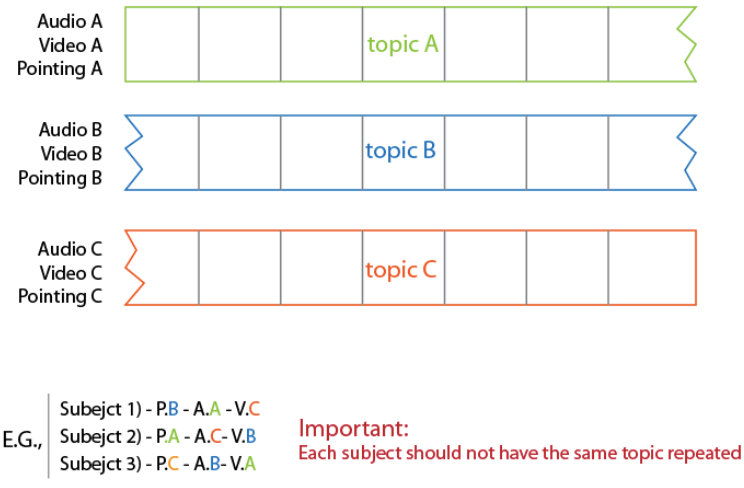


Figure 46. Three topics (sections of a presentation) to be shown by three examples randomly to users.

Research into Saskia's comments on the user experiment lead to a technique by George Kelly 1955 called Repertory Grid Technique. This lead to literature review into the technique and revising and designing the user experiment.

Repertory Grid Technique is a technique for eliciting and evaluating people's subjective experiences of interacting with technology, through the individual way users construct the meanings for a set of artifact's under investigation. While assessing technology, a user can describe the technology in his own words directly from his experience and forming personal constructs (perceptions) that are bipolar in nature. These bipolar constructs can in turn be used to determine how a single element of a technology relates to them on a certain scale.

The experiment would follow a similar structure as before (see Figure 46). We would have three examples and three topics totaling 9 videos, to display to test subjects. The Repertory Grid Technique organizes the experiment into phases to better understand:

Preparation: Create and record (video) displaying three styles of remote presentations and propose them to research participants as examples (elements (columns on the grid matrix)) for them to provide constructs (personal perceptions, attitudes, experiences, etc).

Triad: Select and isolate individual participants for the study where a device will display randomly the three presentations to the research participant (test subject).
After the test subject has seen the three videos (one style of presentation for each topic), the researcher will lay down in front of him three cards. Each card will represent one of the three presentation styles (elements). The test subject then will be asked by the researcher to randomly pick two cards and ask a predefined question: "How are two of these elements similar, and thereby different from a third element?"name the differences of the pair related to the third; "How is the third element different from the other two?"

These personal perceptions of the test subjects are the so called constructs for each construct the test subject creates the researcher should ask the test subject to: provide another construct that is a contrast to the previous construct; provide another construct that means the opposite of the previous construct; in the end the constructs should be bipolar by nature the test subject then should add these constructs into the extremities of the 7-point matrix's rows;

Rating: The researcher should ask the test subject to score the elements related to the constructs on a sliding scale (Likert-type 7-point), 1 related to the left construct, 7 to the right construct.

Analysis: The researcher will gather all the matrices created by the test subject and organize, relate and group similar constructs (meaning and synonymies)to interpret and analyze the results.

With the experiment design almost complete we had to turn our focus in producing or searching for a video presentation (content to be shown) that would fit our strict needs.

8.2.5. Conference Observations

An opportunity to assist two conferences (Gamification, Brussels and CHI Sparks, Netherlands) proved to be a rich ground for observations on slide presentations.

The Gamification conference took place in a large anteater with a large projection canvas.
The first presenter performed two types of deictic pointing gestures (see Figure 47). While referencing content or objects close to him the presenter performed an open hand indicative

gesture. When content or objects where out of arm reach, the presenter performed an extended arm index gesture (see Figure 47 right).

Figure 47. Observations by a speaker at a conference: Left, open hand indicative gesture. Right, index-finger pointing.

The second presenter (conference speaker) presented through an iPad located on a nearby table. The presenter stood behind the table, using the iPad's Keynote presentation application to change slides and to point to content out of arm's reach (see Figure 48). The virtual pointer representation was a red dot with a white inner nucleus. The presenter used deictic utterances while performing the pointing gestures through the iPad, thus connecting the expressions to the content was easy.

Figure 48. Observations performed by a speaker at a conference: Left, speaker standing behind a desk where the ipad was located. Right, speaker interacting with the iPad and the pointer cursor visible on slide projection.

The CHI Sparks conference was held in Arnhem, the Netherlands at a University. The invited speakers spoke in a large hall with a very large projection canvas on a stage (see figure 49). The speakers used a physical laser pointer to extend their pointing gestures towards the presentation and to help the hundreds of attendees to focus their attention.
Due to the size of the canvas the laser pointer was extremely difficult to perceive and follow at a distance. The laser pointer in such a large screen had too fine granularity to be easily seen.

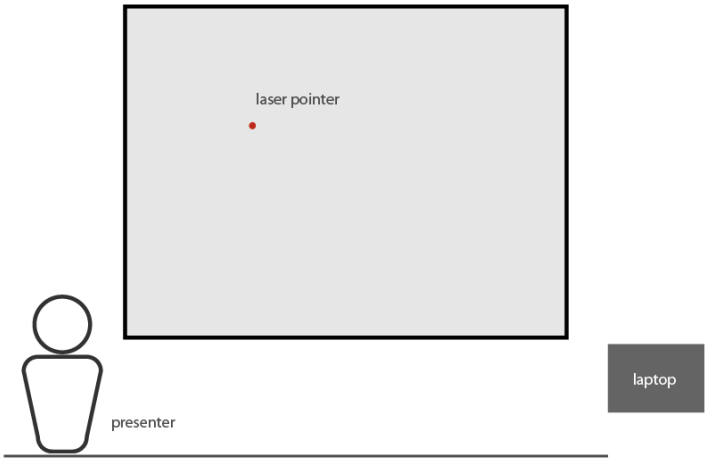


Figure 49. Layout of the main stage of the CHI Sparks conference. Presenters used a physical laser pointer to direct addressees attention.

The observations into the presenters interaction with the laser pointer (and the laser pointer itself) led to, further literature review into experiments performed with laser pointers as a means for pointing and interacting with content at a distance. The authors identified that people are not able to hold a laser pointer absolutely steady (wiggle), and the mean target acquiring time is around 1 to 1.4 seconds. They also identified that the user's start and end points are typically not close to the target, hence the start and end paths of the laser pointer are not good indicators of the user's intentions.

8.2.6. Intent to Gesture User Experiment

The objective of this user experiment was to get some feedback from users on the connection between intents and gestures. Before performing studies on how the audience perceived and interpreted viewing pointing effect within a slide presentation, understanding what gestures people would perform given a selection of intentions could be helpful in designing the future experiments.

Experiment

The experiment required subjects to perform the first gesture that came to mind when the researcher read out loud an intent. A list of intents was created for each slide and each intent required a gesture to be performed:

Slide 1:
"Point out the Google Document"
"Now, point out BlueTie and the Skype icons"

Slide 2:
"Indicate the second bullet point"
"Highlight the third bullet point"
"Highlight the text of the forth bullet point"

Slide 3:
"Highlight all the 1-finger gestures"
"Point to all the 1-finger gestures"
"Group 3 gestures together"

Slide 4:
"Highlight a single artifact"
"Highlight 2 distributed artifacts"
"Relate the two"

The subjects were sat at a table at a 90º from the researcher. This arrangement tried to minimize the test subject's in performing gestures in a way that the researcher could see and not being the first thing that came to mind.
In front of the subject, an iPad was displaying a single slide from a presentation (full screen). The slide was a jpeg image loaded into Adobe Ideas application. The application afforded multiple drawing layers. The bottom layer was the slide while the top layer had a transparent

background and captured the subjects gestures. A 50pixel (almost size of the finger) pen tool, with a 50% transparency and red color was used as the "pointer". The users could see their gestures being performed (its a drawing application).

The experiment was designed and performed during an afternoon at Bell Labs. Twelve subjects performed the experiment. Four subjects where novices and never used an iPad, while eight, owned iPhones or where well familiar with the technology.

As an example the results from test subject Marc are shown below:

Name: Marc
User pool: Expert user, iPhone and iPad owner
Notes: Pointing & Indicating are a different gestures (and effect) to highlighting—towards the same content. Highlighting is persistent (until canceled). Transient (small amount of time, includes drag effect).

Marc's results

Pointing and indicating where different gestures (see Figure 50 left). For indicating, the gesture was more dynamic—to focus even more attention.
A fixed pointing granularity made indicating and highlighting the second and third bullet points with the same gesture as pointing, while highlighting the text was a different longer gesture (adjusting the granularity).
Highlighting two objects or a group, a circular gesture was performed. Marc linked previous indicated referents via a line (see Figure 51 right).

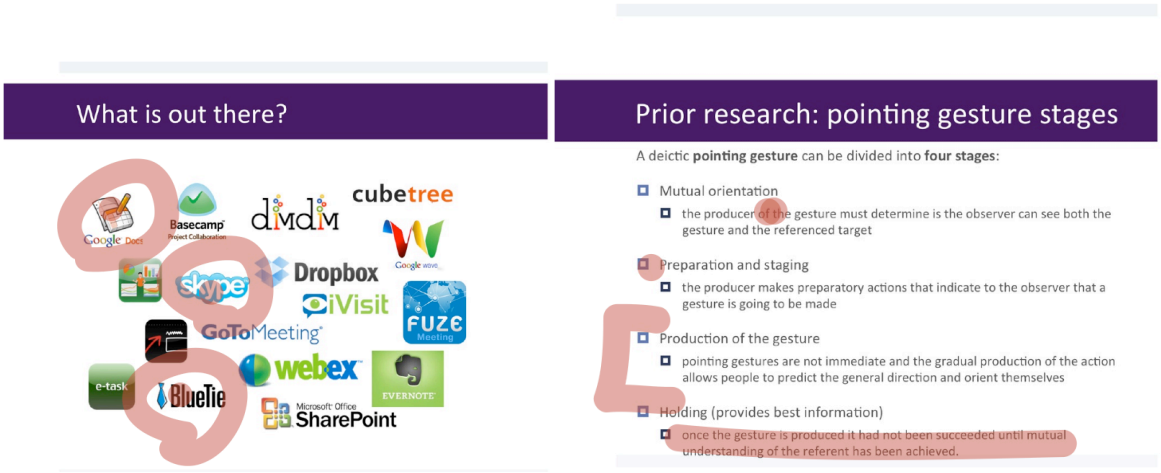


Figure 50. Results from Marc's user test. Left, results from slide 1. Right, results from slide 2.

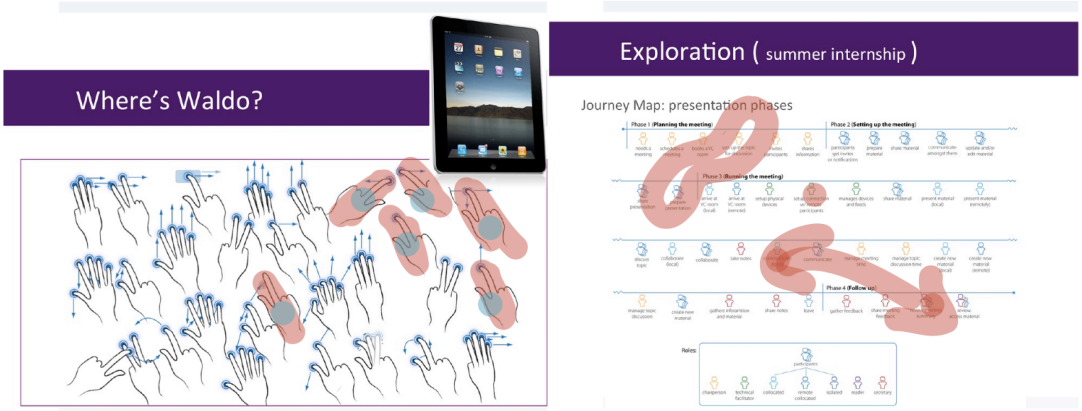


Figure 51. Results from Marc's user test. Left, results from slide 3. Right, results from slide 4.

The twelve results where analyzed individually, then overlaid in order to identify similarities. For each slide, the 12 gestures were overlaid and analyzed as seen below:

Slide 1:
"Pointing" (tap or a touch with minimal movement) had a consistent 11/12 users performed the same gesture.
2/11 users taped the two different icons simultaneously (relating them in time).
1/12 users did a circular gesture for the "pointing" intent—this user was a novice with iPad.

Figure 52. Resulting overlay of the 12 subjects resulting gestures for slide 1.

Slide 2:
"Indicate" had close to the same result as "pointing" with 9/12 users “touching” the bullet point.
1/12 users circled the second bullet point.
1/12 users drew an arrow (Orlando a novice user).
1/12 users dragged the cursor over the bullet point.

"Highlight" resulted in more mixed results:
8/12 users simply dragged the cursor over text they wanted to "highlight".
1 user used his personal highlighting and annotation behaviors and did a box to highlight text and two vertical lines to highlight a paragraph.
1 user did an open ended box to highlight the third bullet point.
2 users circled the bullet point or text to be highlighted.

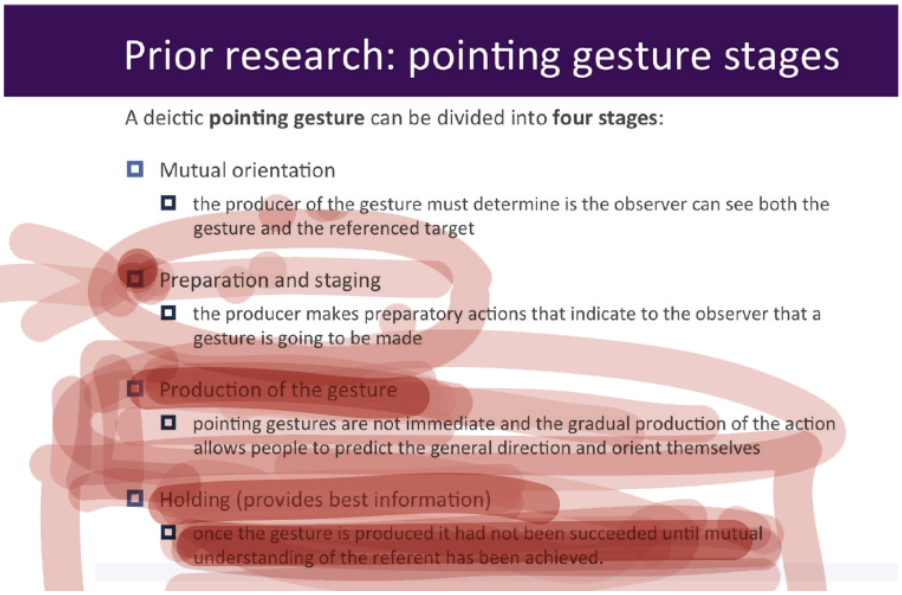


Figure 53. Resulting overlay of the 12 subjects resulting gestures for slide 2.

Slide 3:
11/12 users in order to "point" to multiple individual objects, they performed the same interaction as for the above slides, a tap or touch gesture.
6/12 users changed their "point" gesture when the intent was to highlight.
Circular gesture used to highlight and also group proximity objects. A subsequent multi-pass over the object gesture to highlight.
9/12 users did circular gestures to group 3 near objects together.
1/12 did a square gesture.
2/12 taped the 3 objects quickly.
1 user first highlighted the objects and then used arrows to point to them.

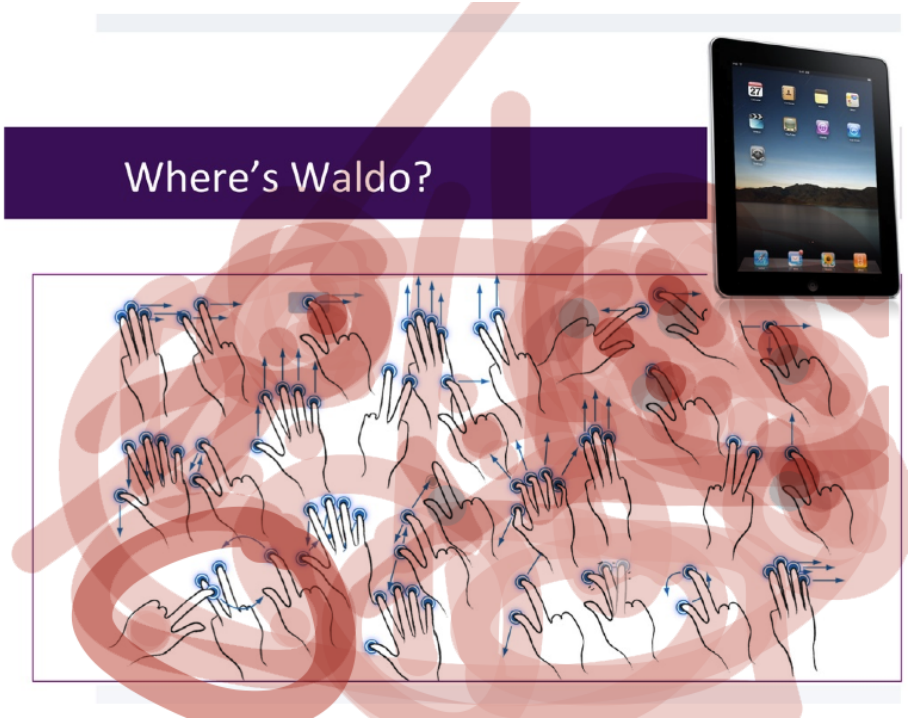


Figure 54. Resulting overlay of the 12 subjects resulting gestures for slide 3.

Slide 4:
7/12 users performed the same as above "pointing" tap or touch gesture, to highlight a single object.
5/12 users performed circular gestures to highlight single object (variating only the granularity (diameter) of the circle).
9/12 users drew lines to relate or link two highlighted objects.
2/9 drew arrow heads.
3/12 users did not draw a line to relate distributed content.

One user commented on, if he had chosen a nearby object he would have drew a line, but since he had already highlighted objects across the slide, he was not prepared to draw a line through the slide.
Two users "pointed" to the two artifacts again, relating them.

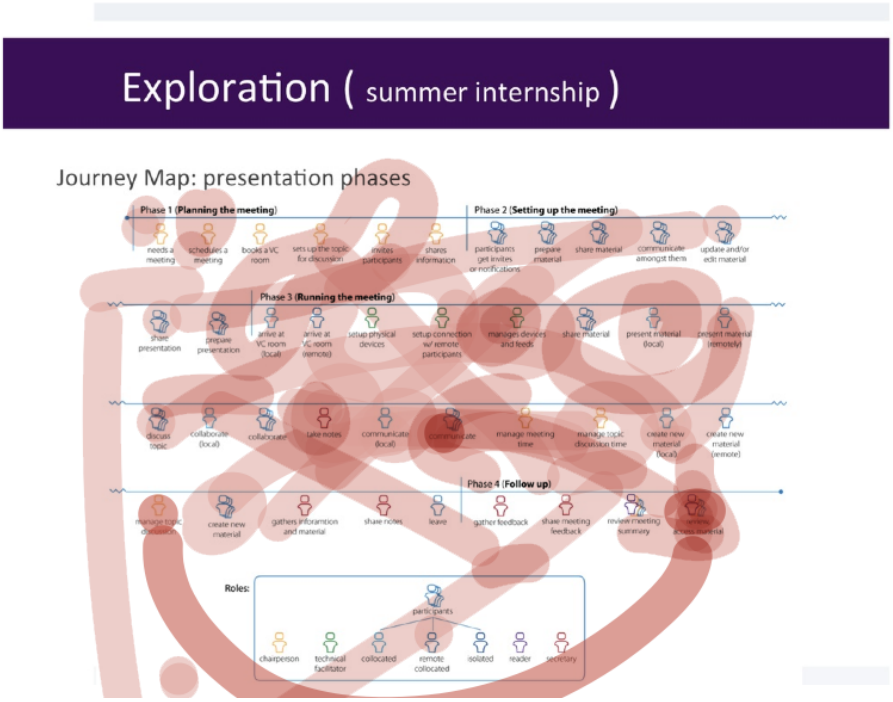


Figure 55. Resulting overlay of the 12 subjects resulting gestures for slide 4.

Conclusion

Expert users simplify gestures. This could be because they are used to the device and its capabilities. This arose some questions: Could the drawing application be influencing some gestures? Does a persistence effect allows for "drawing"?
Novice users were found to perform more personal embodied gestures and techniques for indicating, highlighting, etc.

A total of 134 gestures were recorded and observed. 31.34% of all recorded gestures were "1-finger pointing gestures" (tap, touch). 17.91% of all recorded gesture were "region gestures or tracing" (circular gesture).

For "Pointing", most of the test subjects performed an index-finger pointing gesture equivalent, a "tap" or "touch".

For "Indicating" most of the test subjects perceived this intent to be similar to "pointing" and performed an equivalent tap or touch gesture.

"Highlighting" can be miss leading due to the fact highlighting is somewhat a ubiquitous term used as a persistence technique using a highlighter (semi transparent) most test subject performed dragged gestures (the tool allowed for this) for text most test subject performed a circular gesture to highlight individual artifacts.

"Grouping", most test subjects grouped objects with a circular gestures some test subjects grouped objects with a square'ish' gesture as a container.

"Relating" was normally performed by drawing a line between the two objects to be related. The test subjects mentioned that pointing to them was already relating them (within a time-frame). A test subject mentioned he would prefer some sort of color referencing.

This user study provided enough information (in conjunction with the consulted literature) for a second design iteration of the cursors and gestures. The similarity among novice and expert user's gestures for the provided intents was interesting and could mean a low learning curve for users.

8.2.7. Final Research Spectrum Map

Findings from observations, literature review, state-of-the-art and, a better understanding of the intents and associated gestures, allowed for the pointing cursor persistency map to be revised.

Figure 56 now displays a white area. This is RemotePresence's research focus: is it possible to provide more meaningful pointers that are not as transient as a laser pointer or as persistent as notes and scribbles?
A number of RemotePresence concept cursors where mapped to where we assume the amount of information it conveys and how long in time it could be exposed. None of RemotePresence's cursors are exposed for longer than the slide exposure. This is due to deictic gestures being related to the utterances of the performer of the gesture, the effect (cursor) should not be represented when gesture and utterance or discourse about referent no longer exists—this in real-time presentations.

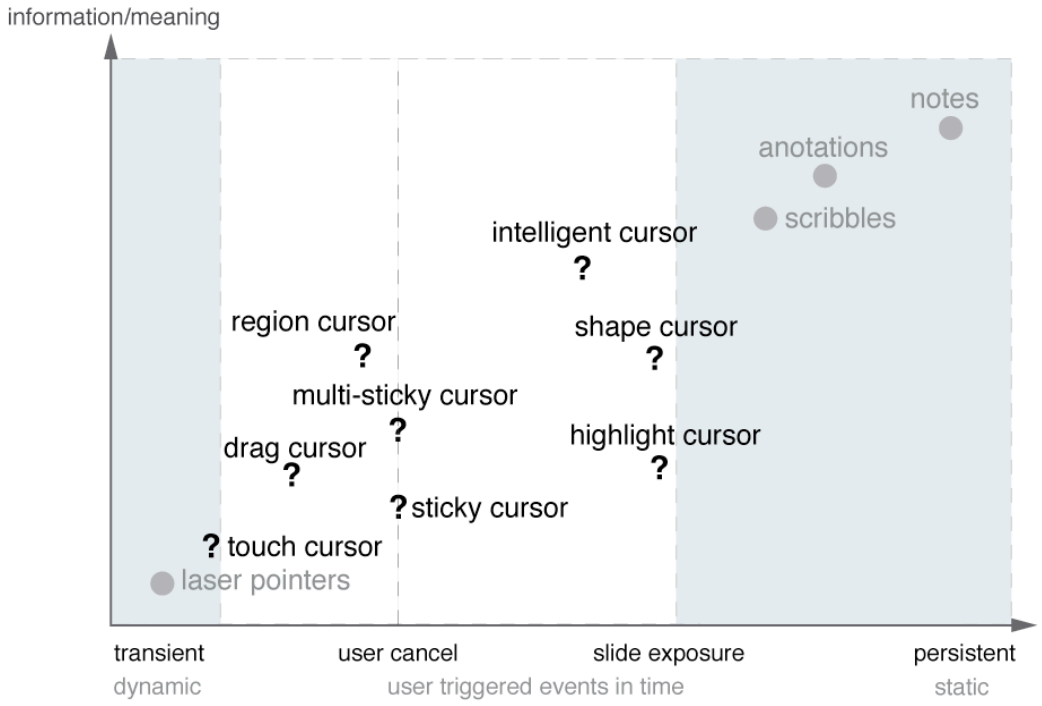


Figure 56. Diagram displaying the cursor persistency and relating quantity of information. Research focus represented as the white area.

8.2.8. RemotePresence Theoretical Framework

In revising RemotePresence's theoretical framework map with the recent information from literature review such as grounding in communication and least collaborative grounding mechanisms (from attentional immersion), figure 57 displays the slides as the common ground, and the gestures performed by the presenter on the multi-touch device, as least collaborative grounding mechanism.

When a presenter decides to perform a gesture because it is easier and faster than uttering the spacial location of his referent within the common ground (the slides), the gesture is considered a least collaborative effort mechanism. If the presenter is provided with evidence from the addresses that they did not understand, he may opt to repair the communication by re-gesturing or by reformulating his utterances.

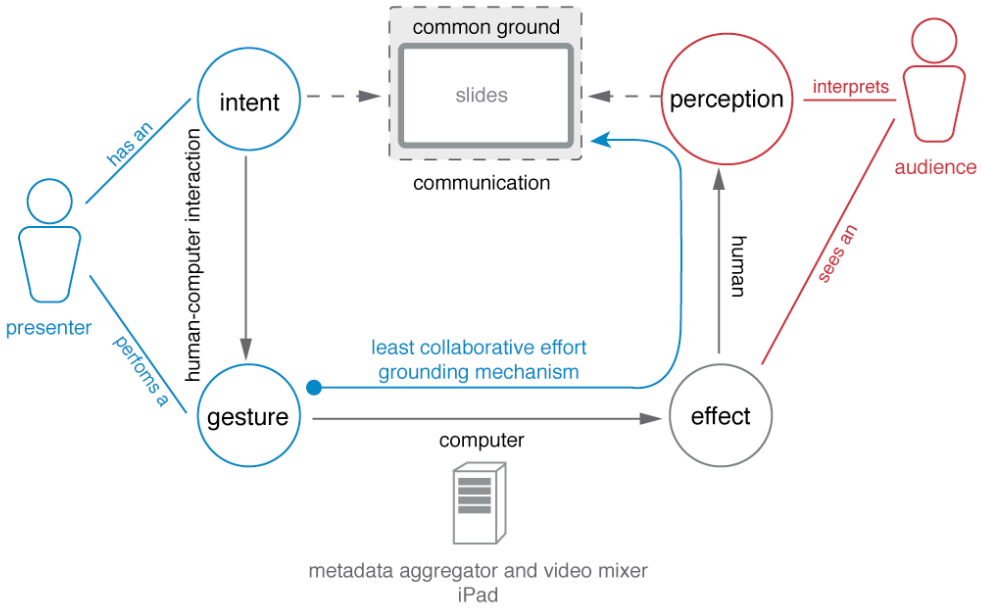


Figure 57. Final theoretical framework diagram for RemotePresence including the notions of common ground and least collaborative effort mechanisms.

8.2.9. The Hague user experiment

Before testing RemotePresence's concept cursor and gesture design principles, a baseline for comparison was required. We wanted to know if pointing added anything meaningful to a presentation and if so, what where these 'meaningful things': Would it help audience members understand better? Would it help the presenter's story telling? Does it provide any personal emotion to the presentation?
We could have chosen one or two variables to test for, but upon discovering the Repertory Grid Technique we knew that this technique would helps us achieve exactly what we wanted: Individual's personal feelings and perceptions about pointing compared to other types of presentations (audio and slide only, and video, audio and slide).

The Repertory Grid Technique

Repertory Grid Technique (RepGrid) was developed by George Kelly in 1955 as part of the Theory of Personal Constructs as a means of assessing the content of an individuals repertory of role constructs—the unique system of interconnected meanings that define an individuals perceived relationships to others.

RepGrid (Repertory Grid) is a methodological tool or instrument used to collect data and to assist in analyzing it, comparable with other techniques such as questionnaires, observation or interviews. An advantage of RepGrid in comparison to other similar techniques is that RepGrid allows for elicitation of perceptions without researchers interference or bias.

RepGrid is primarily used to investigate or reveal attitudes and beliefs, concepts, assumptions, perceptions, and self-insight or reflection, that is, the personal understanding and cognition from individuals. These collections of personal views are known as constructs.
RepGrid is a matrix (see Figure 58) consisting of columns, in which elements are listed for the constructs. The elements are specific, concrete examples that will be used to help the research participants to identify their own constructs or perceptions regarding the particular research topic that is being considered. These elements should be precise, homogeneous, not evaluative, representative, meaningful and relevant to participants, with the examples covering a range.

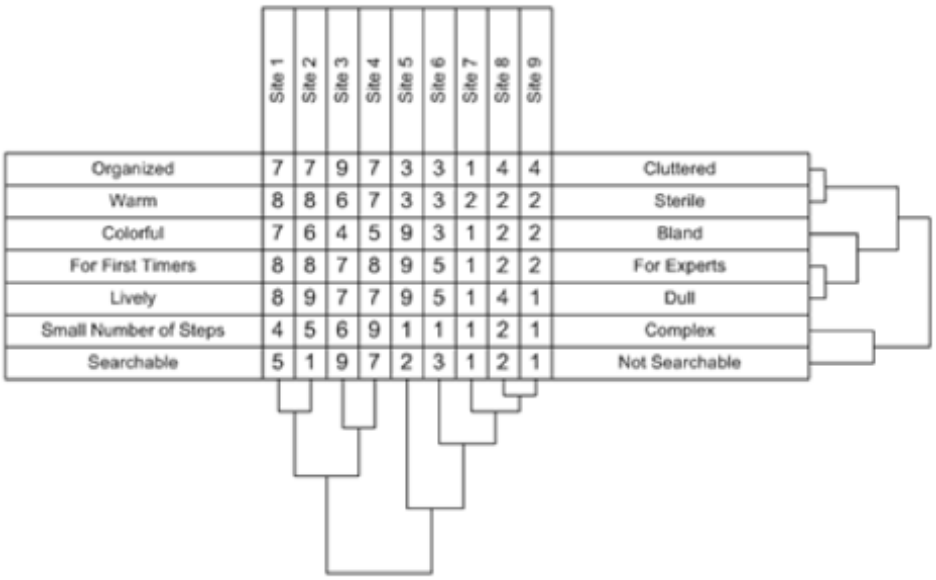
The triad process consists of asking participants to randomly select three elements and then how two of the three examples are different from the third. The researcher does not provide a starting point, but just asks the participant about his or hers constructs that are important from his or hers perspective. The participant writes the construct as the row label in the form of two contrasting or bipolar statements.

The next phase requires participants to evaluate each element with respect to the construct and to fill in a score in the appropriate cell of the grid with a high score(e.g. 7-point scale) indicating that the element indicated the description on the right (column) and a low score (1) for the one on the left (column).

Finally the scores are analyzed statistically in order to find out to what extent:
1. The participants agreed on constructs
2. The constructs were associated with elements identified by the participants as the best or worst examples from the research domain

The RepGrid is less resource hungry (takes less time) than observations and is quicker to complete than interviews. RepGrid has been proven as a communication and collaboration tool. The constructs themselves provide essentially qualitative data although the scoring of elements with respect to the constructs is numeric and can be analyzed statistically.

Figure 58, an example of the RepGrid being applied to a research topic involving analyzing 9 websites. Low scores (1) are related to the construct on the left, and high scores (9) relate to the bipolar constructs on the right column.



	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	
Organized	7	7	9	7	3	3	1	4	4	Cluttered
Warm	8	8	6	7	3	3	2	2	2	Sterile
Colorful	7	6	4	5	9	3	1	2	2	Bland
For First Timers	8	8	7	8	9	5	1	2	2	For Experts
Lively	8	9	7	7	9	5	1	4	1	Dull
Small Number of Steps	4	5	6	9	1	1	1	2	1	Complex
Searchable	5	1	9	7	2	3	1	2	1	Not Searchable

Figure 58. Example of a repertory grid matrix for testing how user perceive nine different sites related to seven constructs.

Experiment

The user experiment was performed at the Haagse Hogeschool, The Hague Netherlands, over one day. The experiment consisted on test subjects viewing three video presentations on a laptop, then providing constructs and scoring them, followed by a semi-structured interview.

There were 9 video presentations. Three videos displaying different types of video presentation representations (video of the presenter with slides, audio and slides, and pointing with slides) for the topic A; Three videos for topic B, and for topic C (see Figure 45-46).

Each topic consisted of a 6-7minute video section—from a longer presentation.
The presentation's topic was on the notion of Dualities. The presentation itself was performed by Dr. Dennis Dams at Alcatel-Lucent. The presentation was captured by a laptop with Screenflick application to capture the screen of the laptop (presentation slides) and Photo Booth to capture the audio and video of Dennis presenting.
Dennis gave the presentation twice. Once for the video and audio versions of the presentation and another for the pointing version of the presentation—the pointing presentations Dennis used deictic expressions and utterances. The pointing gestures were augmented onto the presentation with Adobe After effects video editing software.

Each test subject upon arrival, would fill in their demography information and academic background. Then, each subject would view each topic once. E.g. A->B->C. The types of presentation visualizations would be randomly shown, making sure that they did not repeat. E.g. User U, was shown for topic A the pointing version, topic B the video version, and topic C the audio version. This would ensure that the content (slide set) in which the pointing was shown and the occurrence of when it was shown (in topic A, B, or C) would minimize the outcome of those variable interfering with the experiment.

At the end of viewing the three videos, the audience members where handed a sheet of paper (see Appendix under The Hague User Studies) with a table listing three elements (slides only,

video and slides, and pointing and slides) and two columns with “constructs 1/7 and constructs 7/7”.
The subjects were explained the meaning of the three elements—being the types of presentation visualization that they saw in the videos—and the meaning of a construct—a personal perception.

Each researcher was handed a guideline (see Appendix) on how to perform the experiment and the key questions needed defined by the Repertory Grid technique.
In front of the subjects were laid three cards (see Appendix), each one representing an element (presentation visualization style). The researcher would ask the subject to randomly choose two cards and be asked to compare the two card to the third and then write down the similarities of differences that they perceived. Each one of these personal perceptions were a singular construct (see Findings for examples) that would be filled it on the most left column. Next, the researcher would ask the subject to provide a contrasting or opposite perception (construct) for the right column.
If the subject had difficulties in eliciting constructs, the researcher would ask the user to further explain or reformulate his responses (laddering technique) in order to obtain further distinct and concrete constructs. The cards would be switched 3 times until all the possible combinations where tested. E.g. Audio and video against pointing, then audio and pointing against video, etc.

When the subject could not provide anymore constructs the researcher would ask the subjects to score the constructs that he provided on a 7-point Likert scale where ‘1’ would represent “to a great extent” related to the construct on the left and ‘7’ “to a great extent” the contrasting construct.

The end of the scoring phase led to the semi-structured interview where the research would ask some more general questions (see Appendix) for an overall understanding of the subjects preference and comments.

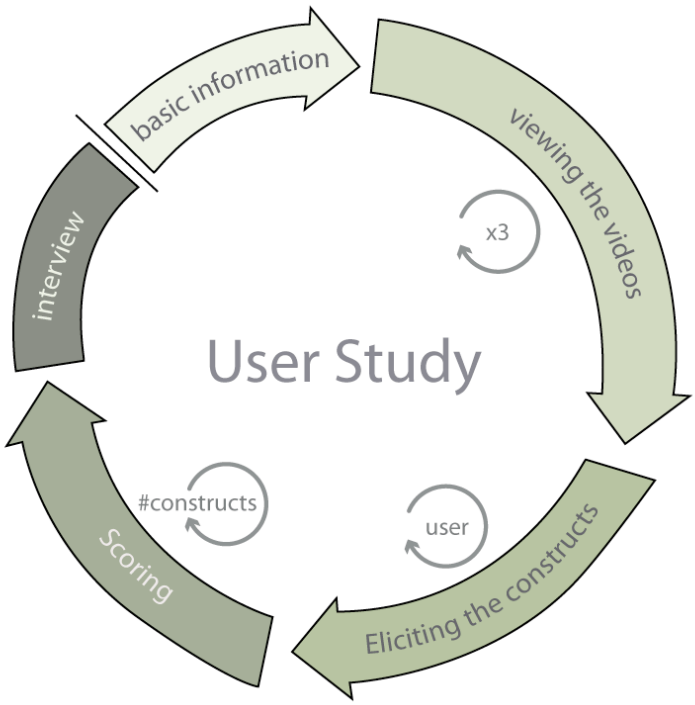


Figure 59. The The Hague user study process flow that each subject followed.

Bellow (Figure 60) the resulting Repertory Grid matrix from the test subject Just. He viewed the presentations in the PAV (pointing->audio->video) order. The constructs he provided where scored by him on a paper sheet (see Appendix) a little different than bellow—designed to be easier for users to understand and score. His results where are mapped according to the Repertory Grid technique matrix.

Alcatel·Lucent

Test Subject: Just
Demography: 26

Background: Comm. MM. Design
Content order: **PAV**

	Elements			
Constructs (1/7)	Slide only	Video and slides	Pointing and slides	Constructs (7/7)
Something that moves	7	2	1	Stationary
Harder to understand	1	6	7	Easy to follow
Helpful	7	2	1	Less helpful
Focus	2	5	6	Relaxed
Tiresome	1	6	6	Easier
Underlying important	7	3	1	Has to search
Distracting	7	5	2	Rest
Emotion	7	1	6	Lack of emotion
Personal	7	1	6	Cold
Vocal emotion	7	1	6	No emotion
Easy to listen	6	1	3	Hard to follow

Figure 60. Just's resulting repertory grid matrix

The numbers seen in the above matrix were the scores that "Just" attributed to each construct relating to a specific element.

1-"in a great extent" (e.g. *Helpful*)
2-"somewhat" (e.g. *Helpful*)
3-"very little" (e.g. *Helpful*)
4-"undecided"
5-"very little" (e.g. *Less helpful*)
6-"somewhat" (e.g. *Less helpful*)
7-"in a great extent" (e.g. *Less helpful*)

The overall results (all subject's constructs) can be found in the Appendix

While performing the user study the researchers commented on how (without looking at the results) male subjects results where somewhat different to the female subjects. During the initial analysis this led to the results being grouped into 2 groups—male and female.

As initial overview over the user study results, the elements that scored highest per subject was identified added to an info graph (see figure 61).

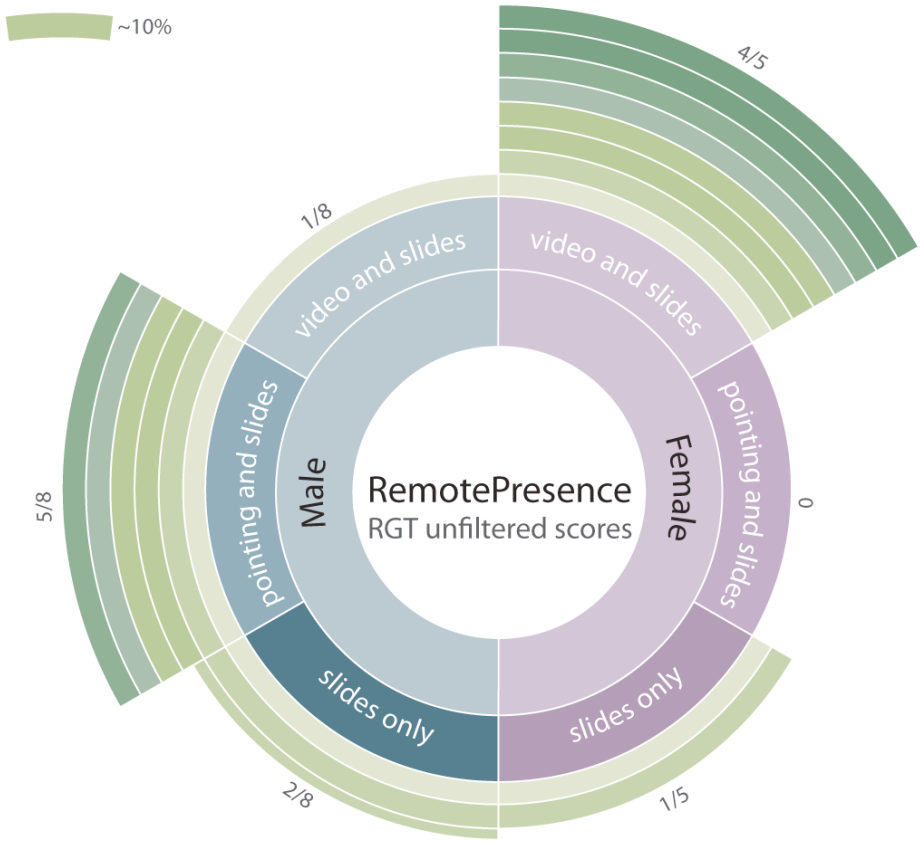


Figure 61. Repertory Grid experiment results: Highest scoring elements per' subject divided by male and female

For the Male group:

- 5/8 scored Pointing highest
- 2/8 scored Slides only (with Audio) highest
- 1/8 scored higher for Video and slides

Female group:

- 4/5 scored higher for Video and slides
- 1/5 scored higher for Slides only

Figure 61 shows the highest score given to an element from all subjects. The graph is divided into two parts. The left (blue) represents the highest score given by all the male subjects. The more the green bars, the higher the percentage of subjects scored that element as the highest. The right side (pink) the female subjects scores are similarly represented.
Interestingly, the researchers initial impression of the difference between male and female subjects are very easy to visualize and identify while looking at the graph. Male subjects

preferred the pointing and disliked most the video, while it was basically the opposite for the female subjects.

When grouping male and female's results together (see Figure 62) the scores for pointing and video even out, while clearly the slides and audio only option was the least preferred.

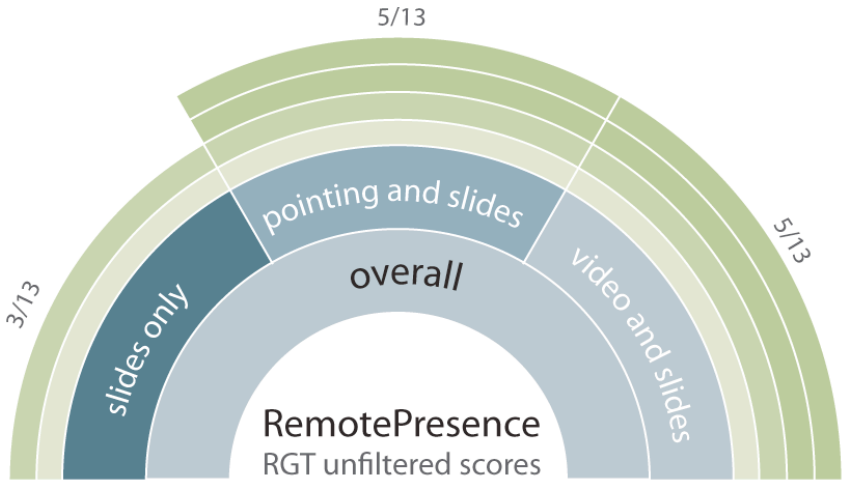


Figure 62. Overall results of the Repertory Grid experiment for male and female combined.

The results form the Repertory Grid technique are consistent to the results obtained during the semi-structured interview:

Male subjects:

- Preferred style:
  - 1/8 preferred Slides only
    - This user mentioned he prefers to create his own mental models and think for himself and not be guided by the presenters way of thinking—this individual is a university professor.
  - 4/8 would prefer Pointing and Video integrated (an element not provided in the study)
  - 1/8 preferred Video
  - 2/8 preferred Pointing
- Was Pointing useful:
  - 6/8 commented on how pointing was useful and would have it
  - 2/8 commented on how pointing was useless and preferred not to have it
- Easiest to follow:
  - 4/8 Pointing
  - 2/8 Video
  - 2/8 Audio

Qualitative results:
Subjects comments when asked: Why Slides and Audio only?

"to be able to form an image of the presenter and what is being presenter by oneself."
"for short presentations I'd prefer the Slides and Audio."

Subjects comments when asked: Why video?

"… because of the rapport (connectedness)"
"more connection with something, the person who you see"
"because when you have already see the slides you have something else to look at"

Subjects comments when asked: Why Pointing?

"thinking like the presenter"
"eyes are guided thought the constructions"
"pointing directs you to important stuff on the slides"
"it made direct connection to who was said and what was important in the slide."
"directed my attention"
"you know where to focus, easier"
"because it was underlaying the important things"
"pointing helps a lot what is being said and the explanation and very helpful"

Female subjects:

- Preferred style:
  - 4/5 preferred Video
  - 1/5 preferred Audio
  - 2/5 commented on the benefit of Pointing and Video integrated
- Was Pointing useful:
  - 1/5 commented on how pointing was useful and would have it
  - 3/5 commented on pointing is useful only when the content of the presentation is complicated or complex and requires some guidance
  - 1/5 disliked the Pointing and would rather not have it
- Easiest to follow:
  - 2/5 Video
  - 1/5 Audio
  - 1/5 Pointing
  - 1/5 Undecided among Video or Pointing

Qualitative results:

Subjects comments when asked: Why Slides and Audio only:

"provides a deeper concentration…form one's own image."

Subjects comments when asked: Why video?

"see the eyes and face" of the presenter
"saw a person--doesn't need to be there all the time."

Subjects comments when asked: Why Pointing?

"first explain then point as a summary"
"its strange..attaches a lot of importance to the mister (presenter)"
"adds emphasis"
"I was distracted by the pointer, my concentration kept being changed"
"If the subject is confusing then the pointing is somewhat helpful."

Consistently, the subjects personal constructs were similar in meaning, to the results from the semi-structured interview (see Figure 63). Male subjects preferred pointing, and female subjects the video. Interestingly, the male subjects now commented on perhaps video and pointing combined would be interesting. 2/5 females also commented on combining video and pointing. This element was not provided during the user study, so these responses where provided without viewing an example.

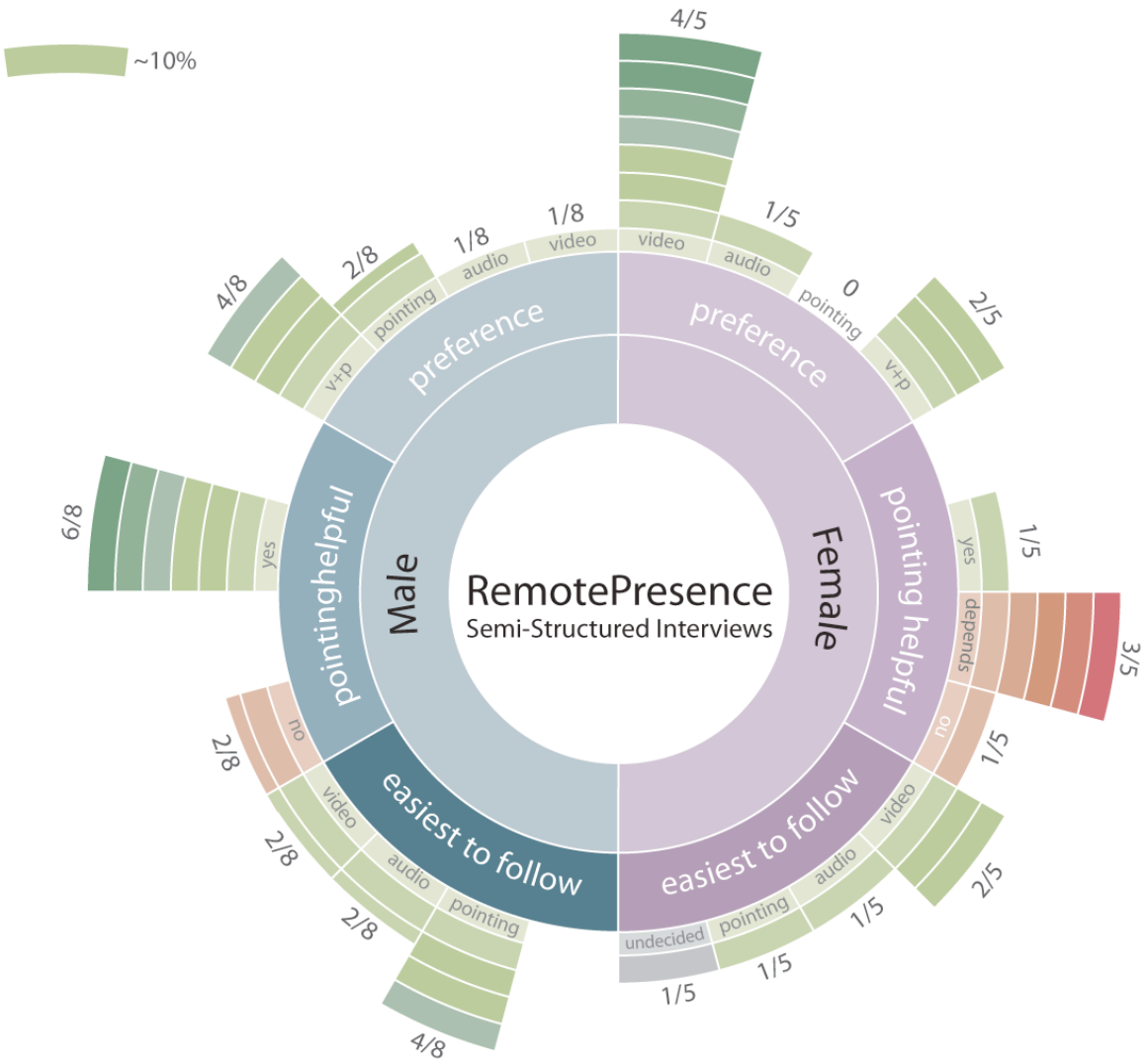


Figure 63. Overall results for the semi-structured interview divided by male and female, displaying element preference, the usefulness of pointing, and which element was easiest to follow the presentation.

Figure 64 shows the overall results of male and female combined. Pointing had a lower overall score with more subjects commenting on the possibility of combining it with video. While before no female scored pointing highest, now in discourse, 4/5 mentioned that they preferred pointing, but, depending on the content being presented—if complicated, confusing, difficult to follow, etc. Female subject recognize the advantages of pointing, but only wish to see it if the content requires it. Female subjects commented on the visual and kinetic aspect of the pointing cursor, namely that the drag effect was distracting and the motion erratic.
3/13 subjects disliked pointing and saw no usefulness in it. These subjects were university professors and commented on how they did not like to be guided and how they preferred to think for themselves.

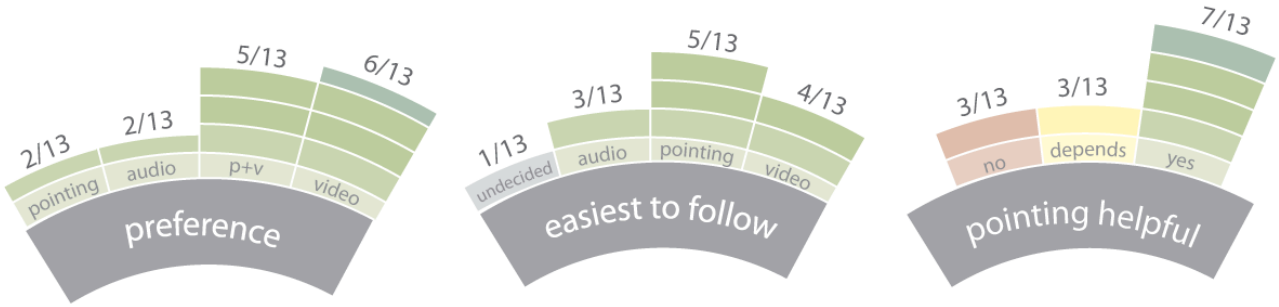


Figure 64. Overall results for male a female combined from the interview

A second iteration over the study results led to filtering and grouping of constructs. Filtering was necessary due to some subjects—for same perception or context—eliciting two or more constructs with the same meaning.
The constructs were analyzed and were grouped into higher contextual meanings. Five groups were created: concentration and attention; presenter presence/social presence/ connection or feeling to presenter; helpful/understanding/comprehension; structure/fluidity; and feelings/perception. The filtered constructs were grouped and then each group was analyzed.

Figure 65, displays the resulting highest scores in terms of "to a great extent" (dark green), "somewhat" (green), "very little" (light green) related to each group.

Group: Concentration and attention:
Audio and slides scored highest followed by pointing. Video scored lowest perhaps due to the video of the presenter distracting the viewers from the content. Comments on how pointing was distracting due to its effects (drag) by some subjects, led to it being scored a little lower than the audio example.

Group: Presenter presence/social presence/connection to presenter:
Video clearly scored highest in this group. The video feed of the presenter clearly provides higher presences and personal feeling to the presentation. Pointing and audio are very similar —too small sample size do identify any meaningful differences.

Group: Helpful/understanding/comprehension:
Pointing and video scored similarly while audio scored much lower in comparison.

Group: Structure/fluidity:
Pointing scored highest. The visualization of the pointing helped viewers follow a story line and be guided through the content. Video had 8/14 second highest scores.

Group: Feelings/perceptions:
Video scored highest with pointing and audio similar.

Figure 66, differs from figure 65, by displaying the second highest score as "not the worst". There is a noticeable difference by having the pointer on the slides as seen by the second highest scores (even if scored on the undesirable construct pole). Here it is possible to identify that pointing in fact adds something to a presentation, perhaps not as meaningful as the video feed of the presenter for certain aspects (social presence, feelings, emotion) but certainly something that the audio and slide alone does not provide as much.

Results shows that subjects identified that pointing adds a certain noticeable degree of presenter presence and feeling towards the presentation—consistent with some literature review on viewing gesture on an asynchronous presentation—but not close to what video offers.

Figure 65. Element results for each group

Figure 66. Element results for each group from the Repertory Grid technique

The Repertory Grid technique allowed for eliciting interesting constructs from subjects while avoiding the researchers introducing any bias information. The researchers followed a pre-defined planning and applied standard repertory grid technique questions for eliciting the constructs.
A laddering technique was applied for those users that presented more difficulty in providing constructs. The subjects sometimes provided small sentences or words that where to general to be considered as a perception or feeling. By asking the subjects to re-phrase the meaning of the work, this allowed for them to use synonyms, or keep of abstracting the meaning until a constructs such as "feel the presenter" was provided. Around 190 individual constructs were elicited that were then filtered and grouped into 5 groups for an easier analysis.

The findings demonstrated that male and females subjects perceived the presentation examples (elements in the Repgrid) differently. Female subjects preferred the video example and disliked the pointing one. Male subjects were the complete opposite. Male subjects commented on how the video was distracting from the content, while female subject commented on how the pointing effect and movement were distracting. Female subjects preferred the video example due to the presence of the presenter, seeing his emotions and connecting a face to the voice.

Pointing was recognized to be helpful when the content required some guidance or disambiguate. Subjects commented on how audio cues (verbalization) for pointing requires lot of brain cycles to understand and relate. A subject commented on the well know issue of the eye gaze of an individual communicating through a tele-communication tool.

Some subjects commented on how sometimes turning off the pointer would be an advantage. Sometimes when the content does not require pointing it can be distracting—this lead to a concept entitled adaptive pointing (Future Work chapter).

An unexpected finding provided researchers with new information for designing an iteration over the user experiment. 5/13 subjects commented on how they would prefer a combination of the video of the presenter with the pointing feature. While this example was not presented or mentioned in the experiment to the subjects, it sounded like an interesting question to approach another experiment. By combining the video and the pointing, would their positive perceptions be meaningful together, thus improving the overall experience of the presentation?

While successful as a baseline qualitative study, not many conclusions can be taken from this small (13 subject) sample. A second quantitative user study would be necessary to provide more concrete information on how viewers perceived the pointing.

8.2.10. Online User Experiment

The objective for the online web experiment was to build on the findings of the The Hague user studies. By refining the videos (shorter duration) and the pointing (effect and movement) we were aiming for a online quantitative study. Hopefully, this user study would confirm or revise the initial results from the previous experiment.

Experiment

The experiment consisted on users accessing a webpage at http://visualcommunications.be/remotepresence. The home page introduced the experiment and provided a form for eliciting some of the users demographic and academic information.
Next, the user would be presented with the video presentations (one at a time). The presentations were randomly displayed to users (similar to the The Hague experiment). The users were not able to scrubb the video (jump in time) or jump to the next video before finishing the current one. At the end of the video a button "next presentation" would appear. Upon clicking a new video would be shown with the next presentation topic. At the end of the last video, a button "continue to scoring" appears taking users to the scoring page where it is possible to score each presentation style based on constructs (provided from the The Hague qualitative user tests).

See appendix for screen shots of the online experiment.

The web page provided additional informations, such as indicating the experiment progress, providing links to the involved research partners, a page describing the Repertory Grid Technique, and a contact form.

None of the previous test subjects participated in the online experiment.

Findings

Twenty-six individuals participated in the online user experiment that was publicized in three universities: University of Madeira; Technical University of Eindhoven, Netherlands; and Haagse Hogeschool, Netherlands. Nineteen out of the 26 individuals finished the experiment, 8 being female subjects and 11 male subjects, with ages between 21 and 51 years. The majority of subjects were students (10 out of 19), two PhD candidates, and the remaining being researchers, lecturers and designers.

Figure 67 visualizes the results of the online experiment divided by male and female test subjects relating their results for each of the tested elements (examples).

No male subject preferred the video and slide example, while 4/11 preferred the pointing and slides example. The combination of pointing and video scored the highest with 7/11.
Interestingly, only one female subject preferred video and slides example, while 4/8 (50%) of female subjects scored the pointing example the highest. 3/8 preferred the combination of pointing and video.

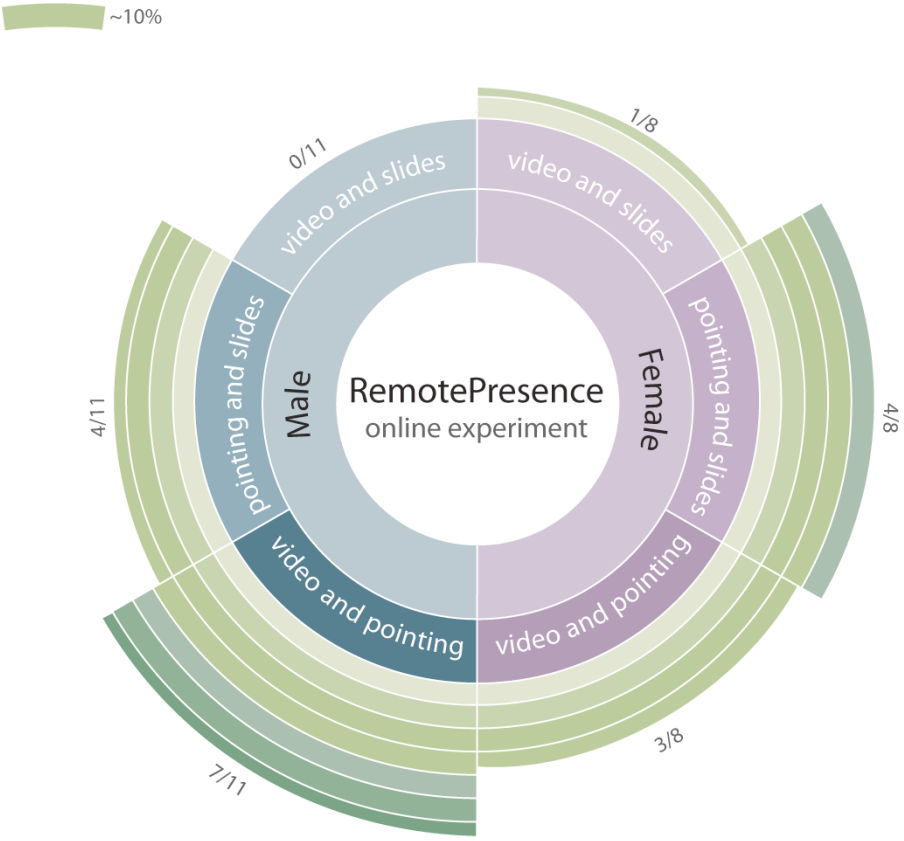


Figure 67. Online experiment results: Highest scoring elements sorted by male and female subjects.

By consulting figure 63 from previous test, 2/5 female subjects and 6/13 male subejcts mentioned that they would prefer video and pointing—even when that example was not provided in the test. We assume that taking into account their comments on the visual aspect and kinetic aspect of the virtual laser pointer, combined with a more adequate use of it in the presentation led to female subjects lower scoring and preference for the video and slides example.

Figure 68, visualizes the overall subjects preferences, i.e., their highest scoring elements. Video was clearly less scored with only 1 out of 19. Video and pointing scored the highest with 10 out of 19 while pointing come at a second closest 8 out of 19.

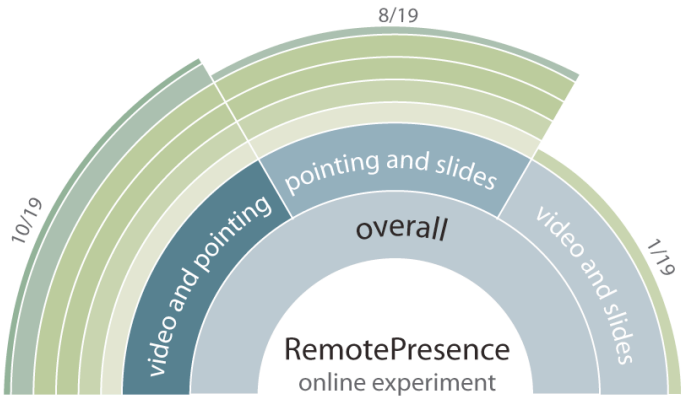


Figure 68. Overall online experiment results (highest) sorted by the three examples.

Figures 67 and 68 demonstrated the results obtained from analyzing the subjects scores, but in order to further understand what did pointing and what did video add to the presentation, a deeper look into the individual construct scoring and how they relate between elements was necessary.

First, an initial filtering of constructs was performed. Below, figure 69 demonstrated the number of undecided votes for single constructs sorted by male and female. Female subjects were more undecided in scoring the constructs that male subjects. The most undecided constructs were: Focused-Unfocused; Sequential-Concurrent; Guided-Free; While some constructs were rated very similar throughout out the elements: Professional-Amateur.
One of the issues for this amount of undecided votes, could be the very personal nature of these selected constructs. They were provided by individuals in the The Hague user study. Probably, some of the online test subjects could not relate or completely understand the constructs, even when the scoring matrix (see appendix figure 3) provided a small description of the construct.

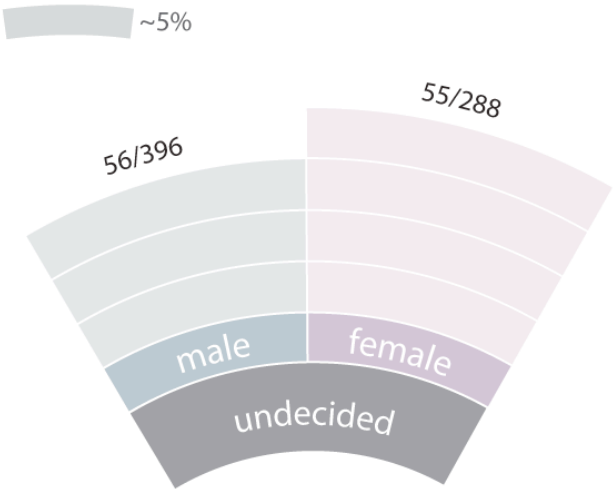


Figure 69. Amount of undecided votes of individual constructs sorted by male and female.

By filtering out the less scored constructs and focusing on the most relevant and interesting. five (positive) constructs were chosen to be further analyzed: Concentrate; Helpful; Understanding; Presence; Personal; Emotional.

Figure 70, presents the five selected construct in a diagram. Each construct belongs to an example's vertical swim-lane, the constructs are sorted top to bottom, from the highest scoring within the element to the lowest scoring construct.

The diagram allows us to easy identify that the concentrate, helpful and understanding constructs where highest for the pointing and slides example, while presence, personal and emotional scored highest for the video and slides example. Each construct has a color label attributed to him and a line. For the concentrate construct, that scored highest for pointing, scored lowest for the video example. The resulting combination of pointing and video resulted in a lower scoring constructs. This means (similar to the The Hague user study) that the video feed of the presenter next to the presentation is somewhat distracting. Similarly, helpful and understanding constructs suffered similar reductions when analyzed in the combined example. Video was identified as being distracting and less helpful in understanding the content of the presenters message.

Emotional, personal and presence constructs scored lowest in the pointing example (with some exceptions of individual high scores). When analyzing the combined example these constructs, that were the highest scoring in the video example, suffer little to no reduction in their scoring. While pointing does not add as much social presence, personal information and emotion, it does not detach that information from the presentation as video does for the other constructs.

Figure 70. The scoring of five chosen constructs, relating to each example's influence.

The small sample size of the experiment was unexpected and did not allow for the experiment to be considered a quantitative, against our initial goal. We attribute this small sample size to the online nature of the experiment and to there not being any incentive for individuals in participating.

Nevertheless, the 19 participants provided interesting results, demonstrating some consistency between user studies while identifying new findings.
Consistent with The Hague user study, male subjects preferred the video and slides example least with no male scoring it. While, the new example, the combination of video and pointing scored the highest. Pointing and slides scored 4/11 lower than the combination but much higher than the video example.
Interestingly, female subject's preferences changed. The majority of them preferred the pointing example (4/8) while the combination of video and pointing came second highest with 3/8.
The fact that only one of the 19 subjects did not prefer to have pointing tells us that pointing does help the presentations and adds sufficient meaning to become perceived and preferred by the attendees.

While video was considered distracting, less helpful, and does not contributed as much to the understanding of the presentation, pointing, did not add as many negative aspects. Pointing did not detach the addressee from the presenters emotions and presence, or add an impersonal feeling to the presentation.
Video consistently scored highest for emotion, social presence and personal feeling to the presentation. The video provides a face for the voice and gesture in the presentation. While, in which case video is more useful, e.g. in presentation where the addressees know the presenter or in presentation that addresses do not know the presenter, was not approached, pointing overcame this barrier, concentrating mainly on the content of the presentation.

We attribute the consistency of male subjects scored and the difference in female scoring between the online and the The Hague study to the refinement in the pointing cursor, movement on the cursor and its application (being used only when needed).

Pointing should be considered a helpful tool for addresses in concentrating and understanding a presentation—especially remote distributed presentations—and the combination of both aspects, pointing and video, provides the best of both worlds for some individuals. Options to disable and show each one of these modal communication tools, could be an advantage in designing for those who dislike them.

9. DESIGN ITERATIONS

This chapter focuses on the gesture, effect and design guidelines for RemotePresence. From the early sketches (see Figure 36-37), and the research spectrum map (see Figure 41), up to now the goal of the designs were to support deictic gesturing, simply and effectively, based on the researched presenter's intentions and gestures.
Figure 56, represents the latest iteration over the research spectrum. The identified region, research of interest, was defined from the left most spectrum, transient (laser pointers), up to the defined user events, user canceled and slide exposure. This spectrum from transient up to slide exposure is where RemotePresence's designs integrate. What meaningful information from deictic gesturing, and how to present that information within the defined spectrum, were the focus of the presented designs and concepts.

Figure 71, demonstrates the defined gestures for the indicative acts of directing-to and placing-for. The gestures and effects were designed from a combination of conceptualization and research, and evaluation. Evaluation determined what pointing added to a presentation and how it was helpful in guiding and directing audience's attention to the relevant content of the discourse.

The top six gestures, are representative of directing-to intentions and actions. The common ground is defined by the slides. The presenter's intent is to direct addressees attention and focus to a particular section, object of referent. The bottom three gesture are representative of placing-for indicative actions. They bring content, objects, and referents, into the common ground of the addressees attention, as changing slides, zooming in to reveal additional content, etc.

While these specific gestures were not tested with presenters, and their representative effect with audience members. We argue that these design guidelines could be used for future research and evaluation and be compared a baseline, provided by the two user studies presented before. We further assume that these designs are more representative of the presenter's intents, and should be easy to perform by them during the presentation activity.

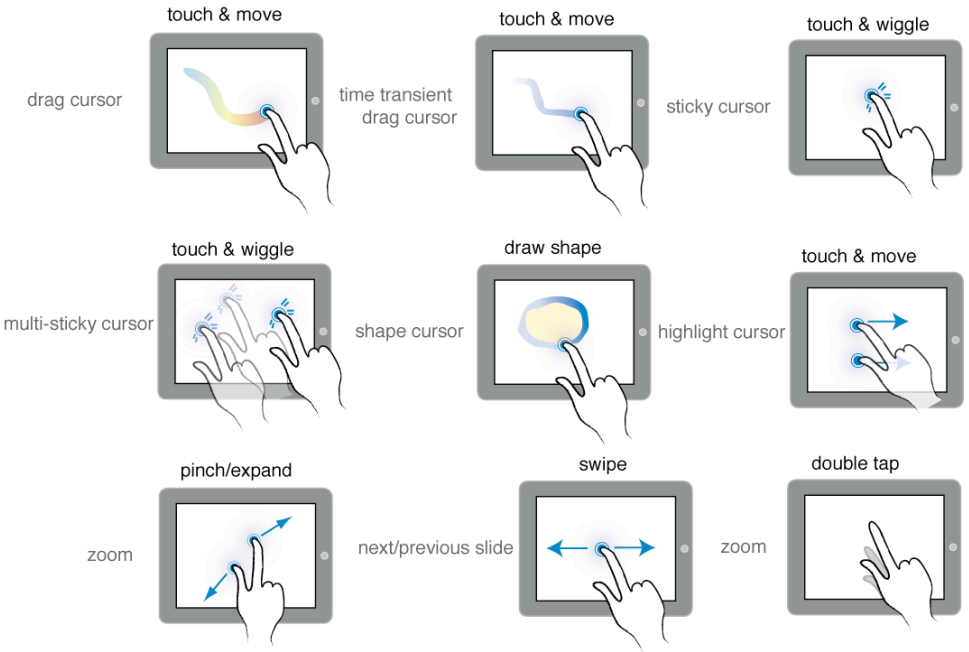


Figure 71. RemotePresence defined gestures for the indicative techniques of directing-to and placing-for.

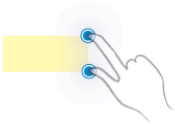
CURSOR NAME	GESTURE	DESCRIPTION	DEFINITION
touch cursor		 effect cycle	ripple effect concept: - The cursor should have a minimum duration. This will minimize the need to keep a constantly interacting with the device
drag cursor			heat surface concept: - Color provides a timeline as visual feedback to viewers - The drag effect allows for viewers to be able to visualy link different touchpoints and for late glances
sticky cursor		 no time lapse effect persistent until user canceled	fingerprint concept: - Fingerprint effect maps to the wiggle gesture - Fingerprint conveys somewhat personal and persistent nature
multi-sticky cursor		 different colors allow referencing specific cursors instead of content	
shape cursor		 highlight tool persistent until user canceled	circular gesture: - Second most used deictic gesture observed in presentations - Circular gesture with variable diameter (depending on granularity) to indicate a group of object or a region
region cursor		 transient region focus	
highlight cursor		 two-finger rectangle highlight	highlight box concept: - The cursor takes on a rectangle shape - Better to highlight text and bullet points
contextual radial menu		 long tap brings up a contextual menu that the user then may choose other cursor designs	contextual radial menu: - Allows for the user to choose differente multi-sticky cursor representations - E.g., color vs. numeric tag

Figure 72. RemotePresence design guidelines relating defined effects to associated effects.

Figure 72, maps the gesture with the description of the effect. An abstract meaning or intent for the gesture is located to the right column. The effects themselves could be used to transmit extra information along with the gesture, e.g, the fingerprint could convey a personal, somewhat persistent meaning to its representation, while a water ripple effect is somewhat transient in nature and represents an epicenter-like event.

9.1. Metadata aggregator and gestures

Bell Labs hold events every so months called technical demonstrators. These events showcase their concepts, ideas and prototypes to other stakeholders and as project updates to higher Bell Labs management. For one of these technical demonstrators, RemotePresence's iPad prototype application was to be integrated Bell Labs SlideWorld project, as a proof of concept and showcase of the gesturing feature, along side Bell Lab's technology.

A scenario for the technical demonstrator was designed to perform a presentation using the iPad and with its multi-touch affordances, integrate deictic gesturing within SlideWorld.

Due to the very limited amount of time for the integration of RemotePresence and SlideWorld for the technical Demonstrator to be hold at France, a hack-like solution was implemented that involved sending messages (events) to a metadata aggregator that then, streamed the information to a video mixer where the gestures were layered on to the presentation as SVG image, and displayed as a RTMP (Real Time Messaging Protocol) stream in a web browser. While most of the technology was available for SlideWorld, the metadata aggregator was not prepared to receive any sort of events from the iPad. New rules were created in the metadata aggregator by Wolfgang Van Raemdonck, that would recognize the HTTP Post messages being pushed by the iPad RemotePresence applications. Furthermore, for the video mixer a SVG module was implemented in order to display the pointing cursors over the slides. The final step consists on merged all the feeds into a single RTMP video stream to be displayed on a web-browser.
Implementation on the RemotePresence prototype consisted on defining messages that would be sent to an URL on particular events. The metadata aggregator then, would compare the message to a defined rule and then perform the associated actions—being changing slides, displaying a cursor at x, y, etc.

Not all the gestures and effects were implemented in the prototype.

- Sticky cursor

Bellow, an example message for the wiggle gesture, the sticky cursor. The URL to where the messages would be sent was defined upon the user turning a "switch on" in the interface, thus activating the send-to-metadata-aggregator feature.

```
NSMutableURLRequest *metadataAggregator = [NSMutableURLRequest requestWithURL:
  [NSURL URLWithString:@"http://imm5.research.bell-labs.com:10015/aggregator/info/add"]
                                cachePolicy: NSURLRequestReloadIgnoringCacheData
                                    timeoutInterval: 60.0];
```

While the bellow message is specific to the sticky cursor event, they all followed a similar structure.

```
NSString *message = [[NSString alloc] initWithFormat:
                        @"{streamId: foo, uri: /metadata/stream/presenter/cursor, cursor: fingerprint, location:
{relx: %d, rely: %d}, timestamp: 0}", coordX, coordY];
[pointingView sendDataToMetadataAggregator: message];
```

Gesture:
The user touches the multi-touch screen at the position he would like to point at.

By keeping his finger touching the screen and wiggling it side to side (as if applying a fingerprint) is detected and a sticky pointer is drawn at x, y position.
The user may lift his finger off the screen and the sticky pointer will remain there until canceled, redrawn (somewhere else) or on next the slide event.

Intent:
Literature identified that the forth phase of deictic pointing gestures conveyed the most information. The longer an individual points at something, the more information he conveys to viewers that what he points at is important, as also viewers that did not immediately look at where he is pointing, still have the opportunity to identify what the performer of the gesture is pointing at.

During a presentation the presenter may find the need to refer multiple time to the same referent. The sticky cursor allows just that.

Effect / visual representation:
As a possible effect, a semi-translucent fingerprint could be applied for this intention, conveys persistency and personal nature—its the presenter's fingerprint, "unique".

Effect life span: until user cancels or slide exposure.

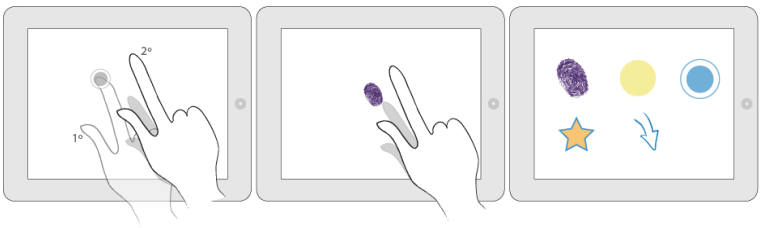


Figure 73. Sticky cursor representation

- Multi-sticky cursor

Gesture:
The user reuses the wiggle gesture. He touches a location for a certain amount of time, then quickly touches another, several times. After the first sticky cursor appears, if the presenter (within a time interval) does other holding pointing gestures for each gestures a sticky pointers will be appended—instead of the one that is reused. The user may clear all of his sticky pointers with a vertical swipe, or on next slide event be automatically cleared.

Intent:
The intent is similar to the holding pointing gesture described above, but here now the user has the opportunity to reference multiple distributed objects throughout the slide canvas. This allows the presenter to without direct interaction, enumerate cursors and create stories between them, and later reference each individual sticky cursor.
For the viewer this may convey the information or meaning that these sticky cursors are related is some way—to be described vocally by the presenter. By tagging the sticky cursors the viewers may easily and more effectively locate the appropriated or references cursor (content).

Effect / visual representation:
The possibility to enumerate each cursor alphanumerically or with different colors allow the presenter to reference his individual references without any other interacting—touching or looking at the screen.
Different cursors may be chosen depending on presenter preference, on content visualization, or dependent on activity.

Effect life span: until user cancels or slide exposure.

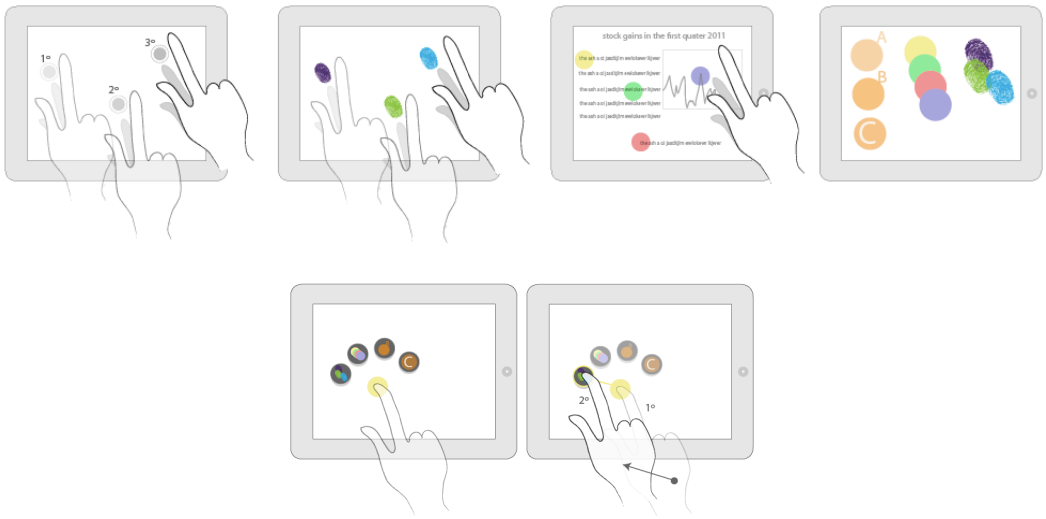


Figure 74. Multiple Sticky cursor representation and contextual menu

- Drag cursor

Gesture:
Striving to bridge humans natural pointing gestures to its digital representations will always be a challenge. Supporting this quick, dynamic pointing gestures on a multi-touch device requires a constant contact with the screen while moving the finger.
The user touches the screen triggers drawing a pointing cursor that follows his finger throughout the screen leaving behind a history (drag effect) of the previous path. When the users finger is lifted from the screen the cursor and trail will begin to fade out.

Intent:
Represents directing attention with movement. By moving the cursor (pointing at different things) a chain of thought might be visible to whomever is viewing, possibly aiding them in the their understanding. The drag cursor (history cursor) could be used for addresses that where not at the moment following the presenters gestures, thus being displayed a small gesture history could enhance coherence.

Effect / visual representation:
An ellipse with a drag effect could be the cursor representation. The cursor's drag effect has a different color associated to the amount of time that the gesture was performed. Similar concept to a heat surface gestures that are "older" appear as blue streaks, while recent ones as red streaks (hotter, more recent).

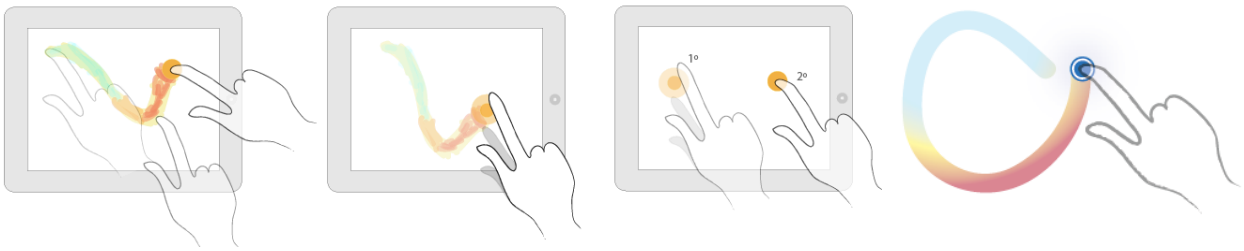


Figure 75. Drag cursor representation

- Touch cursor

Gesture:
The user touches (tap) the screen triggers drawing a pointing cursor on location. When the users finger is lifted from the screen the cursor will begin to fade out.

Intent:
Simple draw of attention to a static location. The presenter taps the location and a pointing cursor appears, remains for a certain amount of time then, fades out. This delay in disappearing could help late glancers recognize and identify the referent.

Effect / visual representation:
An ellipse with a ripple effect could be the cursor representation. The fading effect allows for "late glancers" to be able to still catch a glimpse of where the presenter was pointing to, thus not completely loosing the event.

Figure 76. Touch cursor representation

- Region cursor

Gesture:
A circular or elliptical gesture surrounding an area with content or objects. The shape should close it's self and not be repeated. In the end the users finger should lift to end the gesture.

Intent:
Represents grouping of information. What the presenter or speaker is discussion about is related to that group of objects or content. They are related and equally important in his discussion at that moment. A typical gesture to centralize audience gaze and attention focus to a collection or region of visible information.

Effect / visual representation:
Depending on the gesture the shape and representation might vary. But an area "border" should help addresses focus attention with the area indicated of the content it surrounds.

Figure 77. Region cursor representation

- Shape cursor

Gesture:
A circular or elliptical gesture surrounding an area with content or objects. The shape should close it's self and be repeated at least once more. In the end the users finger should lift to end the gesture.

Intent:
Represents grouping of information. What the presenter or speaker is discussion about is related to that group of objects or content. They are related and equally important in his discussion at that moment. A typical gesture to centralize audience gaze and attention focus to a collection or region of visible information.

Effect / visual representation:
Depending on the gesture the representation might vary. The shape is then filled with a semi-transparent light color. This effect has a longer persistency that the region cursor.

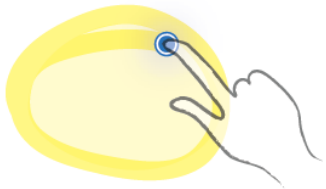


Figure 78. Shape cursor representation

- Highlight cursor

Gesture:
Two fingers positioned vertically are then swiped across the area that the user would like to highlight.

Intent:
Highlighting text. Help viewers focus on the relevant content in a text heavy slide or environment.

Effect / visual representation:
To group a collection of bullet points a rectangular regional representation could be more appropriate than a circular one.

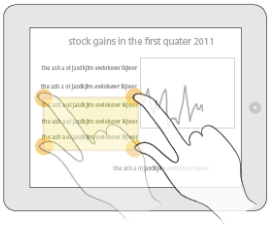


Figure 79. Highlight cursor representation

Navigation events:

- Next and previous slide, zoom in/out and panning

Gesture:
Standardized swipe, pinch or double tap, and tap and move.

Intent:
Placing-for intents. Placing new content (slides), zooming in to reveal more details and information, panning to progressively show/hide content and objects.

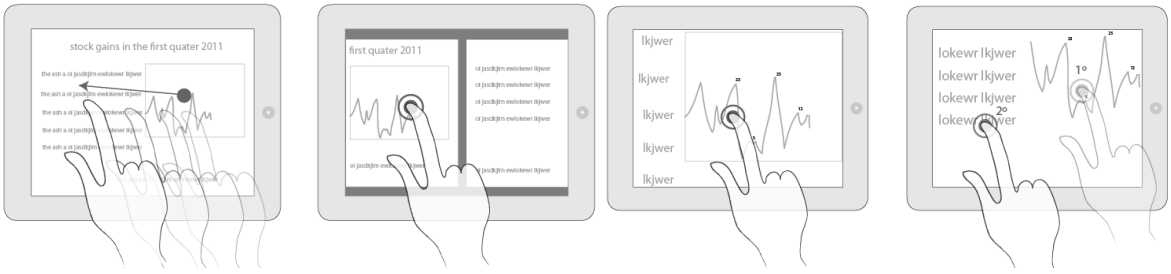


Figure 80. "Standard" gestures for changing slides (swipe), zooming (pinch), and panning.

9.2. Conclusion

While the previously presented RemotePresence cursors went untested, integration with SlideWorld was extremely interesting and was the first taste of RemotePresence in its research context. Due to some limiting technical issues and limitation of the first test integrations, the lag from the iPad to the browser was notable (seconds), sometimes reported up to 1minute in the France Bell Labs technical demonstrator test, feedback was positive and the concept well received. We understand that the increased lag was due to the location of the metadata server and video mixers, and that sending HTTP Post messages from the iPad to the metadata aggregator, introduced lag and jitter. Another identified issue was the different mapping of the cursor on the iPad and the mixer—resolved in a second quick iteration. The absolute coordinate value from the iPad did not mach the coordinate position in the mixer, a simple relative positioning conversion resolved this issue.

The designed cursors serve as guidelines for future researchers looking into supporting deictic gestures within remote presentation settings. From the user studies performed, it is possible to identify that it is extremely important to provide the right amount of information, at the right time. While the drag effect was considered distracting for those whom were focused and following the presentation attentively, we argue that in remote presentation settings, it is possible that addressees could be multi-tasking (consistent with Bell Labs Hypermedia, France's research), thus possible not viewing the presentation. In this scenario, the drag effect could provide the necessary information to the addressee when he returns to see the presentation—perhaps due to some audio clue from the presenter, a deictic expression used, or the addressee did not understand the presenter's chain of thought.

Overall, the involved parties were pleased with the integration and the possibilities that it affords to their SlideWorld project. The designed cursors were featured within SlideWorld at Bell Labs Open Days, October 2011.

10. DISCUSSION

In this thesis we explored, evaluated, and demonstrated the usefulness of a tool for supporting deictic gestures in remote presentation settings, through handheld multi-touch devices.
Initial designs were ideated and conceptualized, but early on the need for a deeper and more comprehensive understanding of the theory and psychology behind this topic was felt. A continuous iteration over literature review, in field observations, and state-of-the-art, helped refine the research spectrum and project context as well as understand how to design user experiments.

State-of-the-art identified some of common problems with accuracy and unsteadiness when using absolute pointing devices as physical laser pointers. Furthermore, an important issue arose from this state-of-the-art study. Physical laser pointers convey minimal bandwidth for the expression of gestural information.
A direct tapping interface was identified as preferable for indicative pointing [19] and should address some (if not all) of the common laser pointer interaction issues. More so, cursors (pointer representations) should display a minimum persistency of 1.4 to 3 seconds in order for viewers to acquire the cursor and relate the referent to the presenters utterances

User testing performed on the iPad helped understand that the connection between intents and the performed gesture were somewhat consistent among the test subjects. Pointing and indicating took two forms: touching the content to be pointed at versus circling the content. More generalized intents such as relating two previous indicative gestures depended on personal preferences, but gesturing a line was the most common.

Before testing the RemotePresence design cursors, a baseline was needed. Two user studies were performed to answer the question “does pointing add anything meaningful to a presentation?” A qualitative user study performed in The Hague demonstrated that male and female test subjects respond quite differently to the pointing. While male subjects preferred the presentation form that utilized the pointing, female subjects preferred the presentation form that included the video of the presenter, commenting on how it was possible to view the presenter’s emotions and connect a face to the voice being heard. Male subjects were more interested in the content than the presenter. They commented on how the presenter helped guide their attention to the interesting content of the presentation. During the post semi-structured interview, a majority of female subjects recognized the relevance of pointing, but commented on how it should be used when the content becomes too complex, complicated or cluttered, otherwise it is distracting.
After considering the comments of the subjects, a new user study was devised in the form of a quantitative user study, but unfortunately due to the sample size of only 19 subjects the findings cannot be quantified. For this experiment, refinements were made to the videos and the pointing effect. Shorter videos and a cleaner cursor designed with more natural touch screen movements provided a much more natural feel to the presentation. From the three examples provided, pointing and slides, video and slides, and the combination of pointing with video, the combination scored the highest with pointing at a close second place. Both user experiments demonstrate how pointing does add meaning to a presentation; now it was possible to confirm and identify what that meaning it. An ability to concentrate, helpful, understanding, and some elements of social presence and personal touch—consistent with other research papers. It seems that pointing is more helpful to the understanding of the presentation than the video of the presenter. The studies show that individuals consider the video to be distracting.

The positive results from the two user studies motivate us more in pursuing the research. If the most basic gestures and effect (virtual laser pointer) are so helpful, perhaps our RemotePresence designed cursors and gestures are able to be even more helpful by eliminating the need for a video feed of the presenter, thus minimizing the bandwidth needed for such remote presentations.

The integration of the iPad prototype with Bell Lab's SlideWorld project was interesting. This provided us with the opportunity to experiment with the concept of RemotePresence in a real setting. Although some technical limitations did influence the overall experience, it provided the necessary motivation to continue and further research and test the concept gestures and designs.

11. FUTURE WORK

Much research can still be performed within the current RemotePresence research context. We learnt that even the most basic of pointing gestures and visualization is helpful within remote presentation settings. Further user studies on the designed cursor effects that best represent the presenter's intention and audience's interpretation can be performed and compared to the already existing baseline studies.

More specific user studies can be performed for each of the 'nodes' in the theoretical framework and the transitions between them, leading to a final comparison of the presenter's intent and audience's interpretation.
Implementation of RemotePresence's designed gestures and cursors in a presentation tool should be the next step for performing additional user studies. While the studies performed focused mainly on the audience members, more specific and specialized studies need to be performed for the presenter.

Other concepts were ideated during this project that are interesting to pursue as individual topics or as an integral part of a continued RemotePresence research project.

11.1. Context and semantic aware pointer

Our current system of conveying pointing remotely does not know what is being pointing at. The presenter touches the screen at a location, the system recognizes gesture and the x, y coordinates and then draws the appropriate effect both locally and remotely.
The context aware pointer would allow the presenter to point at an element within the slide (content) and have an additional action be performed. E.g., Pointing at an already sufficiently large piece of text could highlight that text but pointing at a small excel sheet cell could additionally zoom in.

11.2. Adaptive pointing

Feedback and findings from the performed user studies provided information on how the drag effect for representing the movement in gestures was distracting. The concept behind the drag effect (heat surface) was to provide late glancers the information of previously indicated content and the currently indicated content. If the addressees are continuously following the presentation the drag effect is an unnecessary information.

The pilot Repertory Grid experiment brought some interesting comments such as "I would like to choose when to see the pointing".
Adaptive pointing, is a visual feedback technique based on face detection, eye gaze detection, and active desktop application, to toggle between the adequate pointing effects.
When the system detects that an addressee is not "looking" or "following" the presentation, the drag cursor would be triggered (if any pointing gestures were performed) and later be replaced by the transient less intrusive cursor after the addressee focuses on the presentation —the drag cursor wears out once the addressees attention is back (looking at the presentation).

This balance between providing too much information, when not needed, is a new challenge. The designed tool should provide the right amount of information at the right time.

12. CONCLUSION

The pre-study phase, helped understand and define the project setting for RemotePresence and allowed for a broader research into popular tele-conferencing, communication, collaborative applications, thus making it possible to identify some key aspects that users appreciate and value. This phase afforded exploration of possible research areas within these CSCW tools. Lack of interactivity, between users and with the interface were two of the main issued that could be addressed.
The pre-study phase allowed for a more profound understanding of the scenarios, user roles, activities and tasks performed within the one-to-many and many-to-many scenarios part of SlideWorld.

A second internship at Bell Labs, Belgium, allowed to continue research from the pre-study phase. Further research and discussions led to identifying that current remote presentation tools do not capture the presenters or audience members gesturing and that tools that did support the "pointing" gesture were done by mouse cursors and laser pointers. Research showed that they have minimal informational expressiveness and do make justice to the gestures performed in human communication.

The freedom provided at Bell Labs to perform the research led to a methodology and project approach somewhat different than the Human-Computer Interaction methodology—initially being followed. A prototype was implemented in an early stage of the project, this helped convey the objective of the project to others and further specify the research context and scenario. This approach was interesting due to the fact that the project ended up very differently from what was ideated in the beginning of its lifespan; now, looking back, it all makes sense.

A theoretical framework and research spectrum were designed and proposed, this allowed for a deeper understanding of pointing in remote presentations and the relationships between each research "touchpoint."

Two user studies, one qualitative the other quantitative, allowed for testing of the most basic of pointing effects, the virtual laser pointer.
Findings showed that pointing is helpful in understanding and concentrating during the presentation. When pointing was combined with the detached video feed of the presenter and the slides, the positive aspects of pointing were noticeable, unfortunately some of the negative aspects of video, such as being distracting and confusing, were also present. Video excels at conveying emotion and presenter presence and is experienced as being more personal.

While RemotePresence's designed cursors went untested, Bell Lab's Visual Communication department is implementing the design guidelines from RemotePresence and are using the research to their advantage in integrating with SlideWorld.

Overall the internship at Bell Labs was great and allowed for the development of an interesting research project.

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Appendix

TABLE-OF-CONTENTS

1. Pre-study phase

1.1. Persona

Demographics, background, education and current occupancy

Bert is a 35-year-old research engineer that lives on the outskirts of Antwerp. Bert has a computer engineering background and he loves everything about computers. He is fascinated how fast technology is evolving so when he was given the opportunity to work at a big company as a senior researcher he accepted straight away.

Day in the life

Bert goes to work 5 days a week but in his mind he has never left the office. He is currently working on a couple of projects but there is one that really stands out; he thinks it might be the new big thing so he is excited about working on it.

Work detail, meetings and presentations

As a senior researcher, around twice a week Bert attends some project progress and administrative presentation meetings. Bert likes hearing about what others are doing in some detail and presentations that explore a more technical approach is what he likes the most. Bert enjoys learning anything new as techniques and technologies that he may implement in his projects. Bert likes these small meeting-like presentations – they afford more interaction between participants than larger presentations. Bert likes discussing with his colleagues getting feedback and giving feedback about the content of the presentation.

Bert gives a presentation about his research every 6 weeks. He is fairly confident and does not get nervous when he presents. He normally knows the audience and it's more about project/ research progress or technical presentations what he shares with co-workers to bring everyone on the same pace. Bert uses his work laptop and PowerPoint software to help him present. It is a fairly simple setup that for him works well. He tries to makes his presentations look nice with little text and more images. It just takes more time and effort but they are more engaging and illustrate better what he is discussing.

To Bert pretty slides are just not enough so he insists on focusing on interaction with his audience when he presents. Bert motivates discussions in small meeting like presentations that he thinks are being more engaging for audience and a good way to get feedback and ideas.

Family

Bert is married and has two boys. Bert is constantly busy with work, he is always thinking about his projects. Bert strives to be efficient, managing family and work life.

Goals

Bert's main goal is to work on a big project and help make it successful by employing some new technology he is currently developing.

1.2.Scenarios

Based on the persona of Bert these initial scenarios were created to illustrate the existing usage of the available resources:

Name: One to many – Audience located remotely and individually
Description:
It is a normal day for Bert, he drops off the kids and goes to work. He arrives a bit late so he quickly speaks to some colleagues and then sits at his desk to start programming. Bert in "programming mode" does not like to be disturbed so when he receives an email reminding him of his weekly remote presentation with Jessica, head of User Experience Group of the US office he is not so enthusiastic. Bert is not looking forward to this presentation, it is normally boring and packed with text and he would prefer to keep on working.

Bert goes to a meeting room where he can be alone and opens his laptop. Bert connects to Jessica via NetMeeting by introducing her IP address that Jessica shared via email to all the attendees. It's a general presentation for the whole department. Bert expects the setup to take up some time, the more people the harder it is to organize. Jessica shares her video feed as well as her slides and when everyone is connected she asks if she can begin. It makes her feel uncertain beginning these presentations with little feedback. She cannot see all the audience members and if they are interested in the presentation. She would prefer to have a more interactive presentation but it is not achievable with the current tools available.

Bert tries to arrange the two feeds (slides and video) on his laptop display in way he can see them both at the same time, but one comes at the other's cost.

During the presentation Bert sees the slides being shared and controlled by Jessica. Bert tries to focus more on Jessica but the window is small and quality is not great so he just looks at the text packed slides about the projects user evaluation. Burt now is interested, Jessica is going to present the user evaluation results of technology he has been working on. Bert is very enthusiastic about what he hears and he would like to ask a question about the results but he doesn't find an appropriate moment to make an interruption.

Later during the presentation, Bert gets distracted with other things, he has just received an email from a long time friend, David. Bert wants to tell Peter who is also attending this presentation but in France that David their mutual friend has sent an email. Bert does not want to interrupt the presentation with an off topic dialog so he opens another application and sends a text message to Peter.

Peter's attention gets diverted to another window on his desktop that just appeared in front of Jessica's shared slides, it's a message from Bert mentioning David. By now Bert and Peter are engaged in their chat and are not paying attention to Jessica's presentation.

Name: Many to many – Meeting room to meeting room with one active presenter
Description:
It is the end of the month, time for the monthly meeting between the two company's offices. Bert and co-workers go to a scheduled meeting room and sit around the table in a U setup with the presentation slides in front of the table and the TV screen with the remote presenter and audience shown. Bert's superior is going to give a presentation update to the other Research Director in America. They start by sharing the slides and camera feeds. The setup this time runs smooth and the slides are being projected on the wall and the remote feed is being displayed in the dedicated TV.

Bert carries around a small paper notebook where he scribbles some notes or ideas that he normally has in these presentations. The meeting begins, presenters adjust the cameras and one goes first with his presentation. Bert hears something interesting about a topic a colleague that is not present is working on so takes a note of the slide number and then will send the slide to him when he has the slides available.

It's Bert's time to present some material, John, a colleague pans the camera to Bert as he start his presentation with some slides he quickly put together. While presenting Bert notices that it's really silent on the remote location and asks if all is OK, people on the other side say "yes, all is ok", so he continues.

Bert really dislikes the lack of feedback he gets from the remote side, he does not know how they are reacting to his presentation but Bert is a confident person and just speaks and gestures naturally towards the local audience and to the "TV".

At the end of the presentations a discussion session starts where people share opinions and feedback. Some audience members go through notes and ask the driver (person who controls the slides) to go back some slides for them to point out something. Discussion between audience members is minimal.

1.3. User Profiles

Technical facilitator

Activity: Person in charge of setting up the collocated meeting as well the connection and feeds with other remote participants. Setup can consist of sharing files, displaying presentation onto projection screen, setup video conferencing system with remote participants, and setting up any/other devices needed and/or included in the meeting space.

Background: An individual with a technical background and experienced within the context and devices located in these meeting rooms.

Place/Time: Takes place in a dedicated meeting or video-conferencing room just before and during the meeting.

Participation: Before the meeting starts he sets up the devices and feeds to minimize time consumption of the meeting. During the meeting the technical facilitator may interact with the system by request—some one needs access to some device or someone needs to display some information via a device—or by self interest—adjusting sound levels, camera panning.

Characteristics/Performance: Every meeting or video-conferencing meeting, the devices will require some sort of setup or management of information feeds to them. As the Technical Facilitator the intensity of interaction will be highest at the start of the meeting, then ease out as the meeting continues. As the Technical Facilitator he is requested to show or control information from the different feeds that he has access to.

Product Design Implications: Simple and intuitive setup of the devices and centralized access to information.

Participant:

Collocated

Activity: Invited by the Chairperson to attend, contribute, and collaborate in the meeting with collocated colleagues on a number of given topics. Will be assigned tasks within the group activity by the Chairperson.

Background: An individual with a background in the domain of the discussed topic and familiar with the devices located within the meeting context.

Place/Time: Might prepare material before the meeting for personal usage, presenting or to share with other colleagues. Collaborates and contributes during the meeting at location working closely with colleagues for the meeting goal.

Participation: The collocated participants collaborate and contribute to the meeting with and through a variety of devices. They use these devices as tools to support decision-making meetings, project updates, informative and corporate meetings. They are highly interactive between themselves and work for the overall outcome of the meeting. The topic will be set by the Chairperson as the distribution of tasks throughout the participants, thus participants know what is needed for the decision making process as well as who will be doing what.

Characteristics/Performance: Collocated Participants will attend meetings/presentations around twice a week. They need to manage somewhat large amounts of information (that they prepared or been shared with them).

Product Design Implications: System should support sharing and collaborative work within the collocated space. Ease of interaction between participants at the table and tools for collaborative work such as: Annotations, sketch, text editing, sharing, and control of information flow. A seamless transitioning between tasks and activities needs to be supported efficiently.

Remotely collocated

Activity: Team spirited person that likes to discuss topics in groups. He is confident and enjoys presenting his work, showing and hopefully informing his colleagues something new that contributed to the overall meeting topic. Inform remote colleagues of progress, updates, etc related to the overall context of the meeting.

Background: An individual with a background in the domain of the discussed topic and familiar with the devices located within the meeting context.

Place/Time: Might prepare material before the meeting for personal usage, presenting or to share with other colleagues. Collaborates and contributes during the meeting at location working closely with collocated colleagues for the meeting goal and communicating with remote colleagues.

Participation: The collocated participants collaborate and contribute to the meeting with and through a variety of devices. They use these devices as tools to support decision-making meetings, project updates, informative and corporate meetings. They are highly interactive between themselves and work for the overall outcome of the meeting. They discuss and collaborate with remote colleagues informing them on project updates, work together on the same projects or parts of them. Depending on the assigned tasks they collaborate and communicate more or less with designated groups of colleagues (remote or local).

Characteristics/Performance: Remotely Collocated Participants will remote attend meetings/presentations less frequently then local meetings/presentation. They need to manage somewhat large amounts of information (that they prepared or been shared with them) as well as the connection between locations and synchronization of information.

Product Design Implications: System should support sharing and collaborative work within the collocated space. Ease of interaction between participants at the table and tools for collaborative work such as: Annotations, sketch, text editing, sharing, and control of information flow. The system should provide an easy way of communicating with the remote party, supporting sharing and synchronous communication as well as tools to support collaborative work between the two remote teams.

Isolated

Activity: Invited by the chairperson to attend, contribute, and collaborate in the meeting with remote colleagues.

Background: An individual with a background in the domain of the discussed topic and familiar with the devices located within the meeting context. Due to certain circumstances he cannot attend the meeting physically. He is familiar with tools that allow him to interact and communicate remotely with colleagues.

Place/Time: Might prepare material before the meeting for personal usage, presenting or to share with other colleagues. Connects to the meeting remotely to join in contributing to the discussion.

Participation: The isolated participants connect to the meeting via a variety of devices and tools that permit remote conversations and file sharing. They will participate in discussions and share their point of view with remote colleagues. If they have material to share they would do it via email to the chairperson. When possible they will actively participate in the meeting by collaborating with remote colleagues.

Characteristics/Performance: Isolated Participants can frequently attend meetings/ presentations. They need to connect to the remote location and manage somewhat large amounts of information (that they prepared or that has been shared with them). They may not attend the total duration of the meeting and may even not consider the meeting as their primal focus of attention.

Product Design Implications: Flexible and versatile system that could provide the isolated participant with closely the same functionalities and sense of immersive in the meeting as the collocated colleagues. Communication, situational awareness and sharing should be supported by the system to facilitate the isolated participants interaction. A collaborative tool, should afford the Isolated Participants with the possibility to engage in group activities, and tasks (e.g. designing an system architecture). Ideally they should be able to contribute and collaborate with all the participants.

Reader

Activity: Reviews the content generated during the meeting in the follow up phase. The reader could be a superior (in the companies hierarchy), an external consultant, customers, etc. They can analyze, review, edit, and organize all the information.

Background: Experienced individual in the domain of the meeting topic. He is familiar to the technologies that afford this remote access to large amounts of information.

Place/Time: The Reader role appears after the meeting (during follow up phase).

Participation: The reader does not actively participate in the meeting or contributing with material. He will review the information generated afterwards, he might be the chairperson reviewing material for next meeting, and external consultant reviewing information, the participants in the meeting that need to review some information, etc.

Characteristics/Performance: Depending on the importance of the meeting or topic the frequency of this role can be influenced. Large volume of information can be accessed (depending on quantity of information generated) but should be localized.

Product Design Implications: System should centralize information (e.g. documents, notes, information), ease access, and be cross device and platform.

Secretary

Activity: Responsible for collecting and archiving all the discussed and shared information during the meeting. After the meeting the Secretary organizes the information, files, and other relevant material and shares it with interested participants (reader).

Background: An individual experienced in managing and organizing large amounts of information. He is familiar with the technology to perform his activity and share the information with colleagues.

Place/Time: During the meeting the Secretary collects information. After the meeting he organizes it and shares it to all the participants.

Participation: During the meeting the Secretary identifies the most important and interesting information being discussed and shared, takes notes and saves them for later sharing. Later on he organizes it all into a document or a meeting folder and shares it with invited participants.

Characteristics/Performance: The Secretary role can be attributed randomly to a Participant. The Secretary role can last longer than the meeting. The Secretary needs to manage a large volume of information related to the meeting's topic (or even off topic information) and managing information flow and identifying important excerpts that should be shared with participants.

Product Design Implications: Build in text editor and simple, fast way of recording discussions and retrieving information (documents). The system should support an easy way of organizing all the information and sharing it to a global repository or central information.

1.4. Ideal Scenario

It is the last Monday of the month, time for Derek—Bert's boss—to organize the monthly meeting with presentation for the department's sister branch in the USA on project updates and to help synchronize their team efforts.

Derek accesses SlideWorld's online platform. It is a groupware application with a twist. He enters with his credentials, and accesses the "new meeting" page. Here, he visualizes his and his department's schedules for the best time to have the meeting. He finds an opening Wednesday at 10am, and there is a VC room available, so he books it. Derek sets the meeting's topic and shares some interesting documents he would like fellow colleagues to read before the meeting so everyone is on the same page. He invites people from the department and some external collaborators easily from the list of available or most invited people.

Bert shortly after receives a popup informing him that Derek has invited him to a meeting to be held Wednesday 10am. Bert clicks on the popup and is taken to the meeting's page. In the meeting page he views the meeting topic as well as the shared files, latest updates, a meeting blog, invited participants and a VC/chat room. Bert finds the topic interesting since he has done some work in that area. Bert is exited to present what he has been working on and leaves Derek a message asking him if he should present his material.

Derek receives a notification as a popup on his desktop, he clicks on it and views Bert's entire message, he notices that Bert is online in the SlideWorld platform and starts a chat with him, they discuss the best way to approach the presentation and share some impressions on how to approach the topic Wednesday.

Later that day, Bert starts creating the presentation slides and a short demo of his work using tools he is most comfortable with. By Tuesday, Bert has finished organizing his presentation for the meeting. He uploads it to SideWorld's meeting's repository. Other participants that access the meeting area on SlideWorld can view that Bert has added some new files. They are marked as important, so they view it.

Rita, Bert's most creative colleague comments on the uploaded files, especially the presentation and asks Bert if she can edit some things on it, to make it more appealing.

Bert invites Rita for a Video Chat. Rita is at home, sitting at a nice new desk she bought for the lounge. The kids are running around the room so she selects the background extraction with blur to diminish the movement behind her, keeping Bert's attention on her. Derek comes online and Bert invites him to the Video Chat, by this time there are 3 Video Feeds, but SlideWorld can manage attention demand and focus by emphasizing on who is speaking, creating a more natural communication.

The online meeting went well, they are prepared for Wednesday, by the same time their remote colleagues also start sharing some material on their project progress, Bert reads some of the shared material, impressed, he takes notes of some comments he would like to make tomorrow during the meeting about what Tom (USA colleague) shared. He keeps his notes in his personal area within the meeting page.

Wednesday, 9am Bert and John arrive from their coffee break, and then access SlideWorld to view if any significant changes have been done to any content, John realizes that he has been voted by colleagues as the Technical Facilitator for the meeting.

It's now 10am, Bert, John and other colleagues go the meeting room 1.a. John knows that he needs to setup the devices and connection with USA colleagues quickly so not take up too much meeting time.

While Bert chooses a place to sit at the table, John takes hold of the iPad on the table and access the meeting room in SlideWorld with his login. He goes into setup mode and quickly can send media (documents, website, video, presentation) feeds to the projector. He just needs to select the files from the meeting's repository and drag it onto the desired device.

The rest of the participants arrive at the meeting room. They all take a seat at the table. Some participants bring their personal laptops/tablets others their iPads, and some nothing.

The meeting starts and material is shared to the smart table. Derek sits next to Bert who with his iPad shares his presentation to the table. Derek and Bert go through the presentation and make some quick personal notes.

Other colleagues bring paper notes taken before the meeting and lay them down on the table and share them with colleagues.

Colleagues who have the iPad can have an overview of the material being shared or displayed on the table and can interact with them within the context of the iPad application (no spatial manipulation on the table via iPad). They can view files, edit, annotate, share, the files they have access to.

Ellen is late. Bert gets a message from SlideWorld from her saying that she is late and still on the train, but that she will still join in the meeting from her iPhone. Ellen was supposed to introduce the meeting. She connects to SlideWorld, enters the meeting room and opens the presentation, sharing her video feed and when all are ready she starts to present.

John now drags the presentation file to the projector, and her video feed as well, the system manages the two feeds so that when Ellen is discussing something important she is the focus, and if the slides have the most relevant information or require more attention they are the focus. By using simple keywords Ellen can control how the presentation should be presented. At one point during her presentation she mentions, "if you can see the bottom of the slide" and SlideWorld then magnifies that part. When Ellen points at something on the presentation

on her iPhone a shadow appears on all the other versions of her presentation that are synchronized helping colleagues keep track of were she is.

Derek, informs that at 11:00am the USA colleagues would join into the meeting.
11am the remote colleagues start joining the SlideWorld meeting room, new documents start to appear in the meeting repository as well as on the table and subsequent iPads and laptops connected to SlideWorld.
John drags the main camera feeds from the USA colleagues to the projection screen (or TV) and they start to see their colleagues around the table and that they also have some content on their table.

It's Bert's time to present some material now, all the participants have access to his presentation and have the option to synchronize the slides with him or not. Bert uses his iPad to present, it is easier for him to point and control the presentation with that device. John would find it interesting to know the background of the remote colleagues so he selects the option to visualize that information, mapped to the people around the table on the camera feed, with their names also.
Bert and collocated colleagues notice that the majority of their USA colleagues are programmers and two are HCI researchers and one a research director.

While Bert is presenting, a remote colleague remembers seeing something interesting in a research web article, he accesses the webpage through his iPad and with a click shares it to the tables. He points at the shared frame on his table and his representation of the frame and pointing—arms and hands—are mapped to Bert's table allowing them to manipulate frame position, duplicates and view the content. Bert looks at the content shared on the table, then at the projection screen—were the remote video feed is being show—to see which colleague is sharing the document. Bert does not recognize him, but realized that his name is Tom. Bert remembers that Tom had shared some interesting information earlier and that he took notes. Bert quickly accesses his personal notes and asks Tom the questions he had before in a whisper session to not disturb the meeting.

A designated secretary interacts with SlideWorld to group, manage, and organize all the information been shared, created, and discussed during the meeting, simply.

Derek, the chairperson of this meeting, decides that the best way to approach this topic is through a Brainstorming session between locations and colleagues. SlideWorld is informed of the change in activity and loads the best tools for the task at hand. Shared whiteboards and note pads are shown on the table, people interact with the content though the array of devices at their choice, viewing, communicating, sharing, discussing and collaborating for the overall goal of the meeting.

2. State of Art research

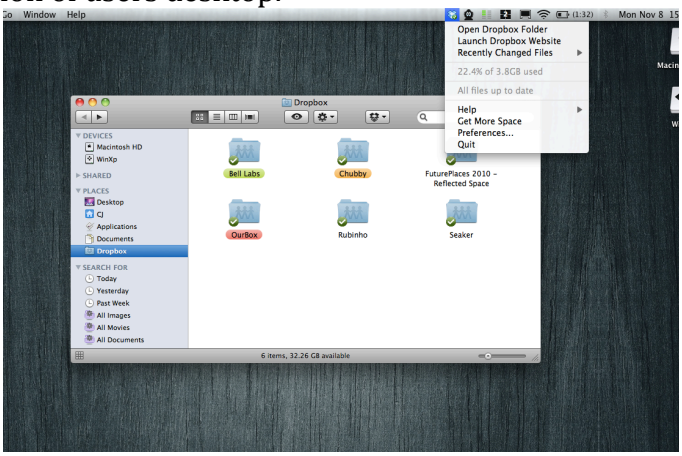
Commercial, free software and service analysis.

1. Dropbox

Summary:

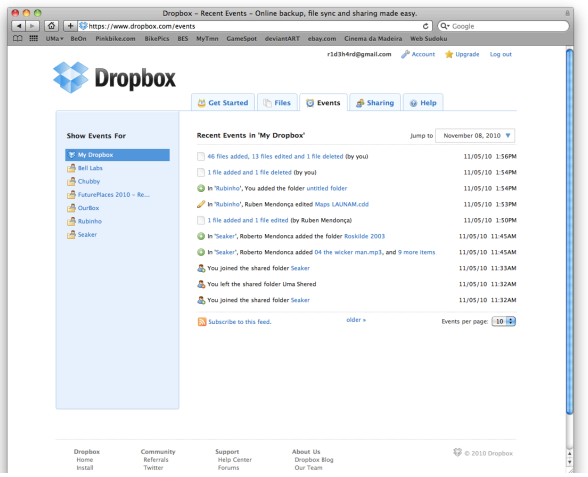
Dropbox is a cross-platform service for file sharing, synchronizing and backup.

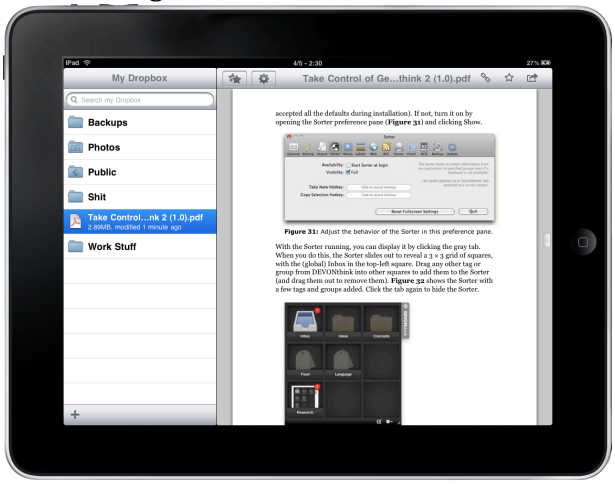
The Windows and MacOS application has a small footprint and a simple, functional interface. Creates a folder called Dropbox in a specific location in the users hard drive. Any modification to files in that folder are synchronized to Dropbox's server automatically, simulating an extension of users desktop.



Dropbox's website behaves as a central account management and information access. Here users can view, remove, and add files to their Dropbox. Also users may create and chose who to share folders with, all in a simple and intuitive interface. The possibility to view file revisions is very useful to keep track of changes.

Dropbox also supports iPads and iPhones with native running application that are simple to use, have a well designed interface and intuitive navigation.





Pros(+) and cons(-) new/interesting aspects (☆):

General:

+ Cross-platform
+ Web-based access and management
+ Free version (2gb)
+ All machines get synchronized when they are on and with Dropbox running
+ Website allows access to files and view images in a gallery and review file versions
+ Keeps older (deleted) versions of files
- Moving files into or out of Dropbox folder does not copy the file
- Dropbox only looks into one folder

iPhone:

+ Can view all kinds of documents (Word, PPT, PDF, Excel, etc)
+ Easy sharing via email (one tap on email button)
+ Fast browsing and simple interface

- No editor within the application
- No creation of new files or documents
- Favorites are cached on iPhone (not saved or downloaded)
- No view of other revisions of the files

iPad:

+ Takes advantage of landscape and portrait modes
+ Export to native apps (Keynote and Pages)
+ Looks better than iPhone application
+ Favorites are saved for offline viewing
+ Search for files
+ No active reading support in Dropbox PDF viewer

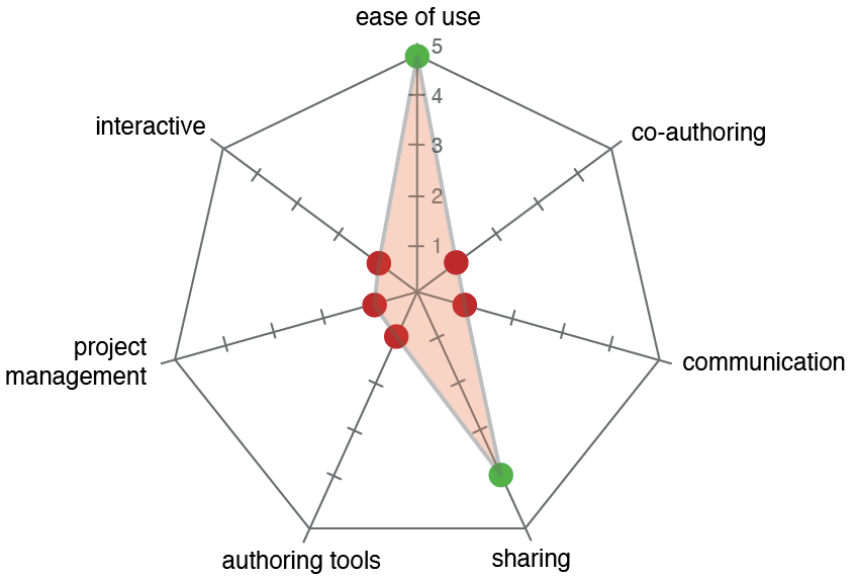
- No refresh button
- No import to Dropbox from other applications

SWOT analysis:

Strengths	Weaknesses
Simple and easy to use Cross-platform, cloud-based Native iPhone and iPad application	Only synchronizes files within Dropbox folder No simultaneous editing on a document No integration with other notification services (e.g. email)
Opportunities	**Threats**
Any user in need of a simple and effective backup and sharing tool	Other similar products that offer more features and better customer service

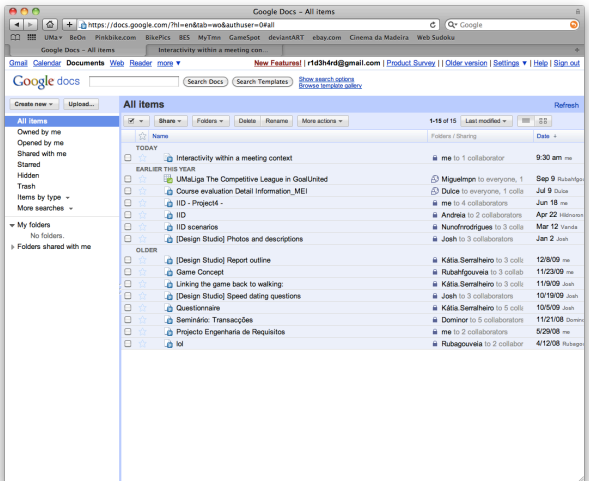
Overall conclusions:

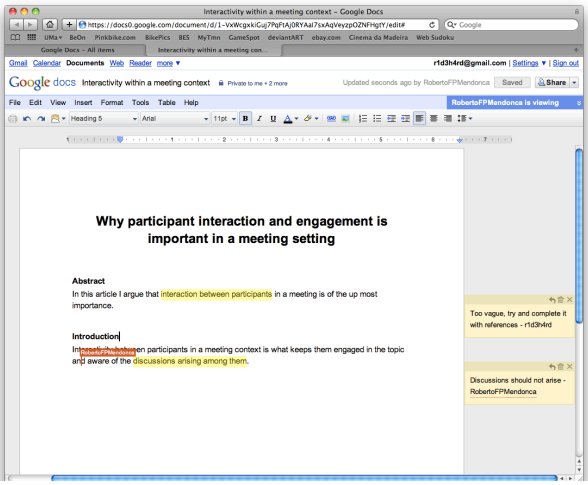
Dropbox is a convenient way to share a variety of different files between people and devices. Dropbox is a simple to use application that has a web-based component useful for file sharing, backup and synchronization even if you are not at your own computer.



2. Google Docs

Summary:
Google documents is a cloud-based document editing and storage application suite, that allows users to create, share and access documents from anywhere. An easy management of documents, spreadsheets, presentations, surveys, and more all in one easy location. This web-based suite affords real time collaboration and communication (instant messaging) between participants.
The document management page allows users to collaborate real time on an uncomplicated document. Users can view other participants cursors, name tags as they type modifications, and create notes related sections or words contained within the document. All participants collaborate on the most recent version of the document and all the documents the user has been invited to are organized by date of creation or modification for easy access in the main page.





Pros(+) **and cons**(-) **new/interesting aspects** (☆):

General:

+ Cross-platform, cloud-based document editing, storage and co-authoring
+ Free version
+ Auto file saving and access to previews file versions
+ Exports and imports most standard formats
+ Export to PDF
+ Secure and reliable
+ Works well on low bandwidth connections and light weight
+ 10 real time participant collaboration in the document suite and 50 in the spreadsheet suite
+ Somewhat familiar to desktop suits
+ Good collaborator feedback as cursor position, name labels, highlight changes
- Requires constant internet connection
- Export and import unreliable with heavy formatted documents
- Feature depth cannot match desktop suits
- Slow if multiple Google Document tabs open

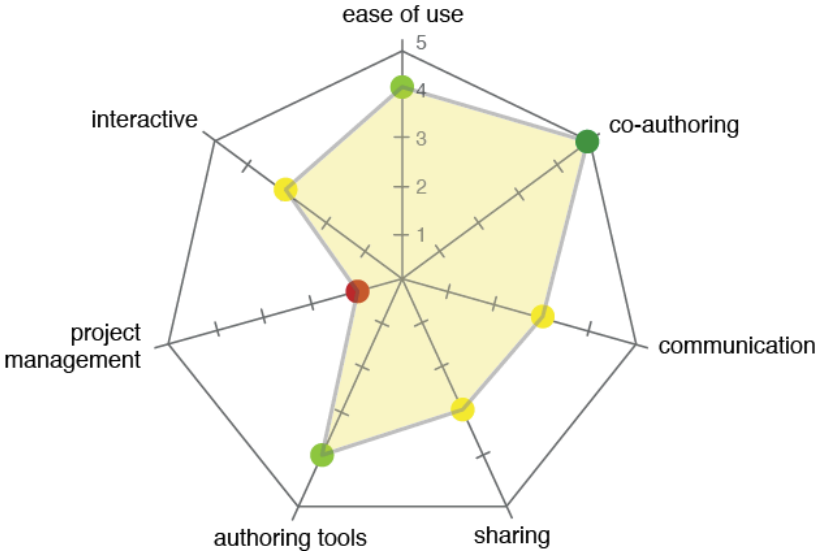
iPad and *iPhone:*

+ Spreadsheet and document editing
+ Sleek, well adjusted interface
+ Sort documents by stared
+ Web-based (no download or install)
- No new document creation
- No native application (GoDocs is the native application for iPad)

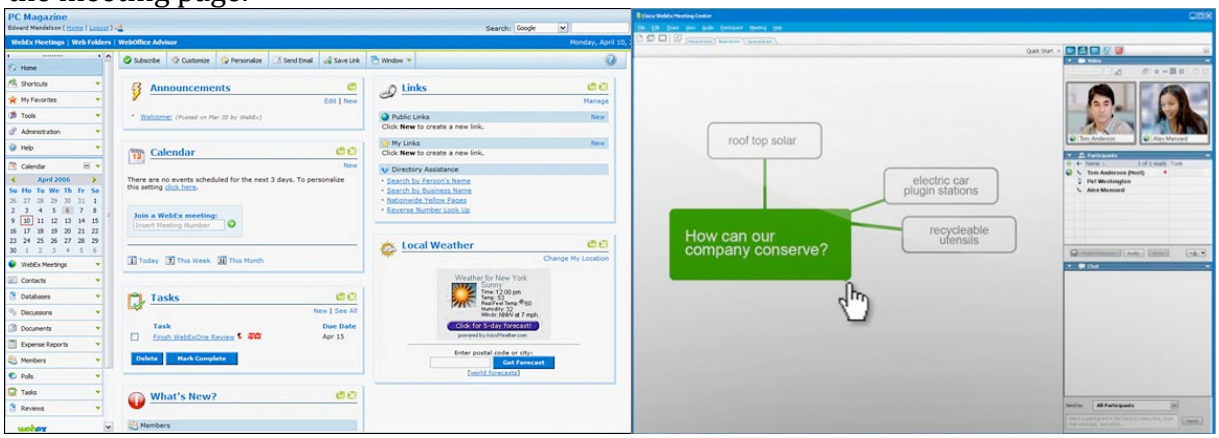
SWOT analysis:

Strengths	Weaknesses
Simple and easy to use Cross-Platform Cloud-based iPad, iPhone and Android editing	No offline editing mode Not as complete as desktop suites Image and formation heavy documents are not well displayed No synchronous (audio) communication
Opportunities	**Threats**
Any single user or group of users needing to create/edit/manage a document or spreadsheet and collaborate in real time on it	Hard to be as feature complete as desktop suites, thus limiting more complex tasks

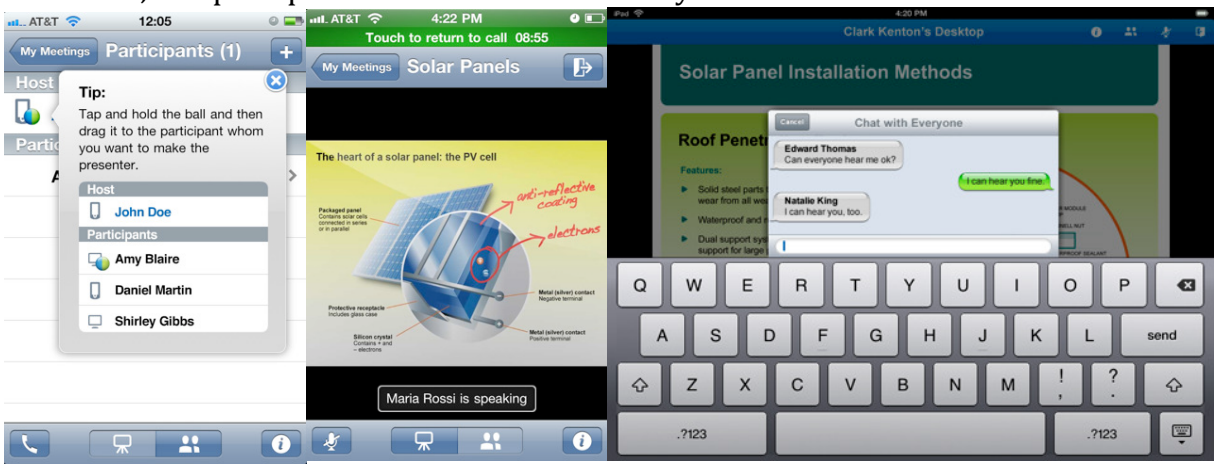
Overall conclusions:
Google Document suite is a useful tool to be used individually or collaboratively for the creation, editing and management of uncomplicated content via a web browser. The iPad and iPhone support allows users to keep updated on content modifications and perform simple document editing.



Summary:
Cisco's Webex is a highly evolved, forward-thinking web conferencing program that stands out as one of the best available [TopTenReviews]
Webex offers users a rich and broad array of features and tool sets for hosting web conferences, perform collaborative whiteboard sessions and meetings from the web-browser. When connected to the Webex server, meetings are easy to begin by sharing a URL via email to participants. Participants only need to click on the URL and are taken to the meeting page.



Attending meeting by way of a mobile device is simple. Connect to the Webex server and select the desired meeting from the calendar and click start. That opens the meeting for attendees, and prompts the WebEx server to call your iPhone.



Pros(+) **and cons**(-) **new/interesting aspects** (☆):

General:
+ Cross-platform web-based application
+ 3G smartphone support
+ Mutual control (pass on meeting control)
+ Participants do not need a subscription to joint online meetings
+ Instant recording and playback of recorded meetings/presentations
+ Rapid screen sharing
+ Real-time multi-point video discussions
+ Compatible with most multimedia formats and popular presentation software
+ Supports annotation and markup
+ VoIP
+ 128bit end-to-end SSL encryption
+ Sleek, customizable interface
+ Easy to use
+ Up-to 25 participants per meeting
- No tool for leader synchronization during presentation

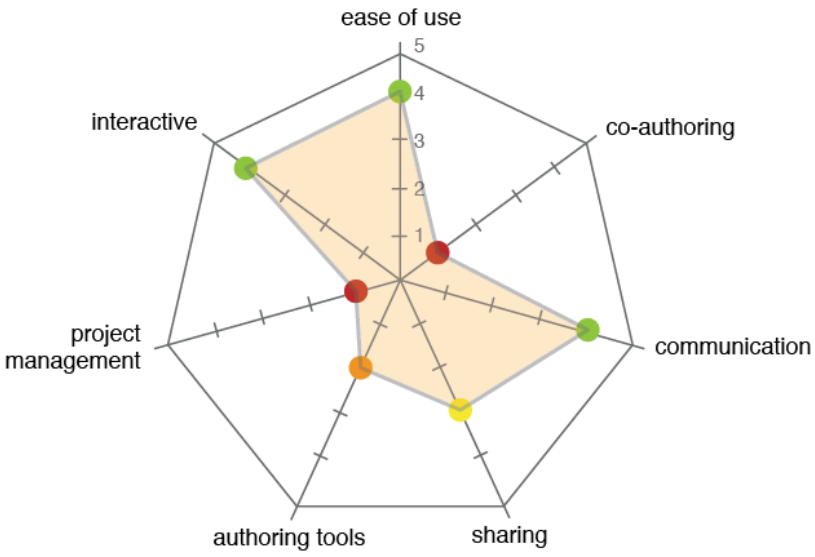
- Lack of presentation directing features difficult presenting content

iPad and *iPhone*:
+ Attending meetings while mobile
+ Attending meeting in full screen (iPad)
+ Free VoIP calls
+ Individual or group chats
+ Situation awareness
+ View content shared by any other device
+ Consistent interface with other cisco products
+ Simple and easy to use
+ Takes full advantage of the iPhone's pinch-and-scroll capabilities for close-ups of visuals, and supports both portrait and landscape modes
+ Cannot present material from Smartphones or iPad
- Cannot attend all the meetings (some are not enabled)
- Only start a meeting on a Windows or Macintosh machine

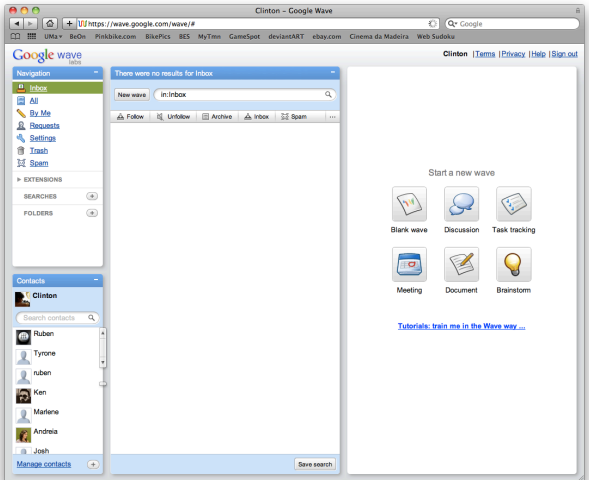
SWOT analysis:

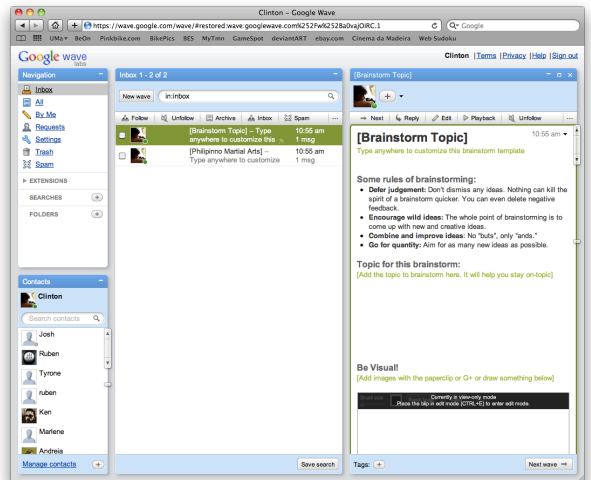
Strengths	Weaknesses
Cross-Platform, web-based application Pay-per-use Complete package for supporting meetings Real time meeting annotation	Missing key features for the presenter of the meeting Cannot attend all of the meetings via Smartphone
Opportunities	**Threats**
Good tool for small businesses to present and conduct meetings Save on employee travel expenses	Other similar suites offer more features as project management

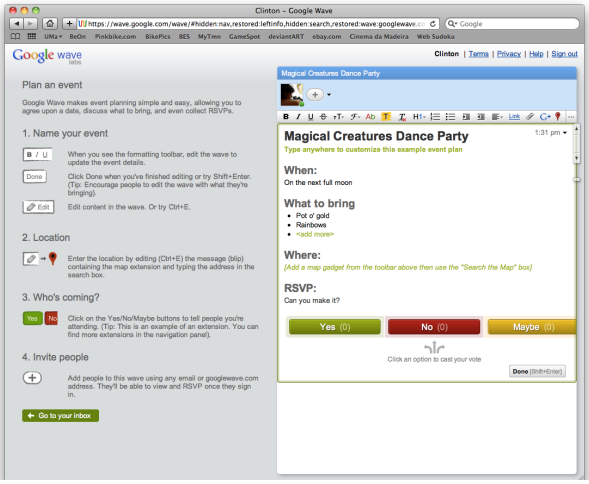
Overall conclusions:
WebEx's features make it a capable tool for education and online slide presentations. Offering a simple way of attending meetings with a computer or smartphone, Webex brings web conferencing anywhere, anytime.

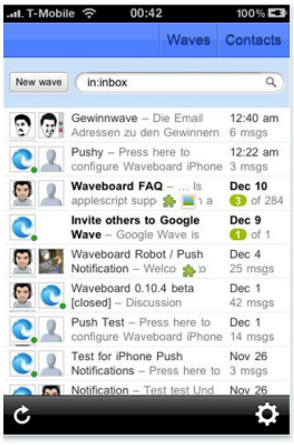


Summary:
Google WAVE is a live, shared, web-based computing platform and communications protocol, designed to merge key features like email, instant messaging, wikis and social networking.
Google WAVE is an adequate tool for brainstorming remotely with colleagues, early concept creating and discussion, and multi user note-taking for meetings. With it's simple and configurable interface and built in tutorial users have the necessary tools to support the above activities.









Pros(+) **and cons**(-) **new/interesting aspects** (☆):

General:

+ Simple to use and navigate
+ Real time collaboration
+ Web-based and cross-platform (Windows, Mac OS and Linux)
- Overcomplicated for new users
- Did not live up to the hype
- Need to filter all the messages manually
- Email and instant messaging together can be counterproductive
- No document revision with rollback
- Cannot Undo other's edits to the document (only manually)
- No recording of who edits what within a "wavelet"

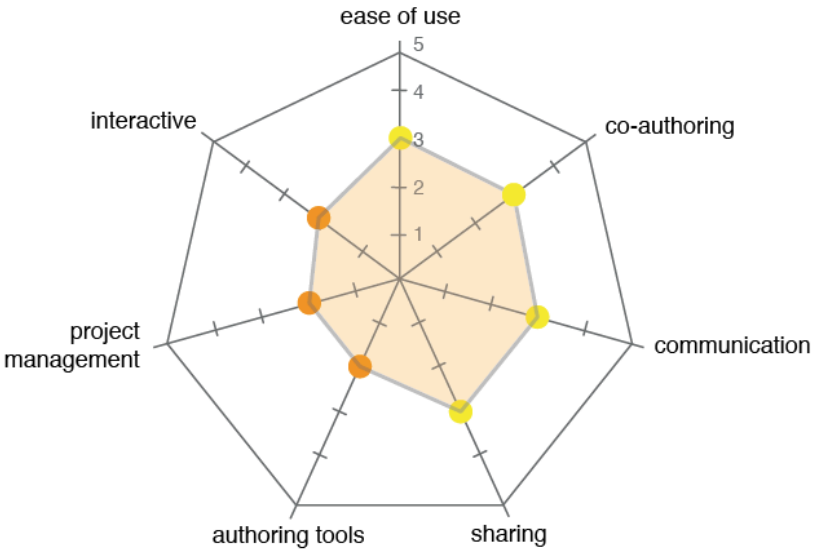
iPad and *iPhone*:
+ iPad has WaveBoard (1.99$) application client
+ WaveBoard offers push notification

+ WaveBoard's interface is simpler and better designed than Google WAVE through the integrated browser
- Using Google WAVE through browser sometimes crashes the application

SWOT analysis:

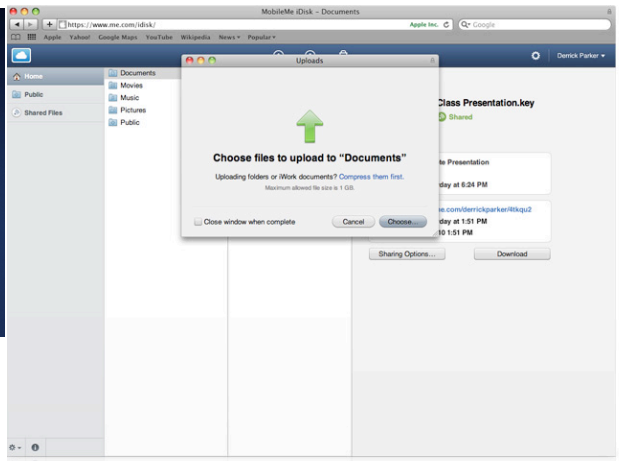
Strengths	Weaknesses
Web-Based collaborative platform Offers tools that support popular collaborative activities	Not refined enough for more complex collaboration
Opportunities	**Threats**
Google has a large number of followers they can reach a vast demography especially individuals and small organizations in need of a simple document collaborative tool	Other web-based tools can be more refined and provide more features for more serious collaboration

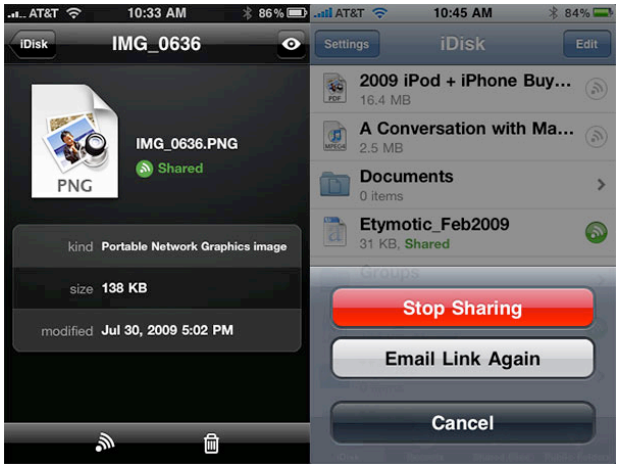
Overall conclusions:
Google WAVE has a promising future. It is sill at a beta level in its development and with some more feature and interaction refinements, better authoring and co-authoring tools within its wavelet's could prove to be a useful tool for individuals or small groups to collaborate and keep in sync.

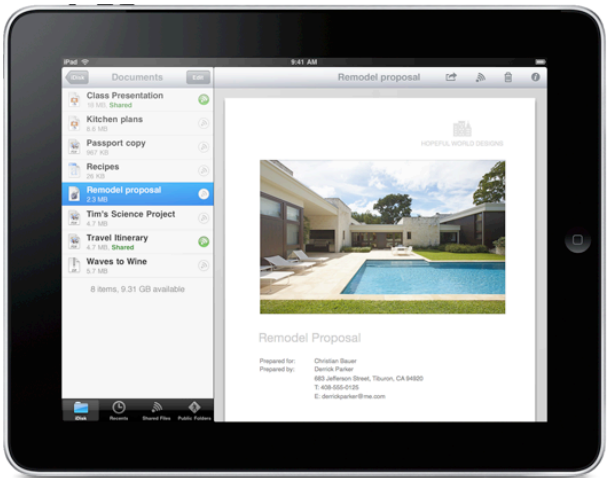


5. MobileMe (iDisk)

Summary:
MobileMe is a $99/year web-based email, contact, calendar, photo, web storage and file synchronization service offered by Apple. MobileMe comes embedded into the devices operating system and has an easy setup and configuration. MobileMe synchronizes you Mac, Windows, iPhone and iPad automatically and effortlessly. The web applications interfaces are consistent and familiar to the related native applications found on Apple computers.
iDisk is the online storage service, and can be found on user's Mac computer as an external hard drive, while in the iPhone and iPad as an application. Through iDisk you can synchronize data across your multiple devices, backup important information as well as shared files with others. The iDisk web application provides users access, visualization and download your files from any computer.







Pros(+) and cons(-) new/interesting aspects (☆):

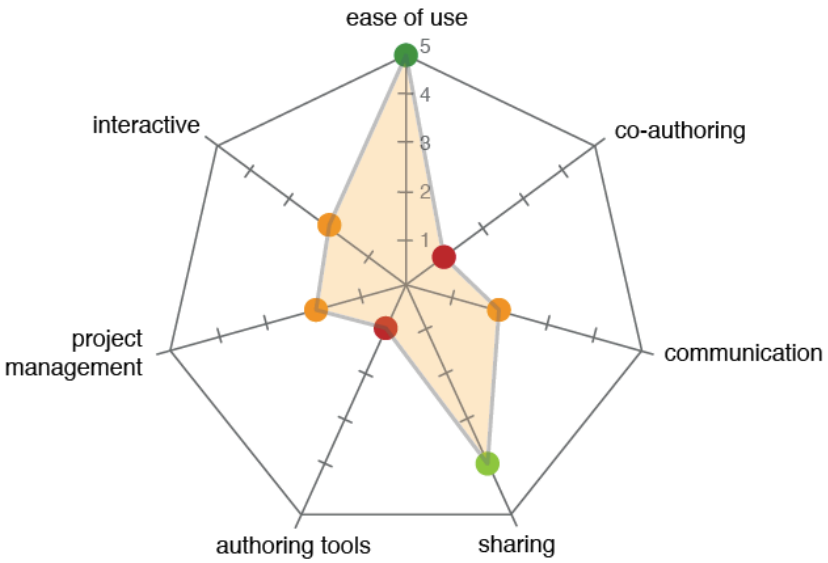
General:
+ Web-based and cross-platform
+ Consistent and familiar interface with related computer applications
+ Non intrusive synchronization
+ iDisk allows sharing with others
+ Efficient way of keeping multiple devices synchronized and updated
+ Microsoft Windows and Outlook friendly (compatible)
- Synchronizing is slow
- Calendar does not synchronize with DAVCal accounts (e.g. Google Calendar).
- MobileMe mail does not synchronize with other pop3 account (e.g. Gmail)

iPad and *iPhone*:
+ Able to view, play, open files through iDisk
+ Easy synchronization of information
+ Well designed interfaces
- Content only refreshes when navigated to folder

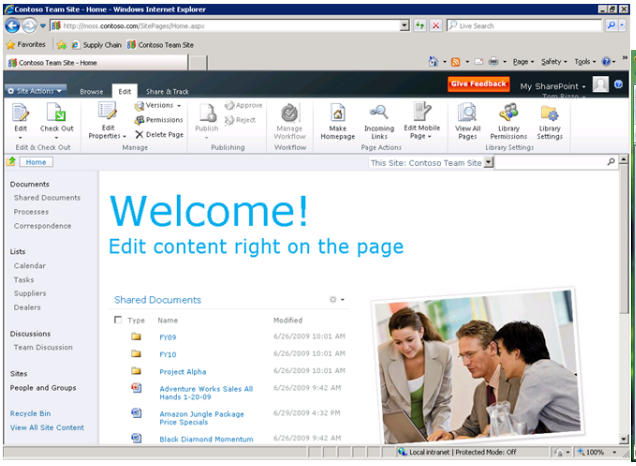
SWOT analysis:

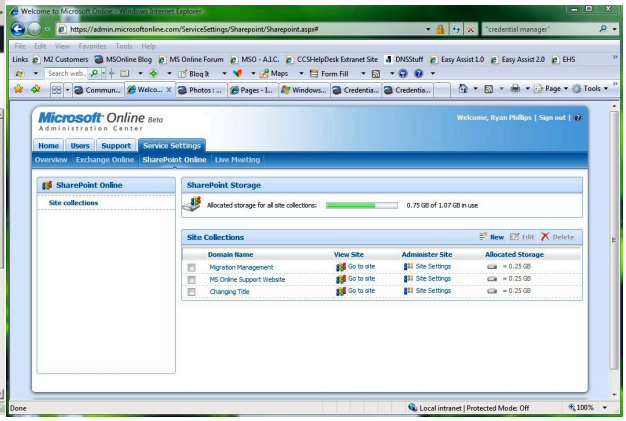
Strengths	Weaknesses
Web-based and cross platform Easy to use with a familiar interface Nonintrusive synchronization iDisk is simple to use	Not compatible with other familiar calendar and email services (e.g. Google Calendar and Gmail)
Opportunities	**Threats**
Useful in almost any environment that relies on self synchronization between multiple devices	Limiting integration and synchronization with other popular services

Overall conclusions:
MobileMe is adequate for people how have multiple Apple devices or a Apple and Windows computers and need a way to synchronize between them. There are similar free services (e.g. Google) that provide similar features (except iDisk). iDisk is an easy and simple way of synchronizing and sharing files between devices and people and with the web component users can access their files and information from any computer.



Summary:
Microsoft SharePoint allows people to set up websites to share information with others, manage documents thoroughly, and publish reports. SharePoint is a family of software products for collaboration, file sharing and web publishing.
SharePoint online is an online intranet service ($5.25/month) that allows users from all sizes of organizations the opportunity to collaborate, share, search and manage information from a single location. Within the collaboration feature users can access surveys, people and groups, calendars, issue tracking and document collaboration.





Pros(+) **and cons**(-) **new/interesting aspects** (☆):

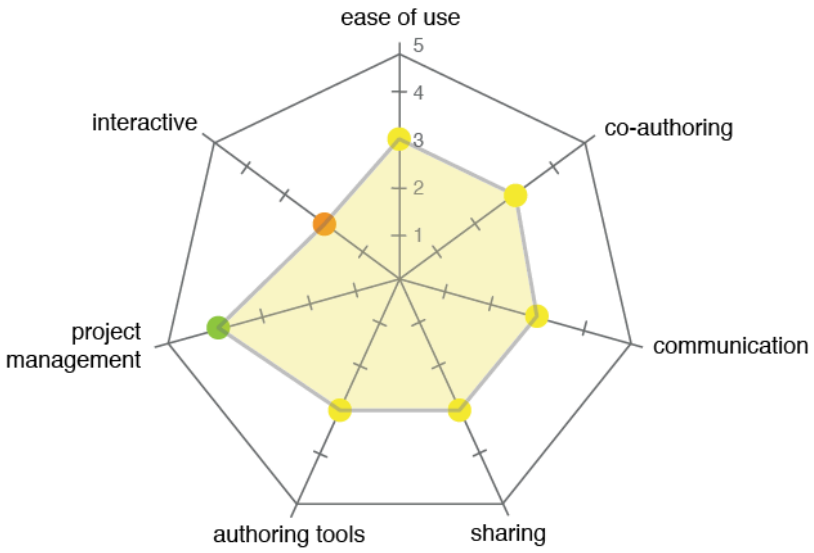
SharePoint Server:
+ Document management
+ Good search
+ Social computing
+ Collaborate on documents
+ Highly scalable
+ Tight integration with Office suite
- Windows OS machine only
- 2010 version requires 64bit OS
- Very expensive
- Requires IE8+

SharePoint Online:
☆ "Deskless worker" can only view and download documents
+ Microsoft Office integration
+ Secure 128bit encryption
+ Administrative center online
+ Offers portals, search, content management, business process and forms
+ Full backup/redundant copy of content
- Basic instant messaging communication
- In collaboration: no presence awareness; social networking

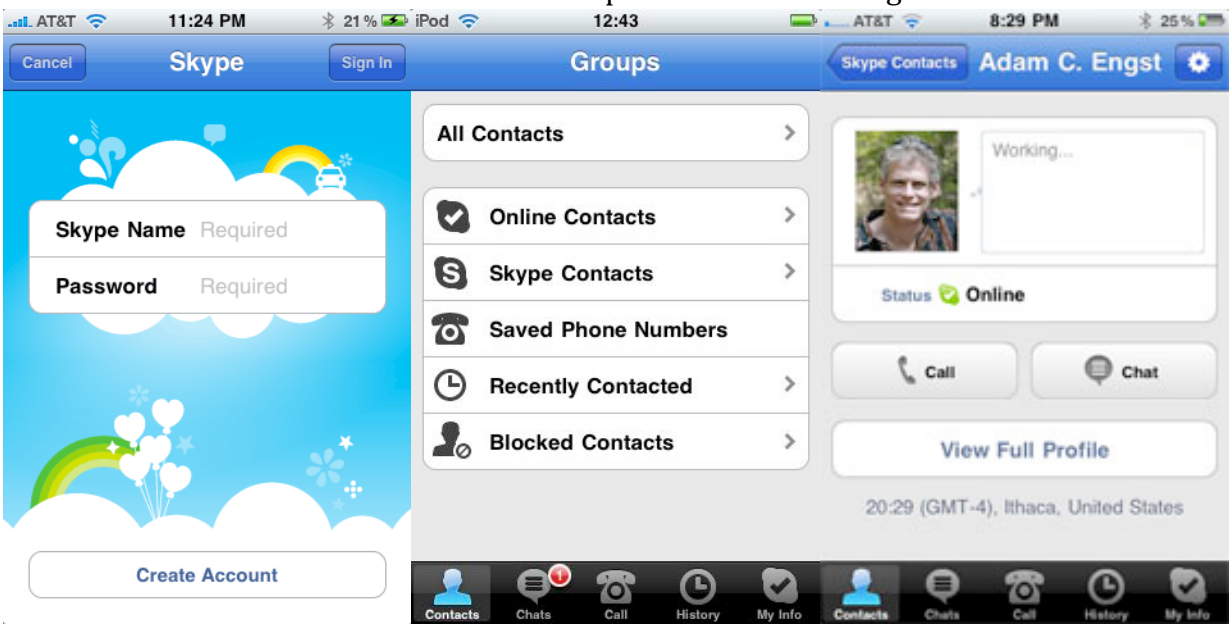
SWOT analysis:

Strengths	Weaknesses
Tight integration with Microsoft Office suite Good content and project management features	Requires Windows 64bit machines to serve SharePoint to users Not cross platform No mobile support
Opportunities	**Threats**
Organizations are ever more hiring remotely located employees that need a service for collaboration and content management	Similar cross platform suites that offer cross-platform and mobile support

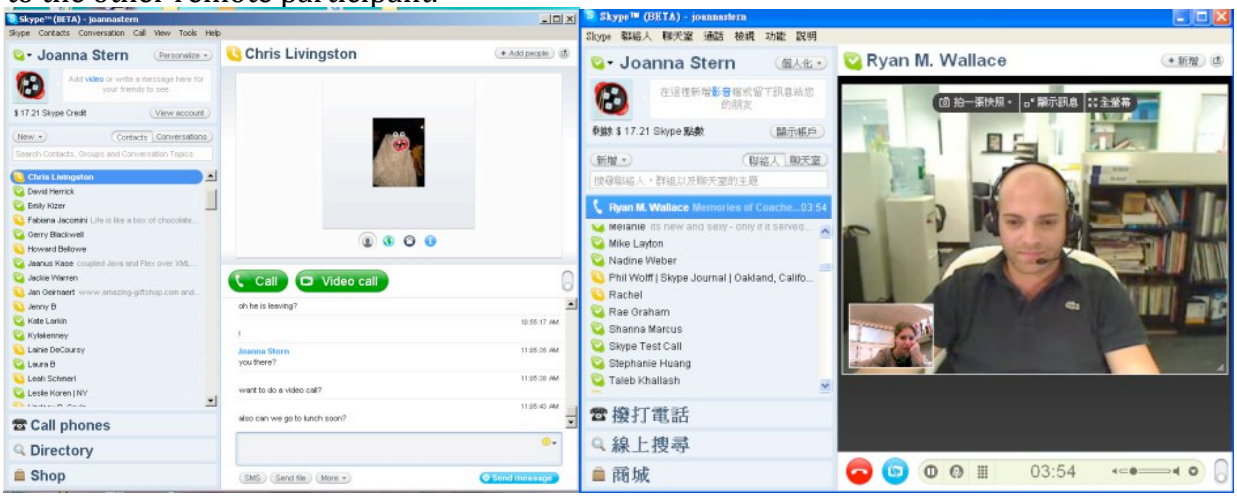
Overall conclusions:
Microsoft SharePoint Server and SharePoint Online offers a wide range of features to support collaboration and content management and with a tight integration with Microsoft Office productivity suite makes it an adequate tool for any size of organization. SharePoint offers some customization to adapt to specific organization's needs.



Summary:
Skype is a popular VoIP service that offers free instant messaging, audio and video chat (audio conferencing and group video call). Skype has focused on a simple and intuitive interface that allows users to perform their tasks easily. Skype's VoIP rates are among the cheapest and the audio quality among the best. Skype has native application for almost all device platforms—Mac OS, Windows, Linux, iPhone, Android and Nokia smart phones. Skype for iPhone has a clean interface displaying only the essential information to the user as well as some feedback of the number of open chats and messages received.



Skype on Mac, Windows and Linux has a share screen feature. Here users are able to exchange their video camera feed for the video feed of their desktop (or region of it). This feature allied to audio chat is a good combination to quickly display and discuss somwthing to the other remote participant.



Pros(+) and cons(-) new/interesting aspects (☆):

General:

+ Screen sharing and screen section sharing
+ Audio conferencing and group video calls
+ Good audio quality
+ Send files to contacts
+ Skype has a consistent interface throughout the different devices

+ Simple and intuitive interface
+ Cheep VoIP rates
+ Facebook integration

- Share screen video quality not high enough to act as a collaborative tool
- Small feature set

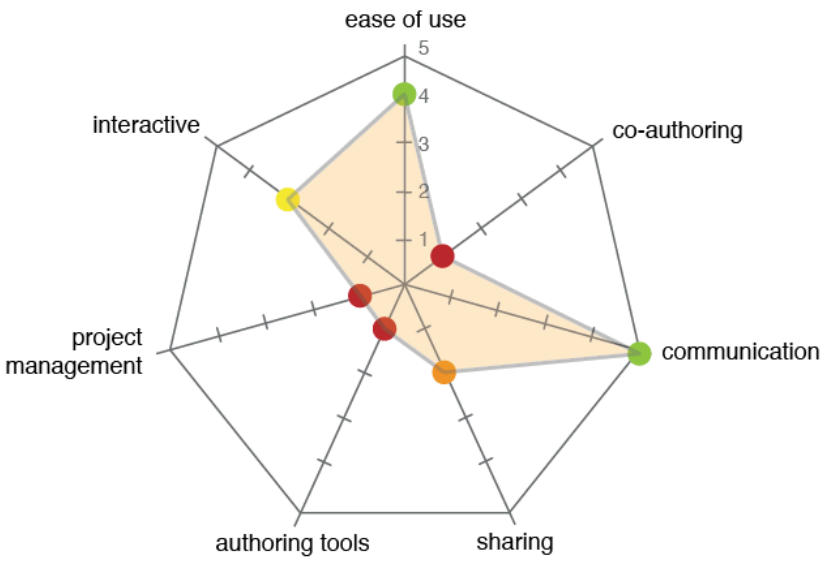
iPad and *iPhone*:
+ Consistent and easy to use interface
+ Native iPhone application interface is well designed

- No Skype video chat in iPhone
- Not optimized for iPad
- Need to toggle between chats

SWOT analysis:

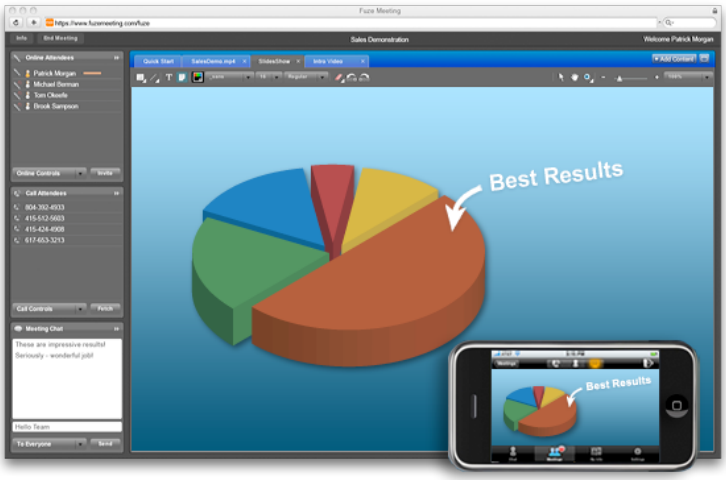
Strengths	Weaknesses
Cheap VoIP fees Free instant messaging, audio and video chats Cross-platform and mobile support	Small feature set No iPhone video call support Only Skype for Windows allows group video calls
Opportunities	**Threats**
Good tool for communicating between people with different devices	More specialized VoIP services and collaborative tools (sharing)

Overall conclusions:
Skype is a good tool for simple communication. Instant messaging, audio and video chats are simple to set up and are good quality. The VoIP service is among the cheapest in the market and Skype's cross-platform and native applications make it one of the most used application of its type.



Summary:
Fuze Meeting is a web conferencing tool that allows users to share everything on their screen in high resolution. Fuze Meeting allows sharing between different devices and with users that do not have a Fuze Meeting subscription. Fuze Meeting allows users to record the meeting for future review and is compatible with Skype VoIP audio calls. Fuze Meeting is a simple service that focuses on chat and screen sharing.

Fuze Meeting allows users to annotate or markup during meeting presentations and role changing (guest to presenter).



Pros(+) **and cons**(-) **new/interesting aspects** (☆):

General:
+ Cross-platform and compatible with all web browsers
+ Native application for mobile devices
+ Browser based web conferencing
+ Import popular social networking tools (Twitter and Facebook)
+ No installation required (Mac, Windows and Linux)
+ Easy to use
+ Presentation tools and annotation
+ High quality screen sharing
+ Presentation/Demonstration feature with pointers and whiteboard
+ Secure 128bit encryption
+ Up to 15 attendees
+ Simple fetch feature (easy to add attendees)
+ Pass on presenter control
+ View PowerPoint and Keynote presentations
+ Free version allows up to 10 attendees
- No video conferencing

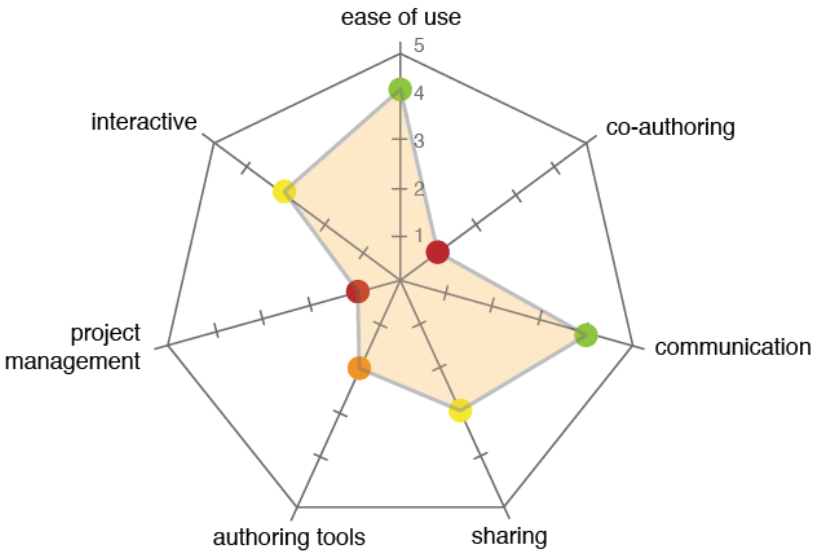
- Not compatible with web cameras

iPad and *iPhone*:
+ Fuze Meeting HD iPad native application
+ Managing attendees
+ Side-out side bar for all meeting schedules
+ Remotely control slides
+ Audio control
- No Skype video chat

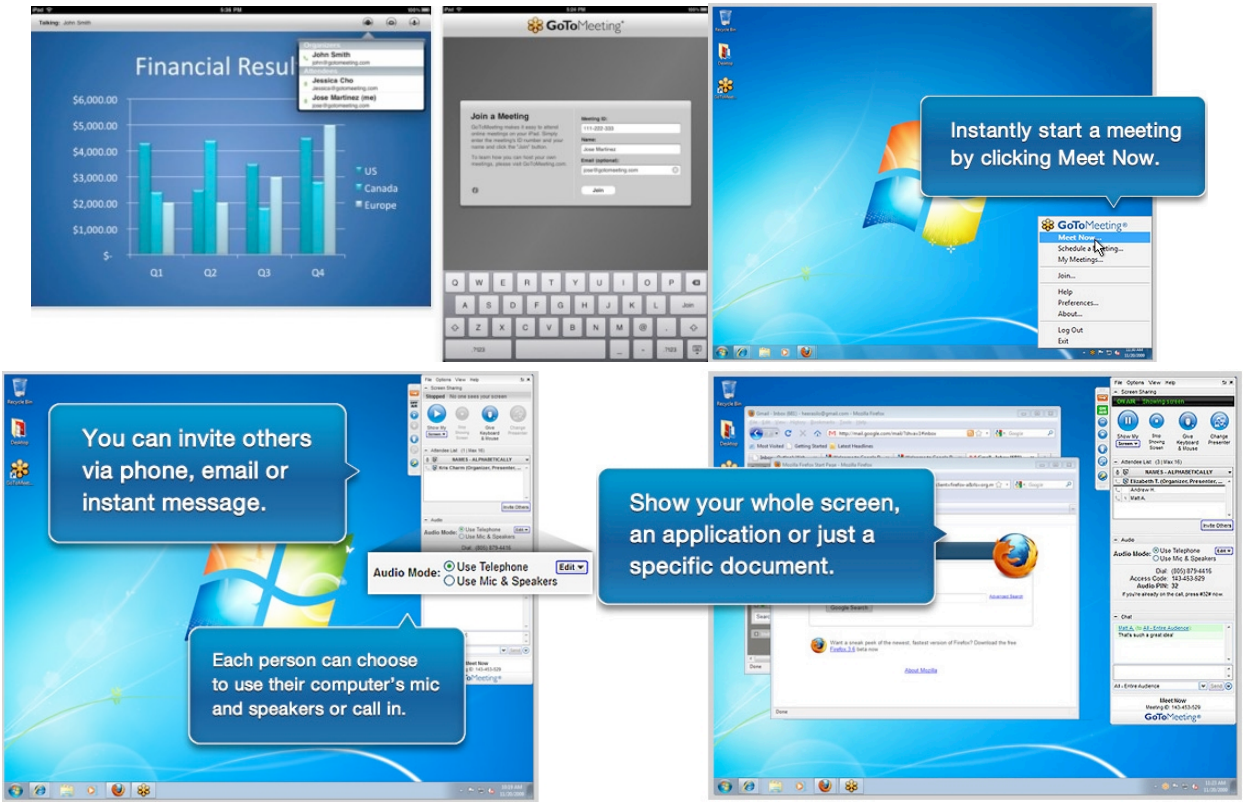
SWOT analysis:

Strengths	Weaknesses
Web-based web conferencing service High quality screen sharing Good presentation support	No video conferencing
Opportunities	**Threats**
Medium sized meetings (up to 15 attendees) located remotely and with different devices Attend meeting via your smartphone	Other web-based services as DimDim (open source) and Adobe Connect offer more features for less cost

Overall conclusions:
Fuze Meeting is a good tool for small to medium sized organizations to hold web-based meetings with attendees located remotely using different devices and platforms. Screen sharing is a powerful tool that allows presenter to share virtually anything (videos, presentations, documents). The pointing and annotation features add more meaningful information to these meetings.



Summary:
GoToMeeting is a web-based online meeting service (payed). Host meetings with up to 15 participants, share any application in real time, present material and collaborate with remote colleagues from within your web-browser. Join a meeting within seconds by clicking on a link sent to your email and host meetings from either PC or Mac machines.
GoToMeeting allows presenters to create meetings and demonstrations ad-hoc or conduct collaborative and interactive whiteboard sessions. GoToMeeting provides a variety of feature as annotation and highlighting tools, interpolated questions sessions to enhance the presenter/attendees experience.



Pros(+) **and cons**(-) **new/interesting aspects** (☆):

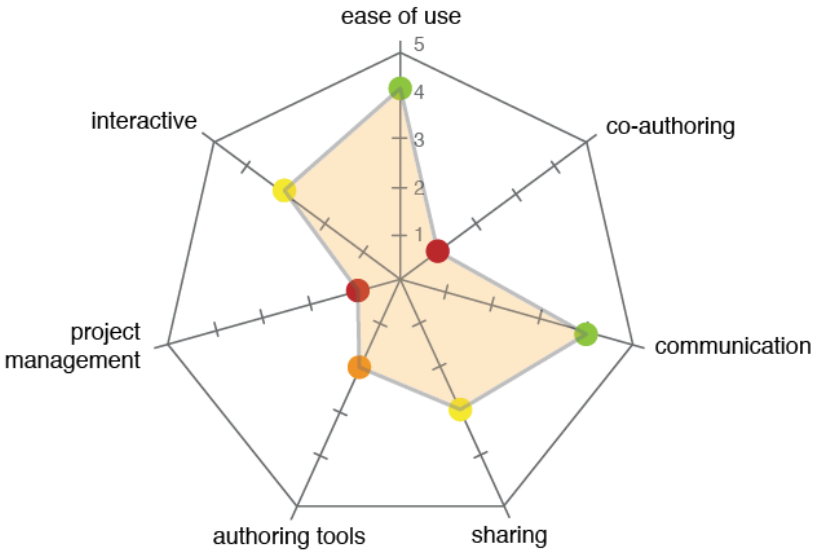
General:
☆Interpolated questions sessions
+ Cross-platform and web-based web conferencing
+ One click join meeting
+ Share control (keyboard and mouse)
+ Desktop recording and playback
+ VoIP service
+ Secure encrypted date
+ Up to 15 attendees simultaneously
+ No need for a subscription to attend a meeting
+ Annotations and highlighting
- Not compatible with web cameras

iPad and *iPhone*:
+ Easy to attend meetings (single tap)
+ Simple interface
+ Pinch to zoom feature
+ Easier than Mac and PC versions to join meetings
+ Good for webinars
- No presenting from iPad

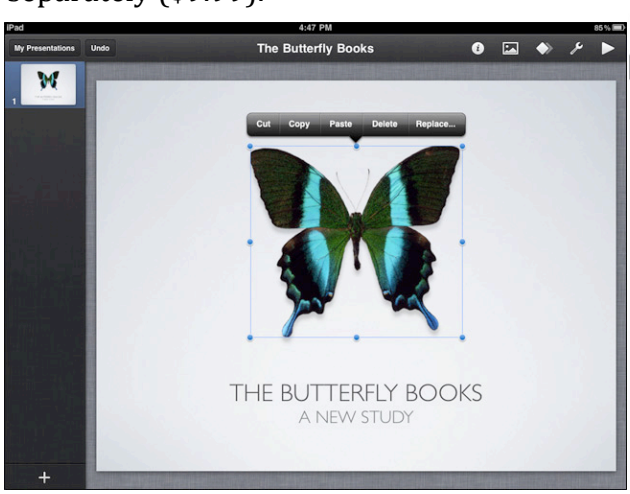
SWOT analysis:

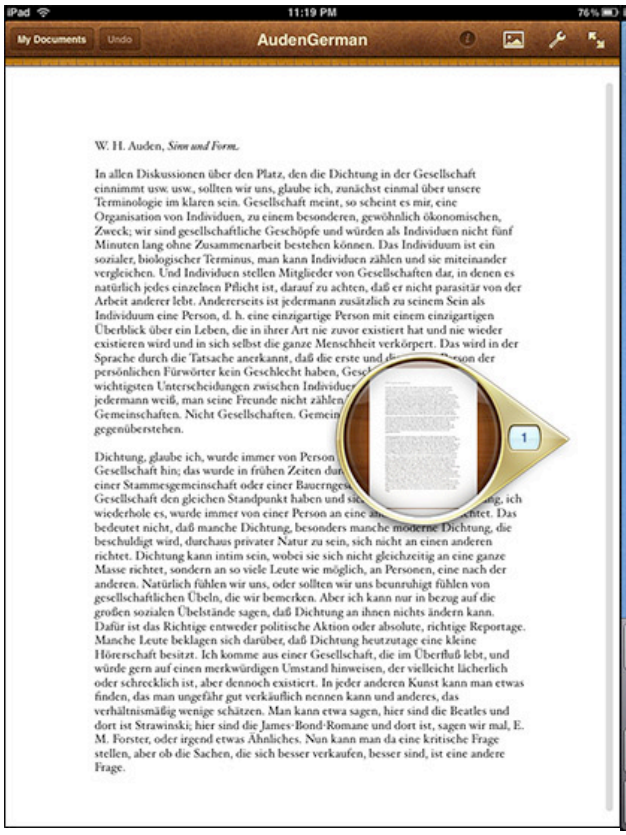
Strengths	Weaknesses
Browser-based Easy to attend meetings iPad application works well for attendees	No mobile phone support No presenting from iPad
Opportunities	**Threats**
Medium sized webinars and meetings	Other web-based services that offer better communication and real-time collaborative features

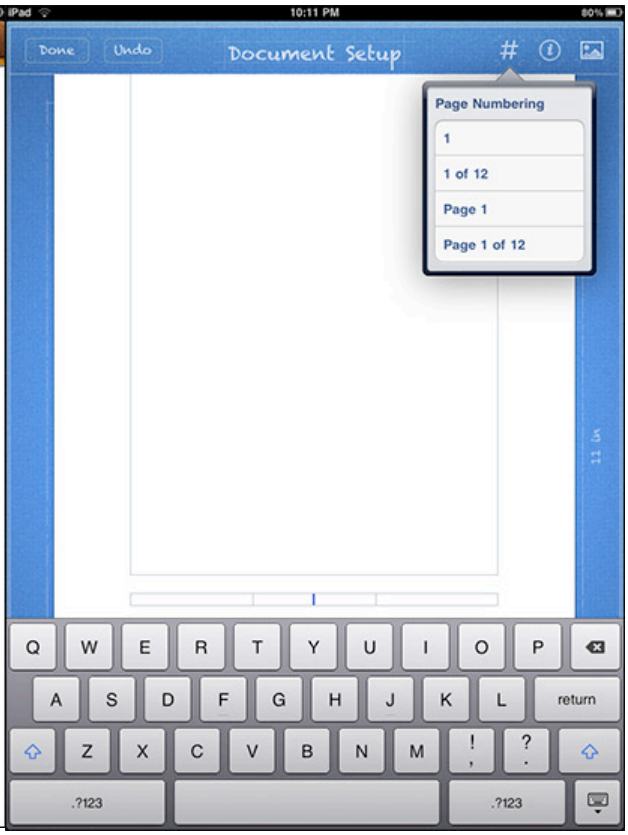
Overall conclusions:
GoToMeeting, overall is a complete and simple to use web conferencing service, with an iPad application that allows attendees to join the meeting without the need of a traditional laptop or desktop. With a flat-rate monthly and annual pricing, unlimited meetings for up to 15 attendees and VoIP, GoToMeeting is a safe bet for whoever needs a simple way of organizing presentations or demonstrations.



Summary:
iWork for iPad is a scaled down version of Apple iWork productivity suite. iWork for iPad is ideal for building presentations, light document and worksheet management. Demanding writers will feel limited with Pages, the word processing application. Pages does not support footnotes, bookmarks, cross-referencing, TOC and some other specific features. Numbers works well for light spreadsheet working, not offering as in depth features as the Mac version. The application that feels most at home is Keynote. Keynote, being a more visual tool, works well with the iPad multi touch screen. Keynote does not try do be like the Mac version. It turns presentation into a pleasurable, simple task. iWork for iPad can connect to iWork.com for easy sharing of documents. Keynote, Pages and Numbers are sold separately ($9.99).







Pros(+) and cons(-) new/interesting aspects (☆):

General:
+ Almost full scale application suite
+ Continuous auto saving feature
+ Applications state is saved if user goes back to home screen
+ Application interfaces were designed specifically for the iPad and multi-touch
+ iWork.com is a simple way of sharing documents publicly
+ Deep undo buffer
- No direct printing from the iPad
- No iWork '08 or earlier support
- Sharing from iPad to PC or Mac is troublesome
- Import process is unintuitive

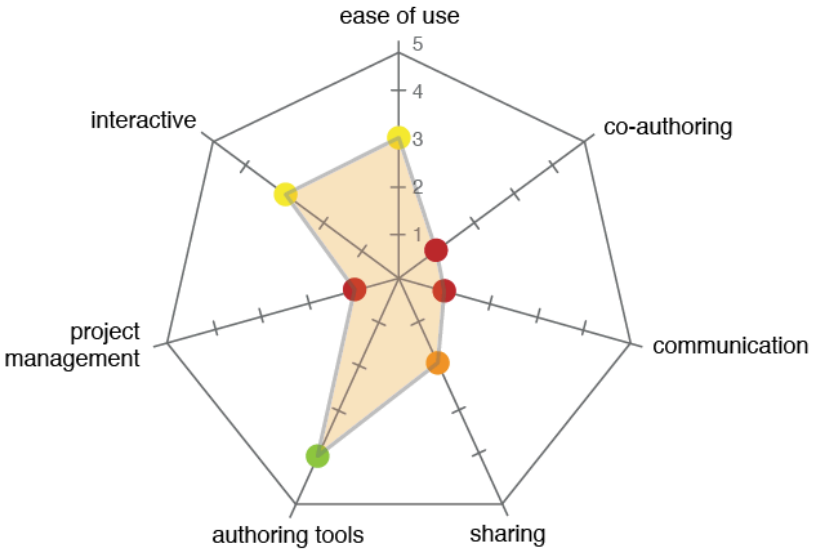
Keynote:
+ Glowing laser pointer appears when touching the presentation (pointer)
- No presenters mode
- No current slide view (if presenting with external monitor)
- Only works in landscape mode
- Slide overview bar takes up some screen retail space

Pages and Numbers:
+ Scrolling provides a page thumbnail preview in Pages
- Advanced features missing
- Cramped interface screen
- Virtual keyboard take up almost half the screen in landscape mode
- Looses the formatting when importing documents
- No document synchronize

SWOT analysis:

Strengths	Weaknesses
Almost full featured productivity suite Well designed interfaces to take advantage of iPad's multi-touch	Sharing between other devices is troublesome Import/export limitations
Opportunities	**Threats**
Provides iPad users with a good productivity tool for the road	Web-based collaborative productivity suites (e.g. Google Documents)

Overall conclusions:
iWork for iPad is a lighter stripped version of iWork for Mac. It supports light document and spreadsheet working. The lack of document synchronization and somewhat difficult file sharing limits collaboration. Keynote, takes advantage of the iPads multi-touch screen and interactions, making presenting on the iPad a pleasurable task. iWork for iPad still lacks some important features for more advanced users but is still a great productivity suite for a mobile device.


ease of use
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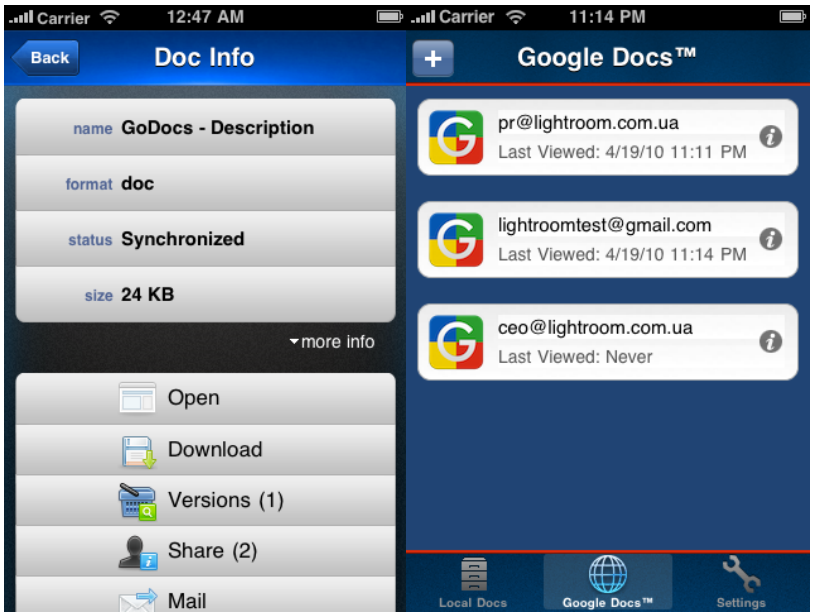
co-authoring
communication
sharing
authoring tools
project
management
interactive

11. GoDocs (Google Documents for iPad)

Summary:
GoDocs is a simple iPhone and iPad application that allows users to access and view their online Google Documents. GoDocs allows users to download their documents for offline visualization and see which revision users are currently viewing. GoDocs does not support editing of documents (v.2.3 allows online editing of spreadsheets) but is a good tool for taking your documents with you, anywhere. GoDocs for the iPad has a larger screen real-estate with this you can view all of your documents with one touch. GoDocs allows users navigate to GMail, GCalendar and view videos and hear audio all within the application.



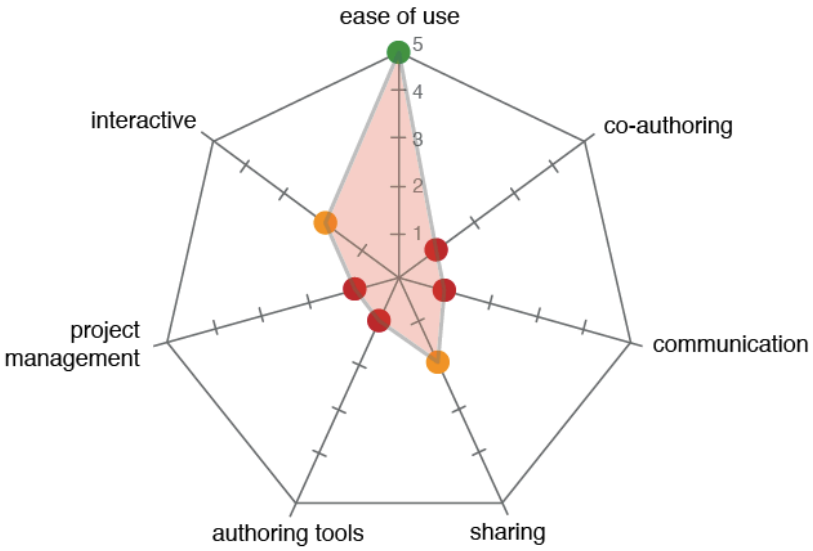
Pros(+) and cons(-) new/interesting aspects (☆):

iPad and *iPhone*:
+ Easy simple to navigate interface
+ View different revisions of the same documents
+ Offline document viewing
+ Email documents from within the application
+ Navigate to other Google services within the application
+ View documents with one touch
+ View images and movies from within the application
- No document editing
- No landscape mode

SWOT analysis:

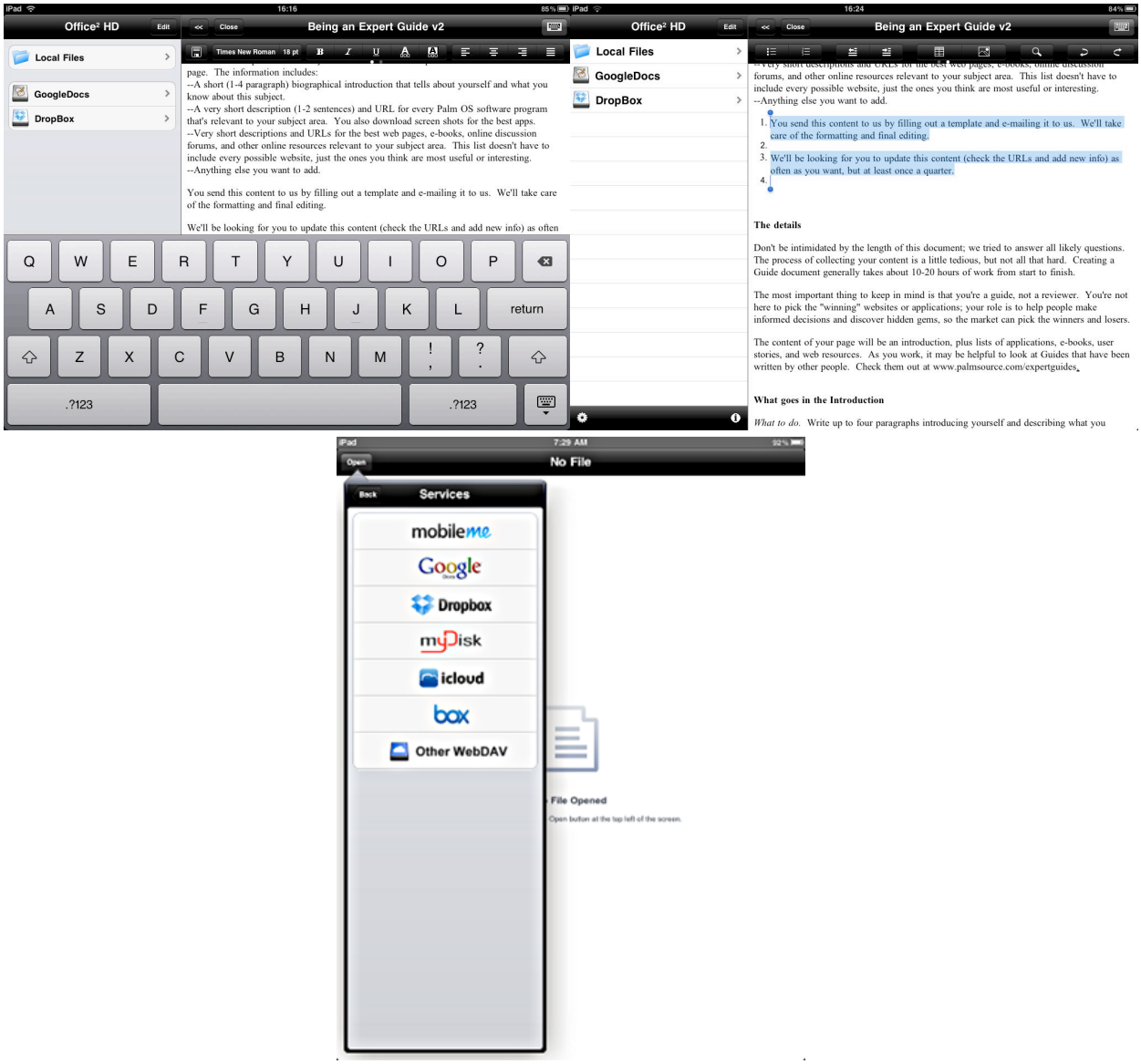
Strengths	Weaknesses
Easy to use View different document revisions Access other Google services from within the application Good document visualization tool	No document editing or collaboration
Opportunities	**Threats**
Anyone who uses Google Documents and has a iPad or iPhone has the possibility to keep in sync and organize their documents	Similar applications that allow document editing and online sharing

Overall conclusions:
GoDocs is a useful application that will increase users productivity by affording them to access their Google Documents from their iPhones and iPads. Interesting features as documents version revision and document organization allied with a simple interface and within application Google Mail and Google Calendar access, turn it into a great tool for the road.



12. Office² HD (iPad)

Summary:
Office² HD allows users to view, edit and create Microsoft Word and Excel compatible documents. Office² HD acts as a local file storage and allows users to set up access to Google Documents, MobileMe, Dropbox and others. Office² HD provides more features than iWork's Pages and Numbers applications, and is cheaper.



Pros(+) **and cons**(-) **new/interesting aspects** (☆):

iPad and *iPhone*:

+ Word 97-2003 compatible
+ One level menu depth
+ Share to MobileMe, Dropbox and Google Docs
+ Straightforward direct interface
+ Consistent with Microsoft Office interface (icons)
+ iPad version has no popup menus just a single toolbar
- No ability to choose spacing in Word documents
- Cannot create PowerPoint documents or view them
- No headings, footers or text styles
- Navigation is not intuitive

- The + button is not to add to the document but to create a new one
- No Save As option

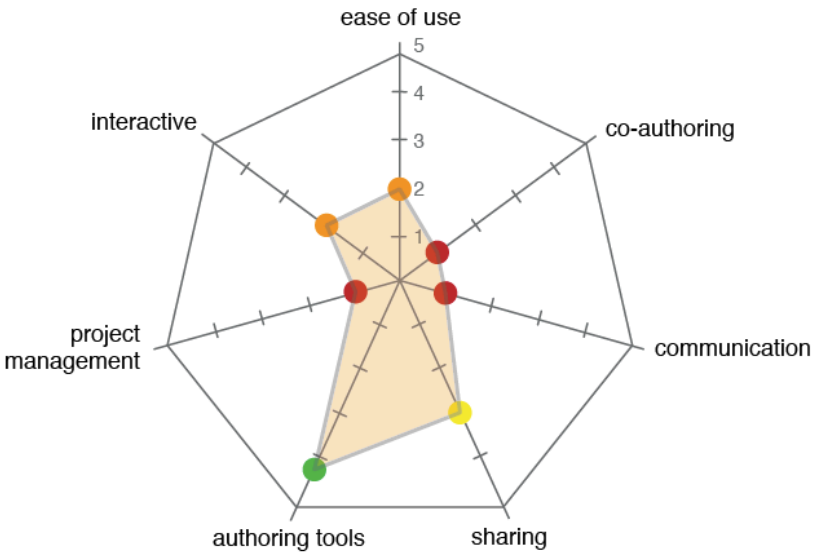
- Blank first boot screen with no information only a single "new" button

SWOT analysis:

Strengths	Weaknesses
Microsoft Word and Excel compatible Some diverse formatting tools Integration with different services (MobileMe, Dropbox, Google Docs, etc)	Not an intuitive interface No way to set default font and size
Opportunities	**Threats**
Good writing application for those who need more formatting options	Not as refined as other similar productivity suites

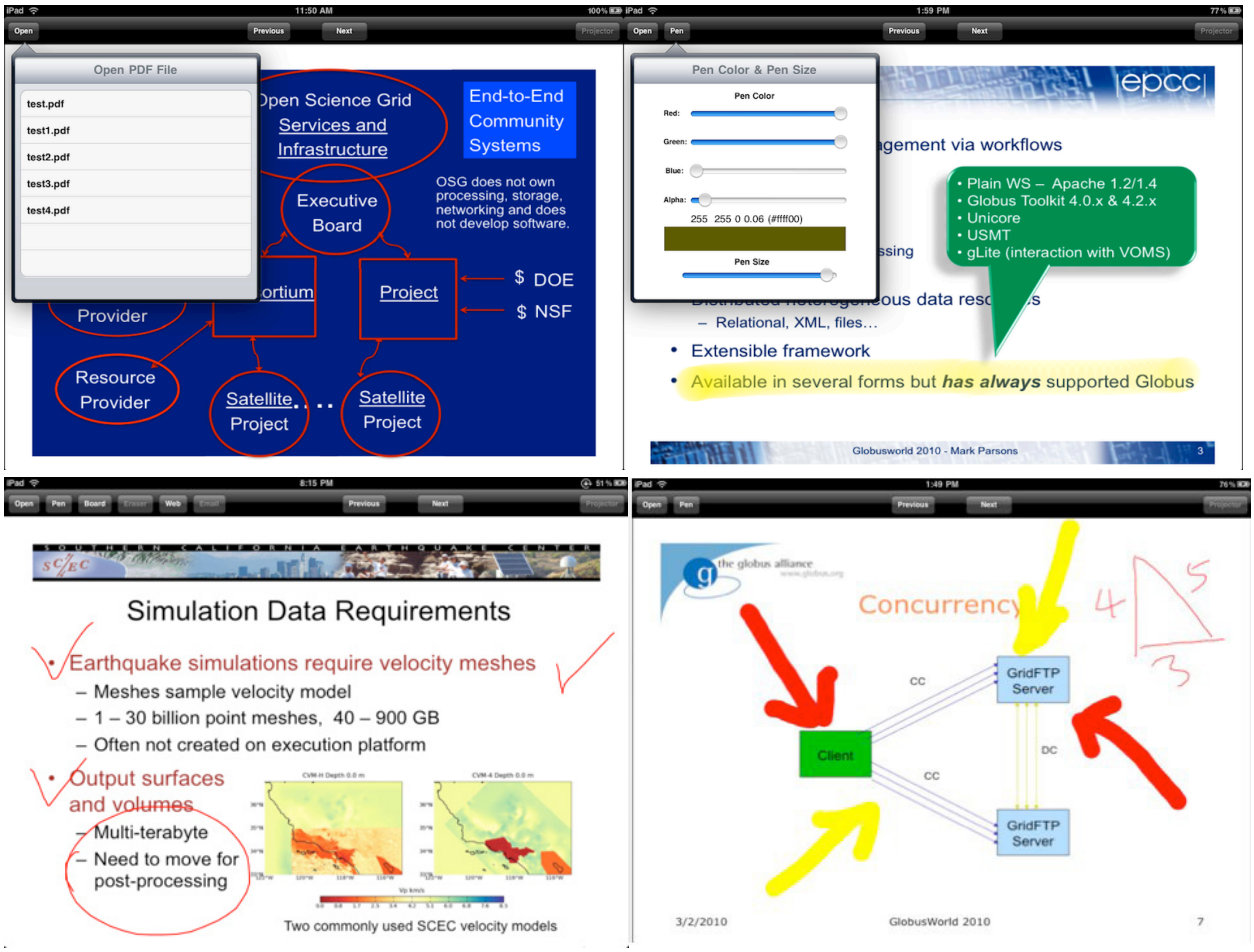
Overall conclusions:

Office^2 HD is a good writing application that supports more complete text formatting features than other similar suites. Office^2 HD offers through iPads to those who need to create Microsoft compatible documents and share them through different file sharing services a great tool to do so.



13. Power Presenter

Summary:
Power Presenter is an PDF presenting application. Power Presenter will automatically detect an external monitor or projector (via iPad VGA cable) and mirror the presentation to became visible on both displays. Power Presenter offers some interesting features to support presentations as, writing with your finger on slides, highlighting text and a blackboard with smooth line drawing.



Pros(+) **and cons**(-) **new/interesting aspects** (☆):

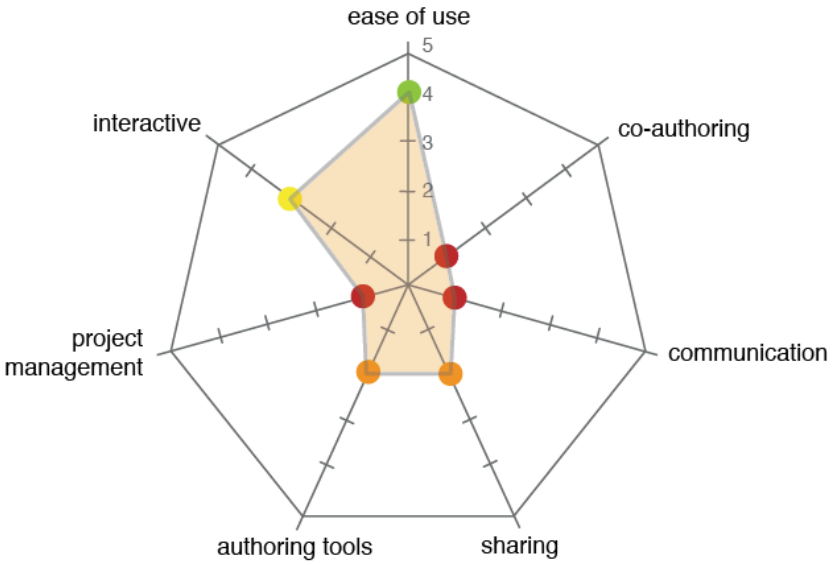
iPad and *iPhone*:

+ Mirror presentation
+ Auto detect projector and setup
+ Send drawings and highlights via email
+ Display video clips
+ Blackboard
- No whiteboard save content
- No markup PDF saving
- No annotation saving
- Only PDF presentation
- Keynote and PowerPoint presentation only through web-content
- Slide advance button too small
- No erase screen button
- No feedback on drawing pen size
- No text input from keyboard
- No communication features

SWOT analysis:

Strengths	Weaknesses
Simple presentation tool Support drawing and highlighting Automatic external screen setup	Only supports PDF No annotation and markup saving No collaborative support No remote presentation
Opportunities	**Threats**
Good presentation tool for simple PDF presentations. Could be used in learning environments	More specific and feature complete presentation tools with editing option and collaborative support

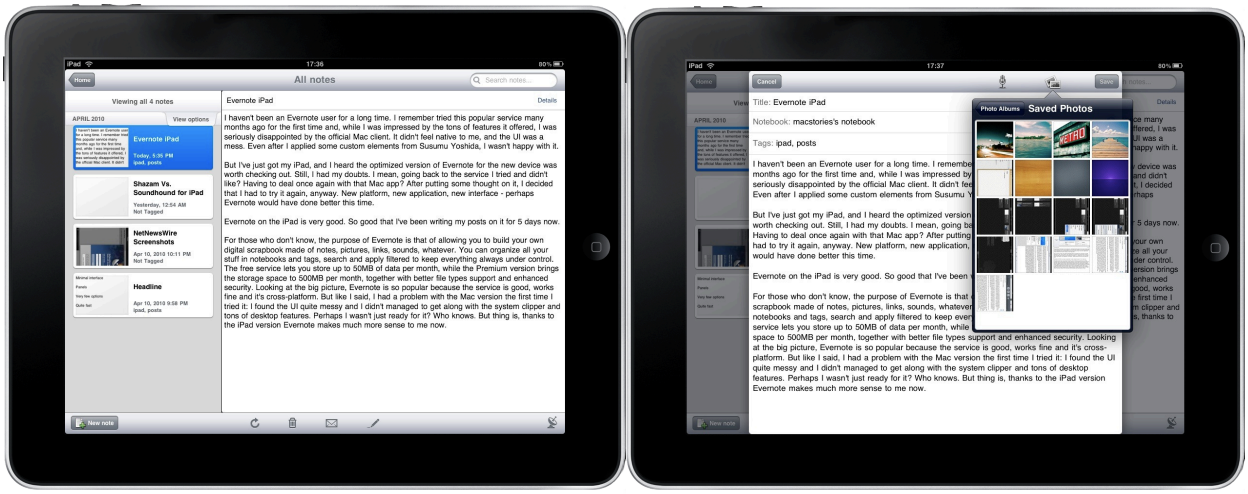
Overall conclusions:
Power Presenter is a simple PDF presentation tool that supports duals displays mirrored. Power Presenter lacks some features to turn it into a powerful presentation tool as saving markups and annotations and supporting Keynote and PowerPoint presentations.



Summary:
Evernote uses technology to help users organize various types of information from several different sources into one, central web-based location. Evernote is a great tool to keep track of notes, web-clips, documents, and allows users to simultaneously record audio notes and text notes useful for meeting contexts. Evernote allows users to create notebooks (a collection of notes), notes and tags.

Evernote runs on a multiplicity of computers and phones, from Windows to Mac OS X, from iPhones and iPads to Blackberries and Nokia smart phones. Evernote's advanced feature includes Optical Character Recognition (OCR) that searches for text within an image and tags that text for futures search results include the image. Evernote on the iPad looks great. The interface adapts to landscape or portrait mode.
Every Evernote user gets an Evernote email that, when emailed to creates a new note in you repository and synchronizes it throughout the users devices.

Evernote's web-based application has a similar interface to the Mac and PC version. This allows users to access their notebook and notes from any computer.
Evernote's premium version offers greater online storage and the ability to search text within PDF documents and attaching Word, Excel and other popular formats to notes.



Pros(+) and cons(-) new/interesting aspects (☆):

Windows and *Mac OS X*:

☆ Recognize text from images for tagging (upload to website) with OCR algorithm
+ Clip web-ages, screen shots and text notes for later reference
+ Organize notebooks and notes
+ Search text in PDFs (premium)
+ Interface consistency between platforms
+ Well designed interfaces for each devices
+ Share notes with other via email
+ Synchronize between devices and web
+ Allows encryption
+ Cross-platform
- No collaborative note-taking
- No integrated audio note taker on desktop versions

iPad and *iPhone*:

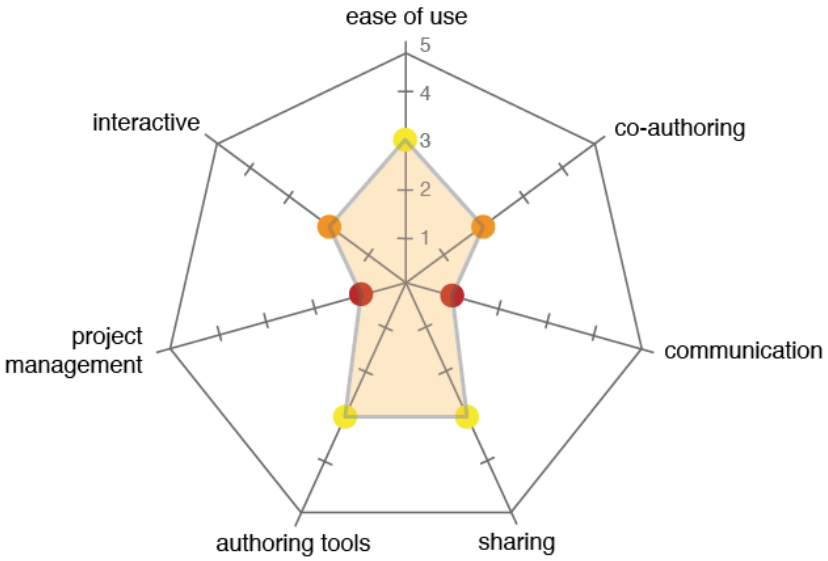
+ Simple, smooth interface
+ Synchronize online
+ Easy to organize information
+ Audio and text notes simultaneous
+ Draw notes
+ Pinch to peek inside notebook (iPad)
+ Geo-tagged notes
- No quick image editing (crop)
- No note editing
- No share to Dropbox
- Inconsistency in modal display from landscape to portrait modes
- No import of 3G video or audio from iPhone recorded media

SWOT analysis:

Strengths	Weaknesses
Cross-platform native application and synchronization Variety of different types of notes Search and organization features	iPad version needs some interface and feature refinements No collaborative note taking
Opportunities	**Threats**
Useful for any user takes many notes, saves web-clips, records audio memos and that has multiple devices that needs synchronized	In an organizational environment the lack of collaborative note taking can limit the tools adoption for group work

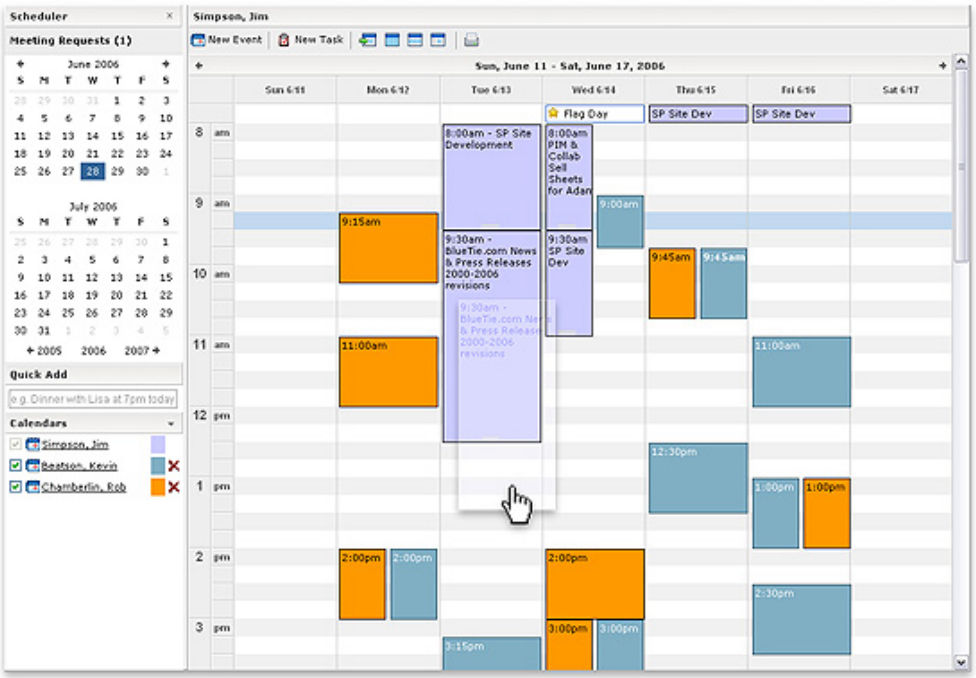
Overall conclusions:

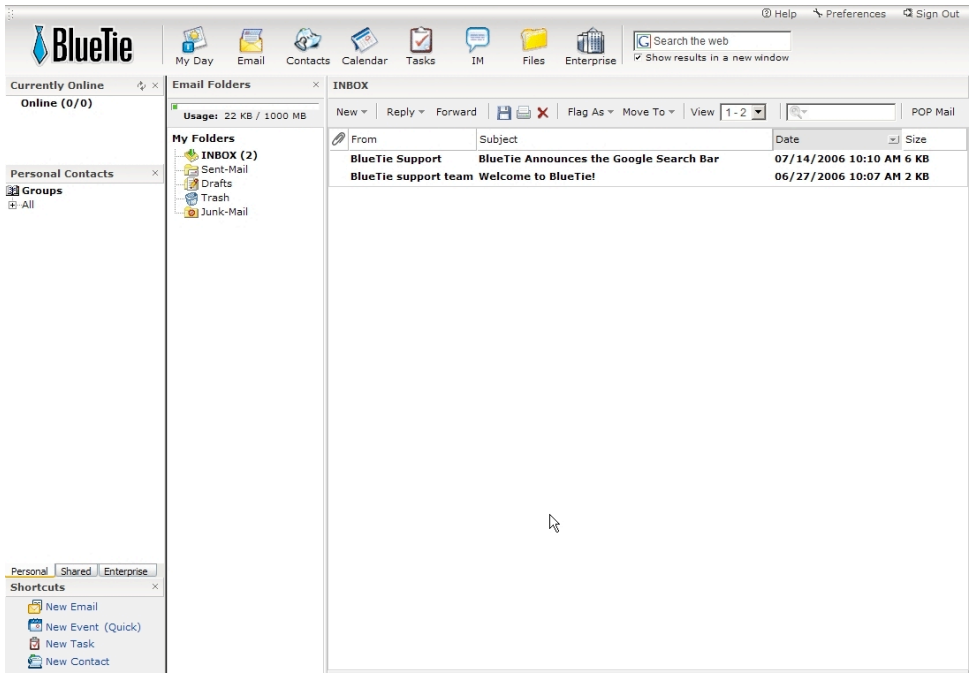
Evernote is a great tool to keep track of ideas, notes and tags. The easy web-clipping, screenshot taking, audio and document tagging allied with cross-platform synchronization make it a powerful tool for those who have multiple devices and need to keep information synchronized between them. Some interesting features as OCR make searching your information much easier since it can detect text from images and tag that text to the image for future searching. Evernote's web-based application allows users to access notes while not on their machines, with a consistent interface and almost same feature depth as the native desktop applications.


ease of use
5
4
3
2
1
co-authoring
communication
sharing
authoring tools
project
management
interactive

Summary:

Bluetie is an intuitive, and easy to use web-based, group collaboration online service that competes against Microsoft Exchange. Bluetie provides users with secure file sharing between Bluetie and non-Bluetie users, a dedicated email service, task management, instant messaging, contact management and calendaring features. Bluetie provides users with the possibility to share data with iCalendar, vCard and webDAV based services (e.g. Google Calendar). Bluetie has a very simple interface that resembles desktop applications with no "eye candy" to distract users from their task. Bluetie's free version allows the creating of up to 20 user accounts, 5 Gbytes of storage each.





Pros(+) and cons(-) new/interesting aspects (☆):

General:

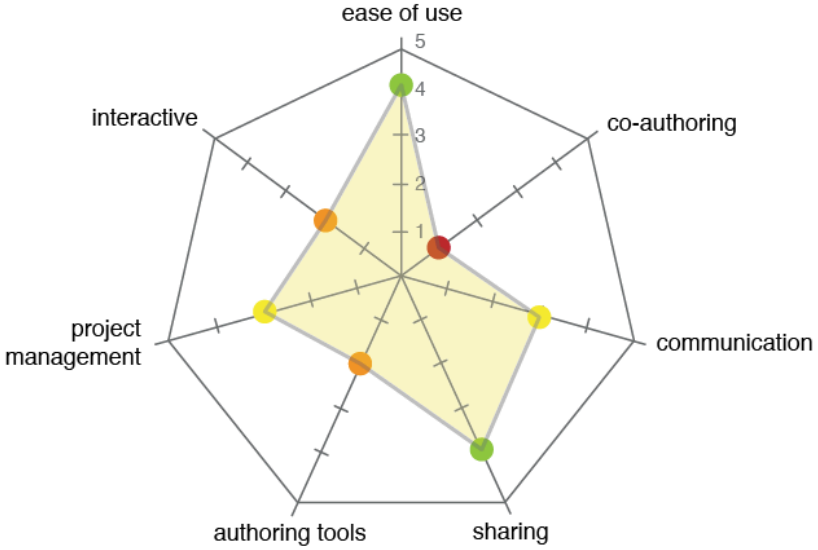
☆ Enter appointments in natural language
+ Highly intuitive and easy to use
+ Secure file sharing
+ Free version supports up to 20 users
+ Manager can manage users and assign Division administrators
+ Web-based
+ Ajax allows for drag-and-drop and right click functions
+ Sharing with other services
+ Server side anti-virus and junk email filter
+ Featuretizements instead of adds
+ Give control of you shared calendar
+ Windows and Mac machines
- No iPhone or iPad support
- No presence indicators (online users)

SWOT analysis:

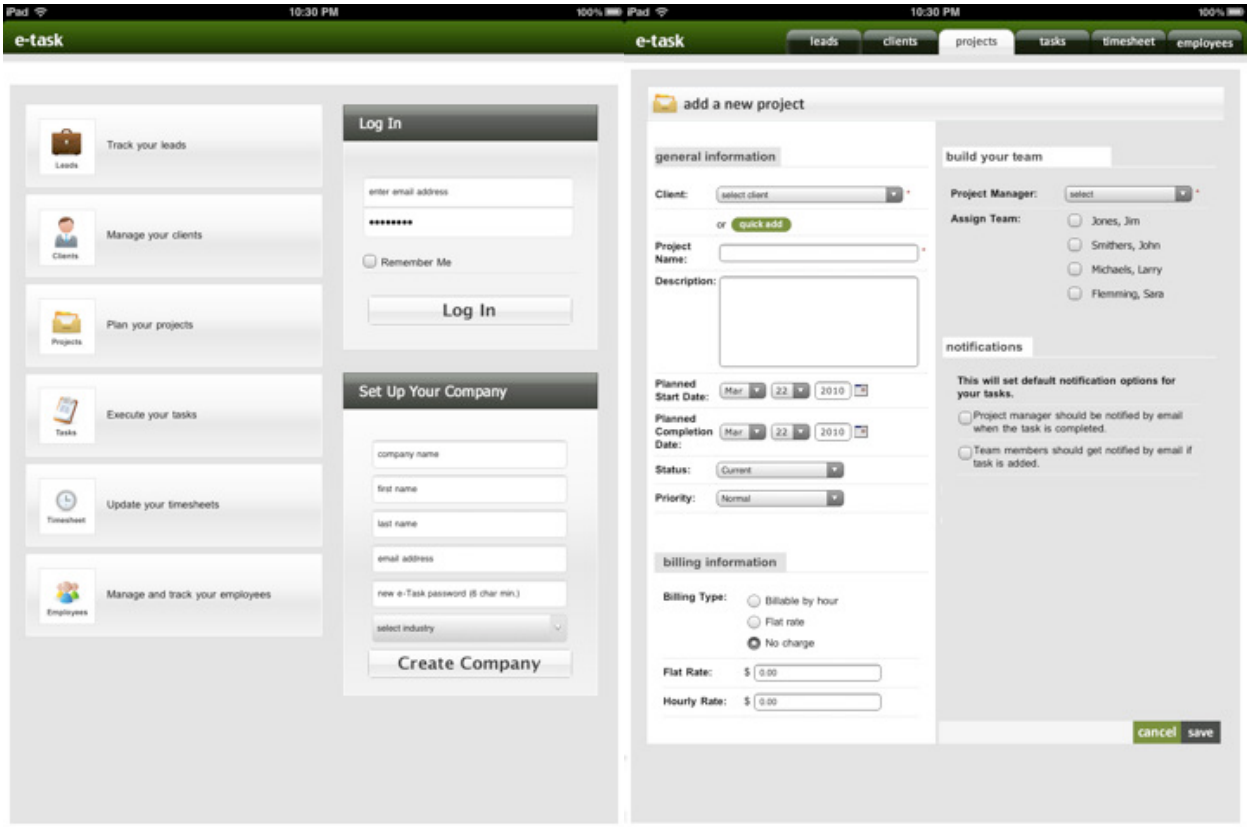
Strengths	Weaknesses
Web-based Up to 20 users in free version Secure sharing between Bluetie and non-Bluetie users iCalentar and webDAV integration	No realtime document collaboration support
Opportunities	**Threats**
Small organizations with a limited budget and without a dedicated email server	More feature complete web-based services that offer co-authoring collaborative tools

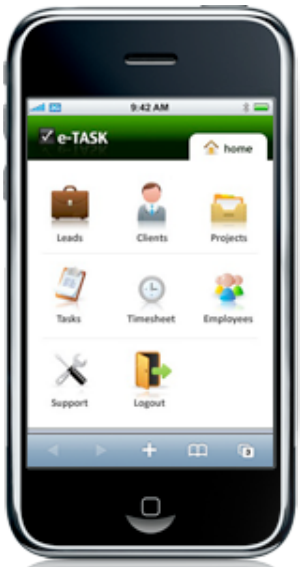
Overall conclusions:

Bluetie is a good tool for small organizations on a budget that require email, calendar and contact management service with instant messaging and secure file backup/sharing.



Summary:
E-task project is a simple online, and mobile project management tool that allows users to track their leads, maintain client information, manage projects, track tasks and time, and manage employee timesheets. E-task project is the iPad and iPhone version that automatically synchronizes with an e-task.net web account allowing users to manage information from their mobile device, as well as run on demand reporting and invoicing tools. E-task project allows users to create new projects, build and invite team members, schedule the project and manage tasks.





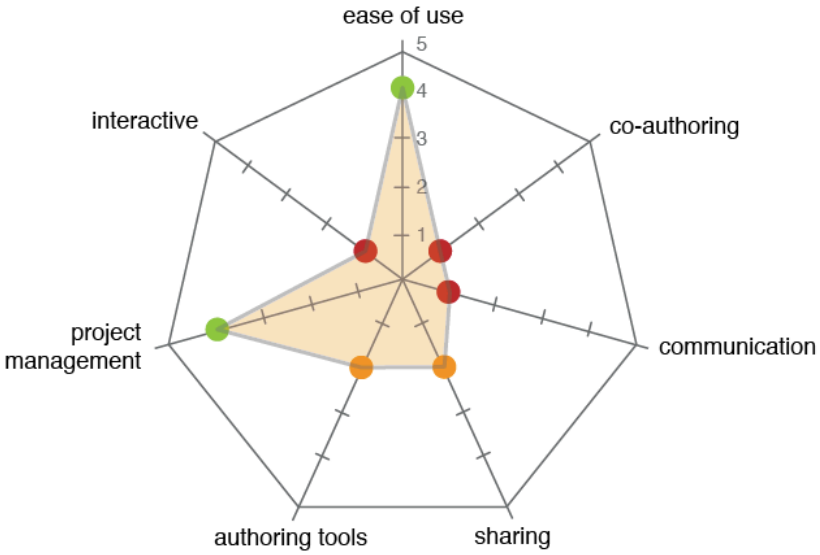
Pros(+) and cons(-) new/interesting aspects (☆):

iPad and *iPhone*:
+ Synchronize between devices and e-task.com account
+ Great project management features
+ Native application with well adapted interfaces
- Quite a few bugs
- Should be more visual (e.g. Gantt Charts)

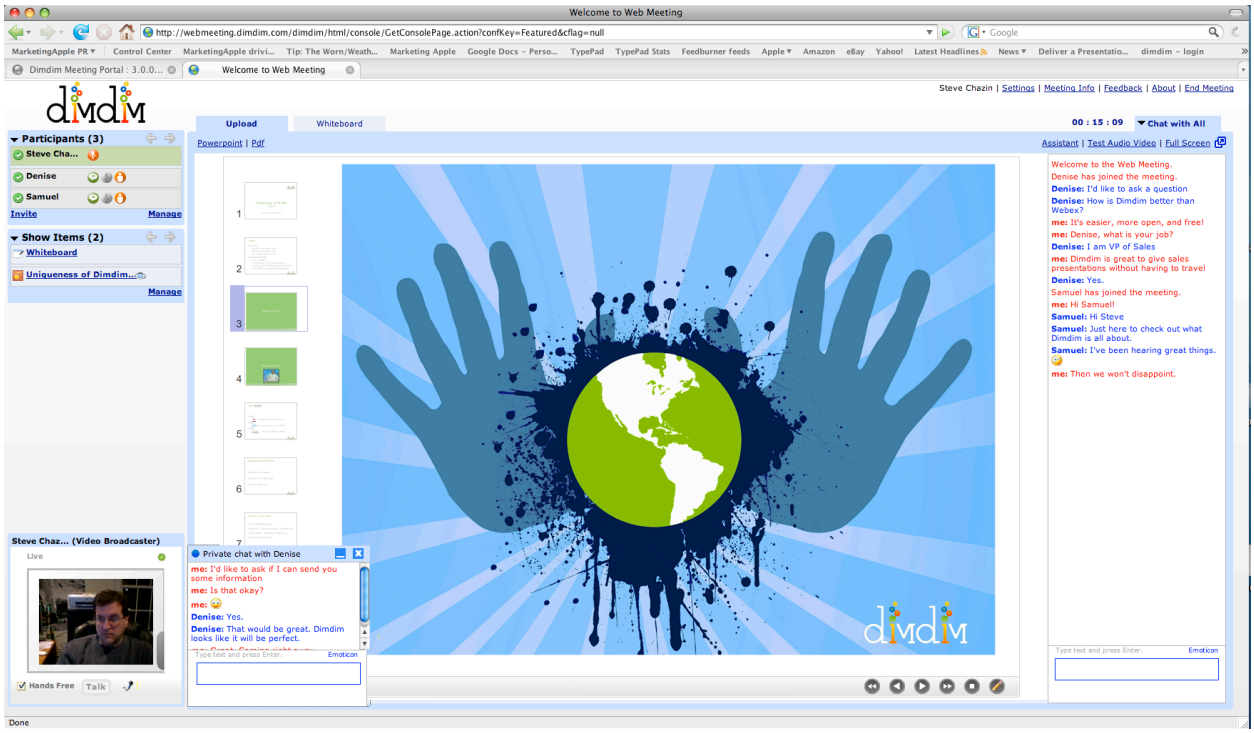
SWOT analysis:

Strengths	Weaknesses
Simple and well featured online project management tool Manage unlimited number of employees	Not as complete as other project management tools
Opportunities	**Threats**
Any size organization that needs a simple and mobile application to manage employees and tasks	Other more feature deep and complete project management suites

Overall conclusions:
E-task is a simple project management tool that has some great features to support small to medium sized organizations needs. With the iPhone and iPads mobility affordances E-task project allows users to manage their projects, employees, tasks and more from almost anywhere.



Summary:
Dimdim is a browser-based open source (to developer and modifiers) web conferencing tool with the ability to be tailored to the users needs. Dimdim is a very easy web conferencing tool, offering users the ability to join a meeting with one click, host a meeting or, change presenters. Dimdim offers some great features such as, conferencing tools, presentation and demonstration tools, instant messaging, shared whiteboards, and to share the presenters screen. Dimdim does not offer as many security features as other competitors.



Pros(+) and cons(-) new/interesting aspects (☆):

General:

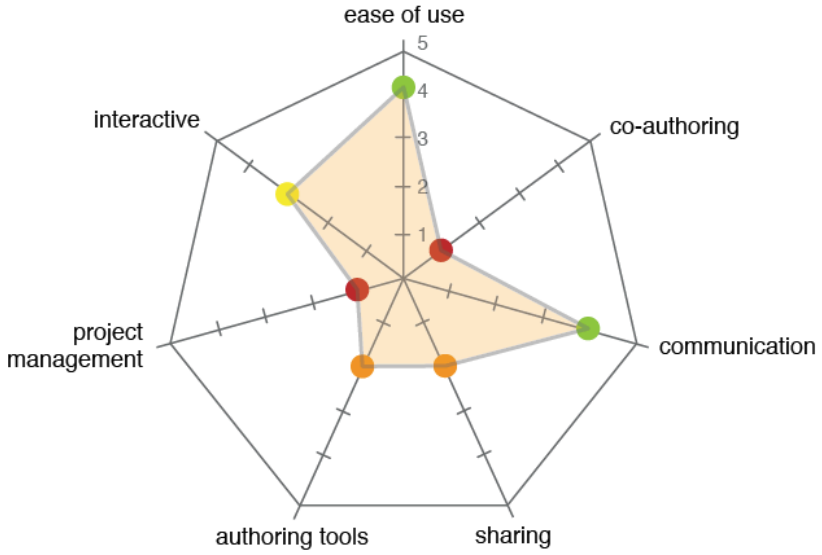
☆ Waiting area before the meeting begins
+ Online web-conferencing tool
+ Collaborate in real time
+ Audio/video conferencing
+ Different sharing features
+ Fun to use and feature deep
+ Open API for integration and customization
+ Pro version meetings up to 50 attendees, 100 webinar attendees, and 1000 event attendees

+ User friendly interface
+ Easy to share screen, whiteboard and presentation with only 2 buttons
+ Easy meeting invite (email or social networking)
+ Meeting recording
- VoIP sound quality not up to standards set by other VoIP services
- Tricky to get audio and video going
- Latency with desktop sharing

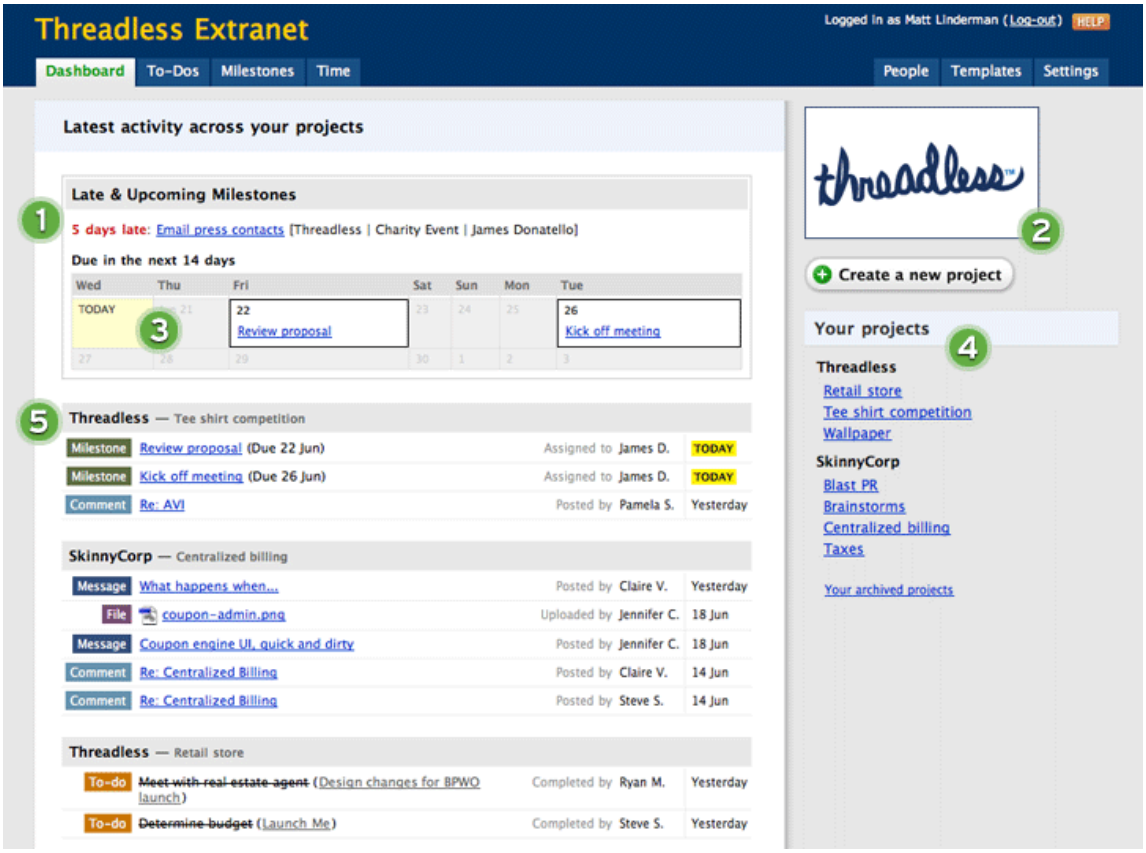
SWOT analysis:

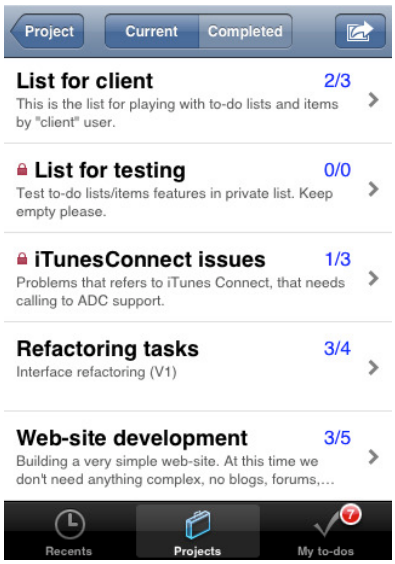
Strengths	Weaknesses
Well featured web-based conferencing tool Easy to invite, join, create meetings Video/audio chats Shared whiteboards, screens and presentations Meeting recording and playback	Audio and video communication has lower quality and lacks some features Latency with desktop sharing Security
Opportunities	**Threats**
Great tool for any size organization that needs a web-based easy to use web-conferencing tool to keep clients and employees up to date and collaborating	Other similar services offer better security and communication features

Overall conclusions:
Dimdim is an easy to use, feature deep, web-conferencing tool adequate for any size organization that requires a simple, online tool to present, communicate, collaborate and share material to a group of attendees.



Summary:
Basecamp is a dynamic and versatile web-based project management tool that everyone from designers and developers, to teachers and students can use with ease. Basecamp provides every paid subscriber ($49/month) a centralized location from where the project leaders, team members and all the others who are part of the project team, the ability to upload and share files, as well as review work from others. Clients are updated on the developments of the project while project leaders assign specific tasks to team members and monitor their work. Basecamp allows users to tag messages to almost everything as a simple way of communication and collaborating. Basecamp provides a writeboard feature where clients may write todo lists or messages to employees.





Pros(+) and cons(-) new/interesting aspects (☆):

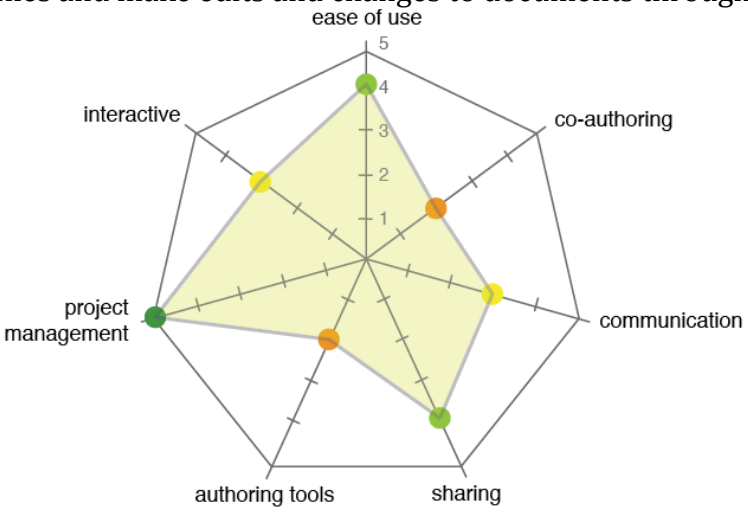
General:
+ Cross-platform and web-based
+ iPhone, iPad and Blackberry support
+ Focus on simplicity and intuitiveness
+ Attach messages to virtually anything
+ Central file repository
+ Supports popular file formats (.doc, .ppt, .psd, .mov, .zip, etc)
+ File revisions
+ Prevents risks of undelivered email
+ ToDo lists, milestones and chat
+ Permission system
+ Use personal server (no storage limit)
+ iCal support (one iCal per project)
+ Dashboard displays the situation awareness (project milestones, todo's, messages, deadlines, etc)
- Use of writeboards bothersome
- Setting up chat is difficult
- No webDAV support
- No Outlook or Exchange integration

iPad and *iPhone*:
+ Tap provides users with a popup menu (edit and delete) for easy of use

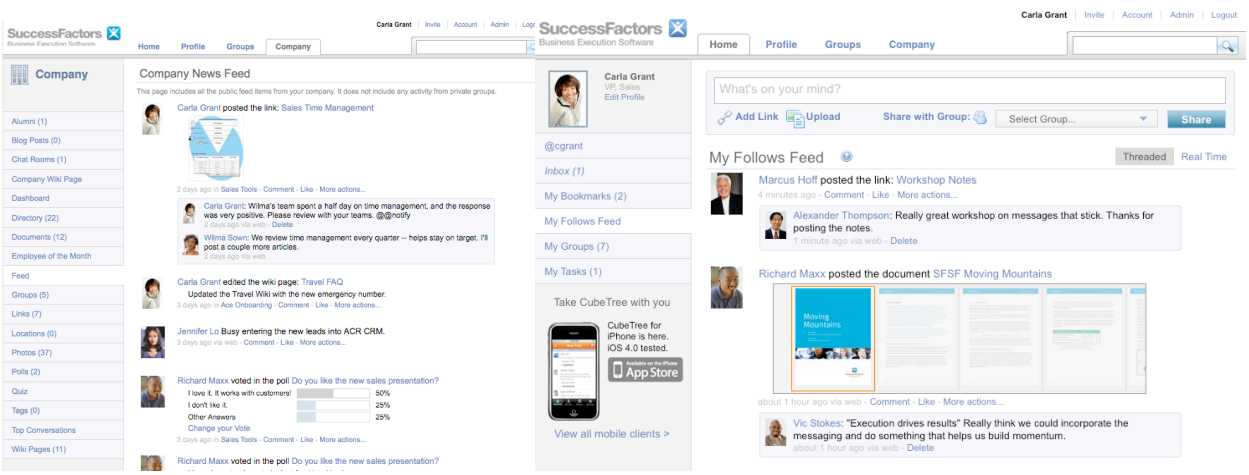
SWOT analysis:

Strengths	Weaknesses
Web-based project management and collaboration tool Feature deep Easy to use, intuitive, interface Video and audio communication	No realtime document collaboration No webDAV and Outlook integration
Opportunities	**Threats**
Individual, remote teams and small organizations that need a simple to use project management tool with some good communication features	May not support larger organizations needs

Overall conclusions:
Basecamp is a great tool for telecommuters, remote teams, and individual to small sized organizations. Additionally it can be a great resource to work with clients, as they can add to-do lists, upload files and make edits and changes to documents through writeboards.



Summary:
CubeTree is a cloud-based online enterprise collaboration tool built on a social networking model, adapted for companies. CubeTree is modeled after sites like Facebook and Twitter, where employees and clients can belong to a network and groups. CubeTree integrates, messaging, content sharing, microblogging, activity feeds, wikis, user profiles, and user walls. CubeTree for iPhone allows users to get greater cross company visibility, latest status updates, and participate in discussions from anywhere.



Pros(+) and cons(-) new/interesting aspects (☆):

General:
+ Web-based social network
+ iPhone, iPad and BlackBerry support
+ Familiar to popular social networking sites
+ File sharing
+ Secure HTTPS and SSL protocols
+ Cloud based enterprise collaboration suite

iPad and *iPhone*:

+ Supports the essential features
+ Upload photos of whiteboard sessions or to capture key ideas

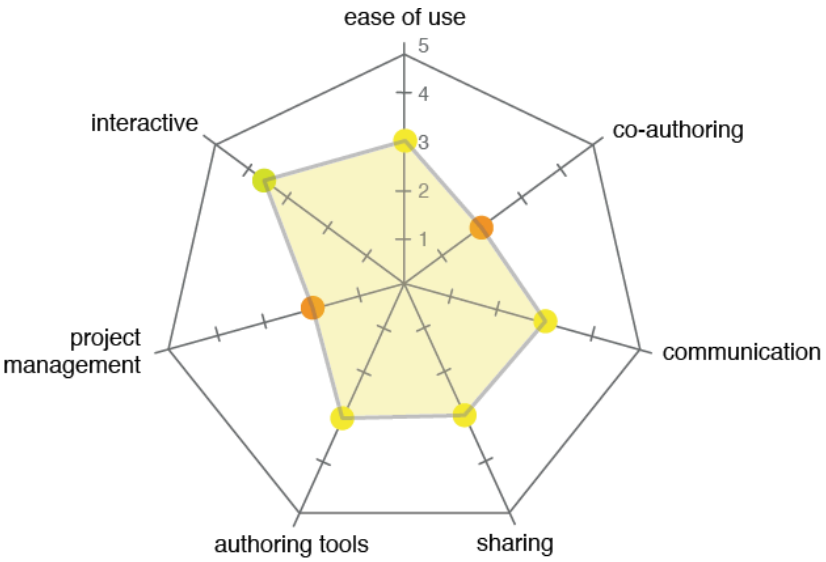
- No native iPad application

SWOT analysis:

Strengths	Weaknesses
Cloud based social networking tailored for business and enterprise usage Feature deep	May be distracting or counterproductive
Opportunities	**Threats**
CubeTree can be used by any size organization	Users in a business context may need a real time document collaboration tool

Overall conclusions:

CubeTree brings social networking to enterprise and businesses as a collaboration tool. CubeTree's social nature allows employees and clients to be connected and communicate through a familiar website. Users can share information and ideas, post comments and messages, and overall, keep up to date.



Summary:
iVisit is a very versatile online video chat service that comes in three packages. iVisit Presenter (basic free version) which allows users to hold video conferences and multi-party meetings (up to 8 people), share desktop and display a presentation. iVisit mobile allows users to access iVisit features from their mobile phones. iVisit Client Server allows users to operate their own secure communication server with fully administrative and user access privilege features.

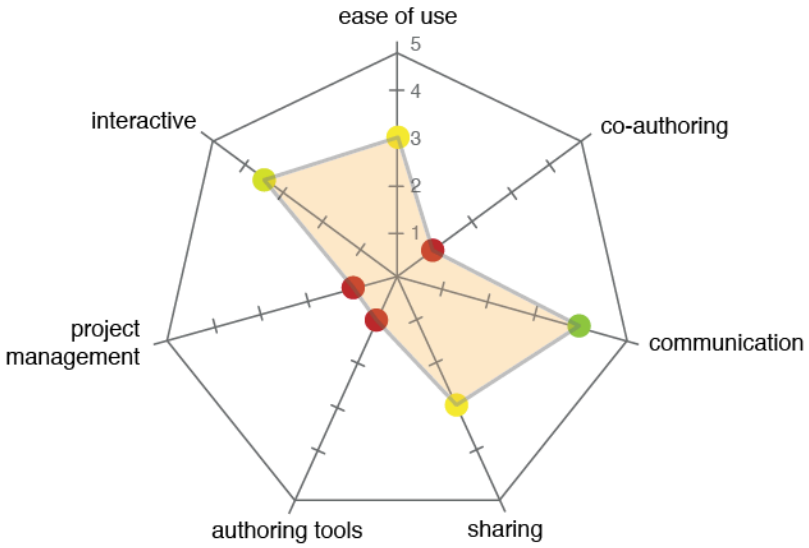
Pros(+) **and cons**(-) **new/interesting aspects** (☆):

General:
+ Video/audio conferencing
+ Share screen and presentation
+ Multi-party meetings (8 participants)
+ Attend PowerPoint presentation and meetings from a mobile phone
+ Instant messaging and video chat support for mobile phones
+ Big buttons, icons and easy to use contact profiles
+ Offline audio or video messages
- No iPhone or iPad support
- Interface looks "antiquated"
- Inadequate help file
- Bad customer service
- Needs installation

SWOT analysis:

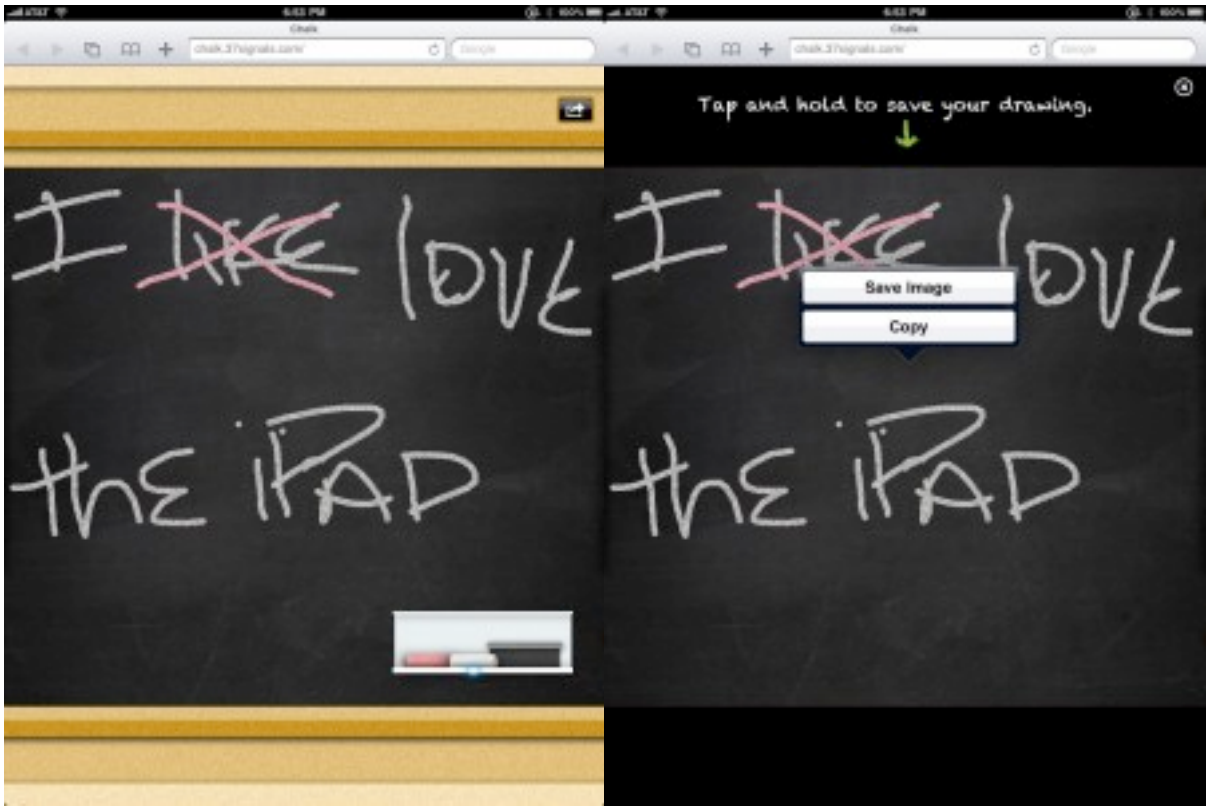
Strengths	Weaknesses
Hold multi-party meetings and presentations (8 people) Share screen, presentations while holding video conferences Mobile phone support	Customer services and help files are inadequate Looks and feels old
Opportunities	**Threats**
Small organization with remotely located employees or clients in need of a simple tool to hold video conferences, meetings and presentations	Web-based services that afford the same service with more specific meeting and presentation features

Overall conclusions:
iVisit is an easy to use and versatile communication service. By supporting meetings and presentations with video conferencing, screen and presentation sharing, makes iVisit into a useful tool for small organization to keep employees and client up to date.



21. Chalk

Summary:
Chalk is a free iPad only HTML based collaborative web application. Chalk allows users to draw ideas on a blackboard with two different color chalks and a eraser. Users then save the image for later reference into the iPads Photo Library and email it to colleagues and friends.



Pros(+) and cons(-) new/interesting aspects (☆):

General:

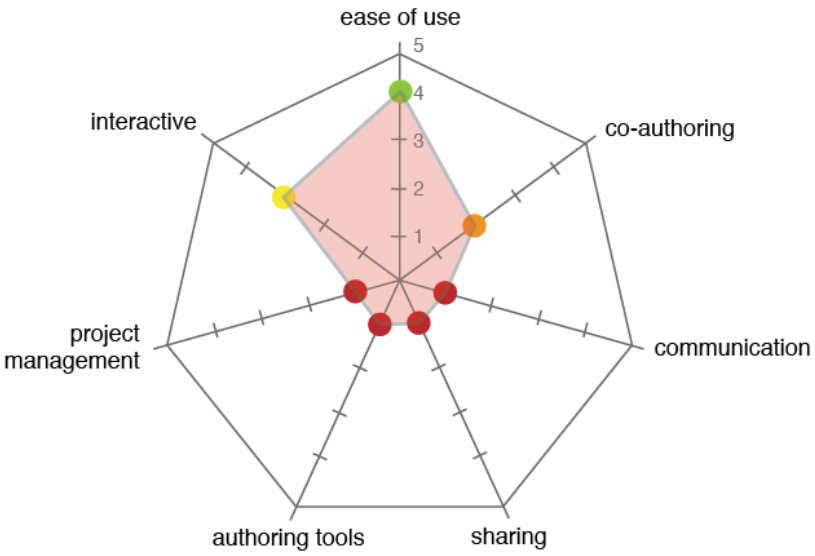
+ No need for internet connection
+ Web application
+ Easy to use
- No sharing to social network
- No real time collaboration between iPads
- No diagram or more advanced design support
- No direct sharing (email, Dropbox)
- No full screen backboard

SWOT analysis:

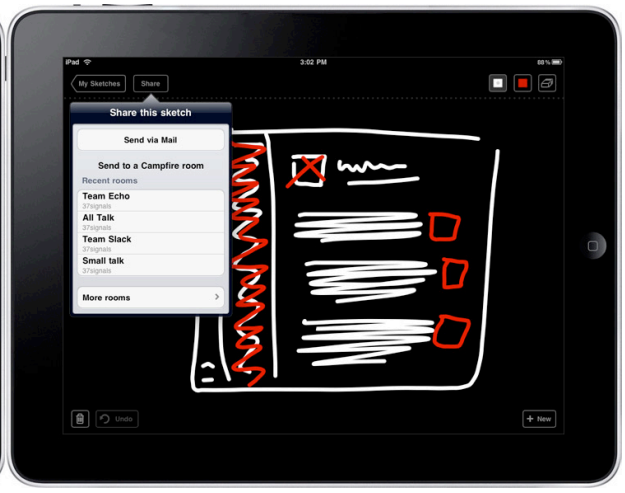
Strengths	Weaknesses
Easy to use straightforward interface Web-based application with offline usage	Very limited features No direct sharing and real time collaboration
Opportunities	**Threats**
Chalk is an ideal application for design and software teams that need a simple way of sketching ideas and saving them for future use	Too simple for profession business usage Other (paid) application support more in depth features

Overall conclusions:

Chalk is an easy to use yet very limited collaboration tool for the iPad. Chalk is useful to record ideas sketched as if on a blackboard in digital format.



Summary:
Draft is another application from 37 Signals (as Chalk, BaseCamp, Campfire and others). Draft ($9.99) is and iPad only simple to use drawing application that integrates with Campfire (sketch into meetings). Draft saves automatically your work and purposefully offers users limited tools. Draft allows users to draw in two colors and one brush thickness, no other features are available except for emailing and sending to a Campfire meeting.



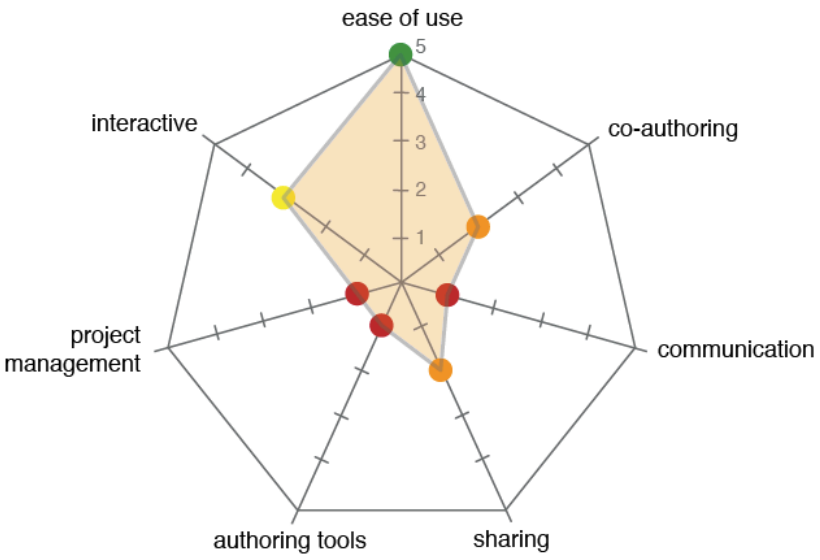
Pros(+) and cons(-) new/interesting aspects (☆):

General:
+ Very simple and straightforward
+ Campfire integration
- Static canvas
- 1 level undo
- Very basic
- No inter-iPad collaboration

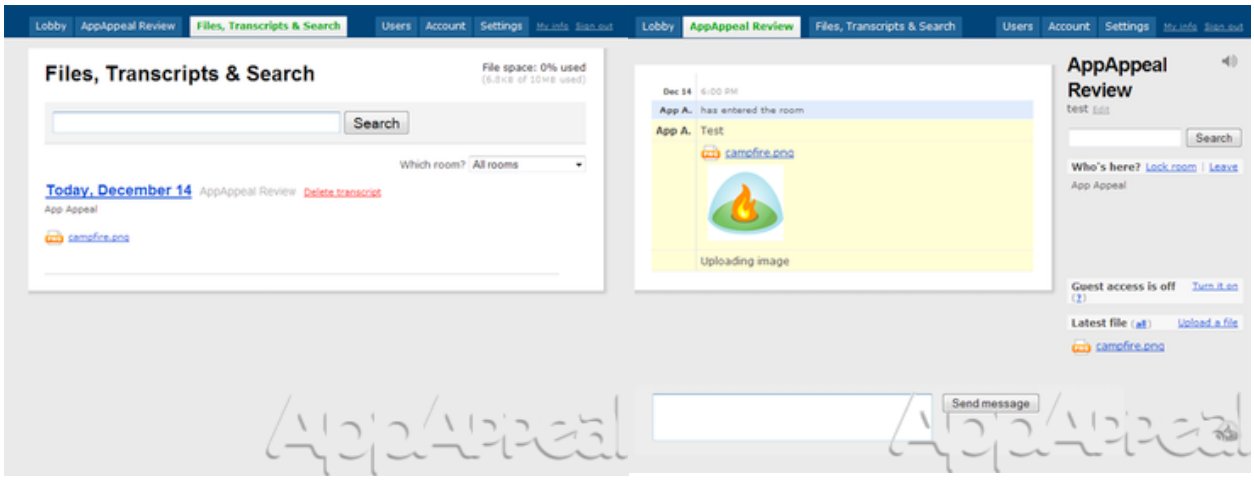
SWOT analysis:

Strengths	Weaknesses
Easy to use drawing application	Too simple offers the users with no choices or control over how to draw Costs $9.99
Opportunities	**Threats**
Web designers may feel competed to use a tool like Draft to sketch initial ideas and email them	Similar applications that afford vector drawing and diagram support

Overall conclusions:
Draft is a simple to use and allows users to use their finger to sketch ideas down for later reference. Draft's integration with Campfire make it a good tool for sharing ideas during a Campfire meeting.



Summary:
Campfire is a web-based team collaboration tool with instant messaging designed for groups of individuals. Campfire lets businesses set up password-protected chat rooms quickly and easily. Users can invite clients, colleagues, or vendors to collaborate in real time. Campfire integrates with 37 Signals project management application, Basecamp, so you can assign projects to dedicated chat rooms. In addition, Campfire lets you upload files, which is ideal for updating projects on the fly.



Pros(+) and cons(-) new/interesting aspects (☆):

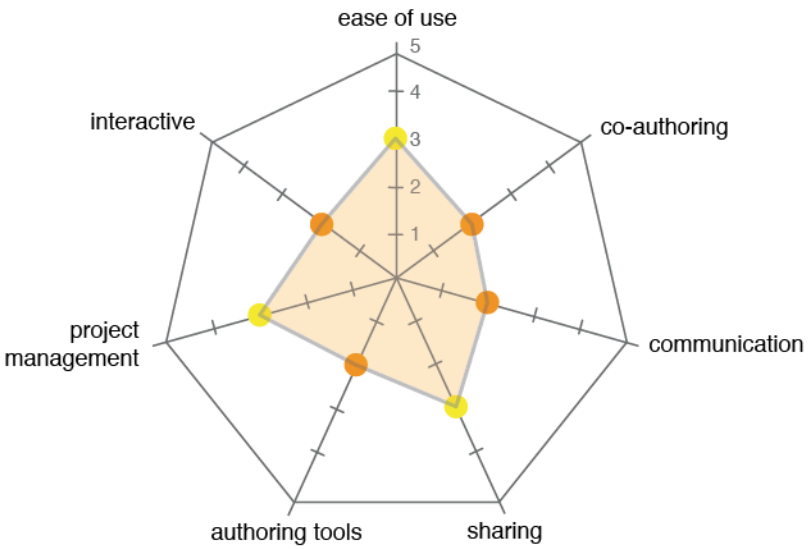
General:
+ Secure 128bit password protected chat rooms
+ Basecamp integration
+ Easy to share (drag and drop)
+ Interface consistency with other 37Signals application (as Basecamp)
+ Transcript searching
+ Admin room member management
+ Easy invite to chat room (URL)
+ Upload files to chat room
+ Cross-platform and native iPhone application
- Limited integration with Basecamp
- No daily digest
- No iPad support
- No new message alert

iPhone:
+ Live image previews within the chat screen
+ Inline viewing of popular file formats (Excel, Word, PowerPoint)
+ Landscape support
+ Unload photos
+ SSL accounts supported
+ Transcripts
+ Free application

SWOT analysis:

Strengths	Weaknesses
Secure password protected char rooms Three level administration (admin, member, guest) Transcripts Integration with Basecamp	Not tightly integrated with other 37signals services No audio or video conferencing tool
Opportunities	**Threats**
Any size organization in need of an easy and quick way for communicating between clients and colleagues	Other team collaboration suites afford more interactive communication features as video conferencing

Overall conclusions:
Campfire is an instant messaging communication solution for businesses that are, or not, part of Basecamp community. Campfire allows businesses to organize secure password protected chat rooms with members and guests, for collaboration, sharing and contribution to the defined meeting room topic (or Basecamp project).



Summary:
Facetime is an easy to use video calling software for Apple exclusive products. Facetime is very easy to use and has no setup required. Facetime allows users to video call from their iPhone 4 or Mac's to other iPhone 4, iPod Touch and Macs through a Wi-Fi network for free. all that users need to begin a video call is an Apple ID account and a some sort of identification (email or phone number). Facetime automatically retrieves all you contacts from Address Book and adds them to Facetime. Calling is as simple as selecting a contact from a list. Facetime runs in the background so even when the application is not actively running, user are still able to receive call requests, accept or decline them. Facetime allows users to add favorite contacts to a list, view missed or latest calls.

Pros(+) and cons(-) new/interesting aspects (☆):

General:

+ Very simple to use and start video calls
+ Good video and audio quality
+ Free service over Wi-Fi network
- No sharing of any kind (documents, desktop, etc)
- Exclusive to Apple products
- Contact list does not display who supports Facetime

iPhone:

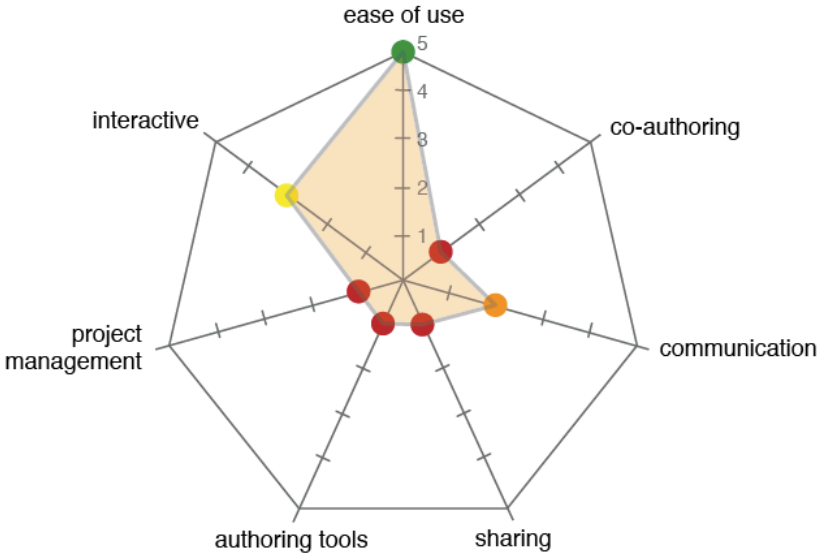
+ Seamless transition front facing camera to rear camera
+ Free service
- Only supports iPhone 4
- No recording messages

SWOT analysis:

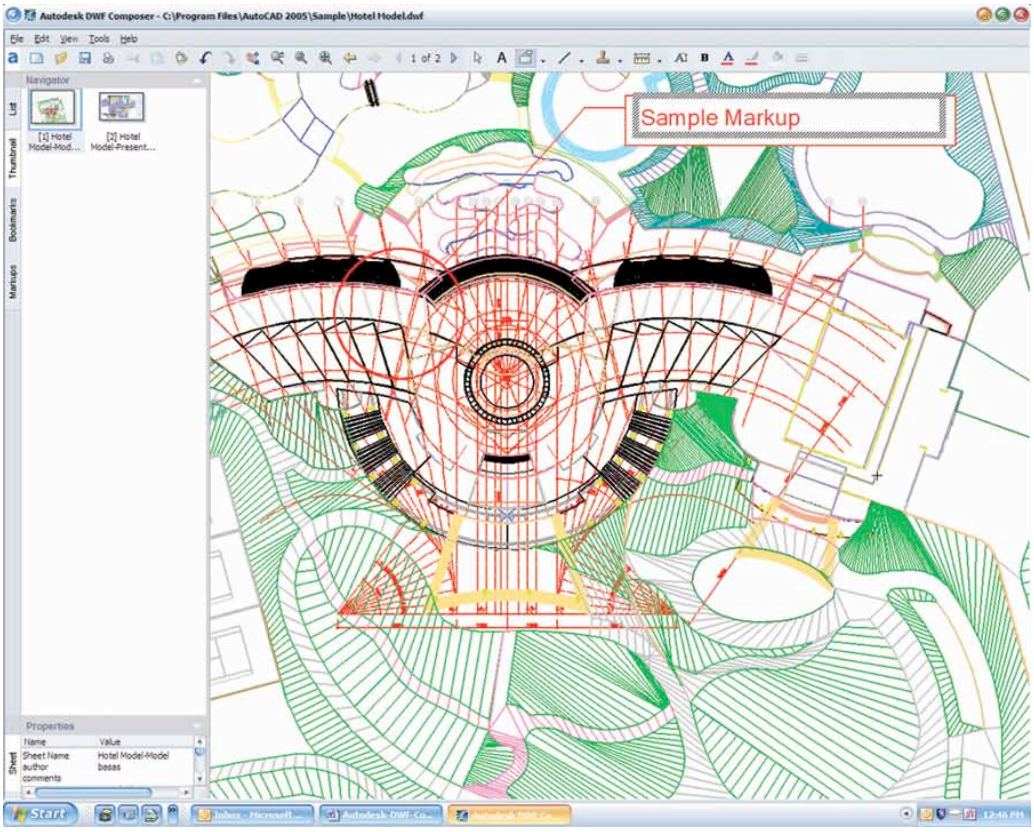
Strengths	Weaknesses
Free service based on Wi-Fi network Very easy to use Good use of iPhone dual cameras Great inter-apple device video communication	Very feature shallow
Opportunities	**Threats**
Free video communication between Apple devices	More feature deep communication tools like iChat and Skype make Facetime seem incomplete

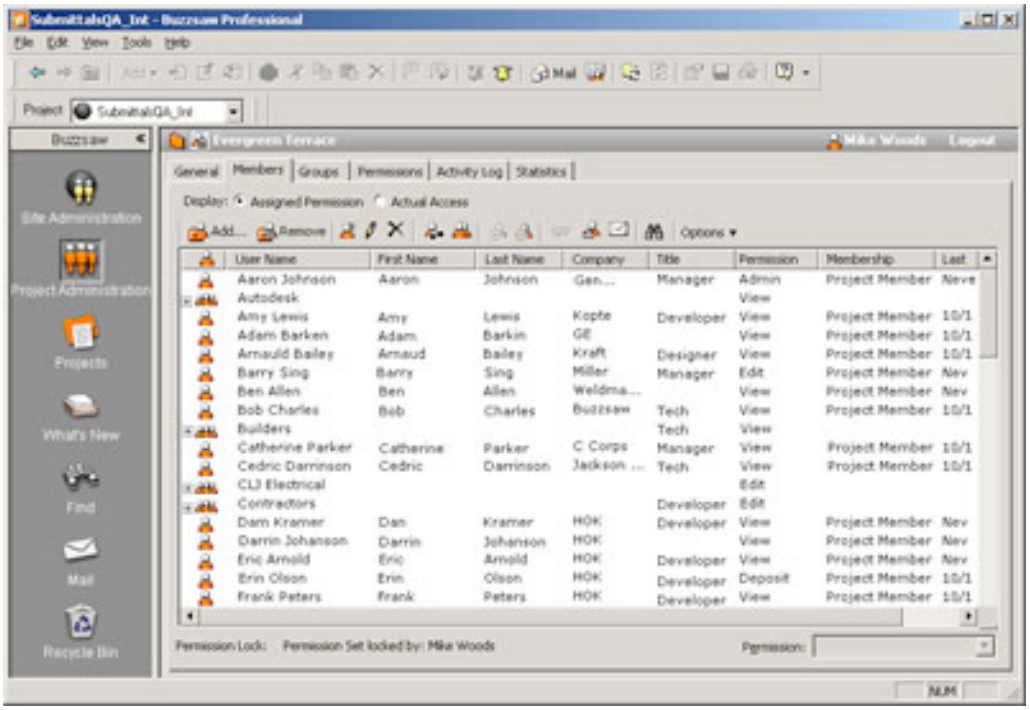
Overall conclusions:

Facetime is a great, simple to use video chat tool for keeping Apple users connected. Facetime users that are accustomed to Skype and iChat may feel disappointed with the lack of features that Facetime has to offer.



Summary:
Autodesk Buzzsaw is a web-based software as service, that focuses on document sharing, and data management tools for architecture, engineering and construction firms. Autodesk Buzzsaw is created for project teams to better centralize and synchronize information, securely exchange project information, enhance team collaboration through design reviewing and support building information workflow.





Pros(+) and cons(-) new/interesting aspects (☆):

General:

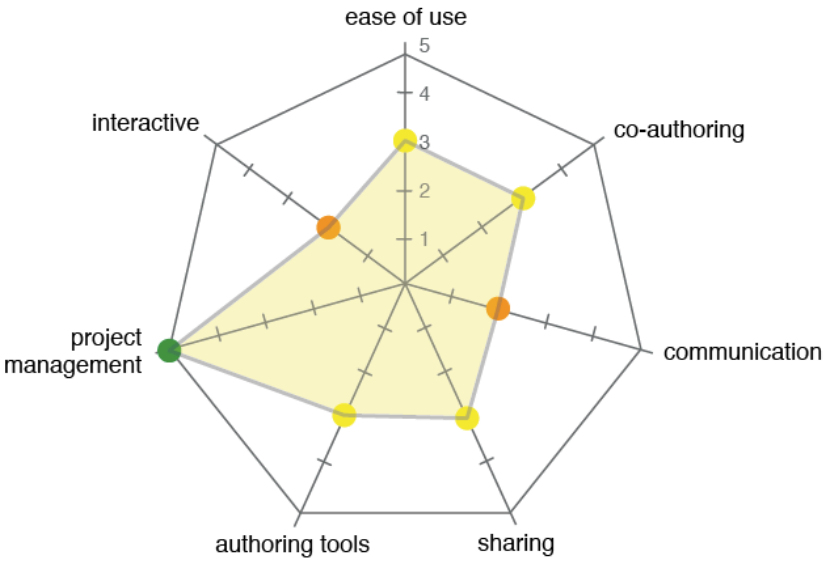
+ Web-based software as service
+ Cross-platform
+ Easy to use with familiar Windows Explorer interface
+ File locking
+ System redundancy
+ Complete permissions
+ Cloning projects
+ Easy email invite to project
+ Project file template for easy use
- No mobile phone support
- No real time document collaboration
- No instant messaging
- Administrator needs to install client

SWOT analysis:

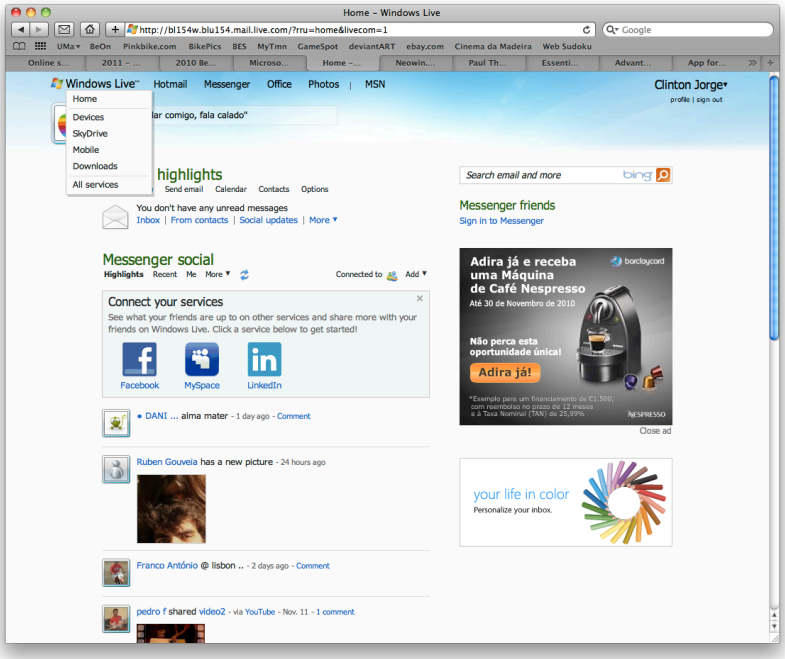
Strengths	Weaknesses
Complete feature deep document management solution Web-based cross-platform	No realtime communication and collaboration No mobile device support
Opportunities	**Threats**
Architects, engineers, construction firms in need of a document management solution	Electronic document management solutions that afford communication and mobile phone (PDA) support

Overall conclusions:

Autodesk Buzzsaw is a great tool for architects, engineers and constructor firms in need of a complete electronic document management solution. Autodesk Buzzsaw provides users with server redundancy for maximum stability and uptime, a full set of management features, permissions, and easy collaborator inviting through email.



Summary:
Windows Live is a cross-platform collection of Microsoft's popular online services and applications. Windows Live incorporates a email service (Hotmail), instant messaging service (Messenger), an online storage, backup and file synchronization service (SkyDrive), a document authoring suite (Office), all with mobile support for access almost anywhere. Essentials is the desktop application that brings all these services together and offers the online synchronization feature with SkyDrive.



Hotmail
Hotmail is an online email service that offers a number of tools to keep users inbox organized and practical. Hotmail allows users to access Microsoft Office files from inside Hotmail. Intuitive spam filtering, virus scanning and inbox organization are Hotmail's key features.

Office
Live Office allows users to work with Office files virtually anywhere. Office free web application allows users to edit, view and share, Word, Excel, PowerPoint and One Note documents right from the web browser.

Mobile
Windows Live Mobile allows users to keep in touch without a computer. With the mobile application users can email, instant message or video chat, share social updates and synchronize photos and documents to SkyDrive on the move.

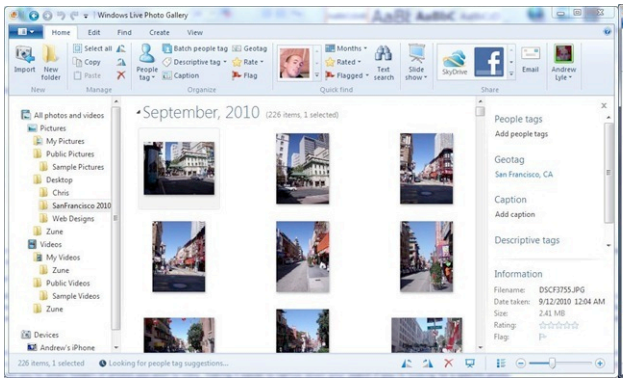
SkyDrive
SkyDrive allows users to access and share documents, photos and videos from almost anywhere up to 25GB with password protecting for increased security.

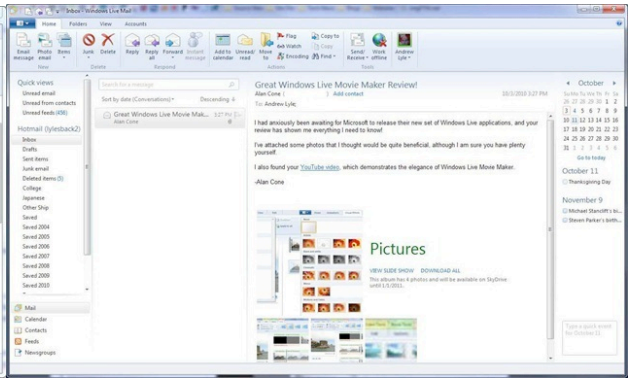
Messenger 7
Messenger is a communication service that allows users to share and talk in real time. Offering IM, audio and video chat, file sharing, and now social network integration.

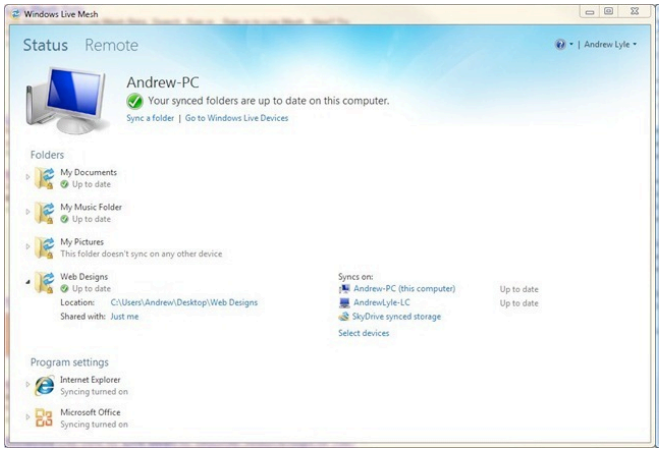
Messenger keep users connected to friends across social networks with ease, whether on you computer or phone.

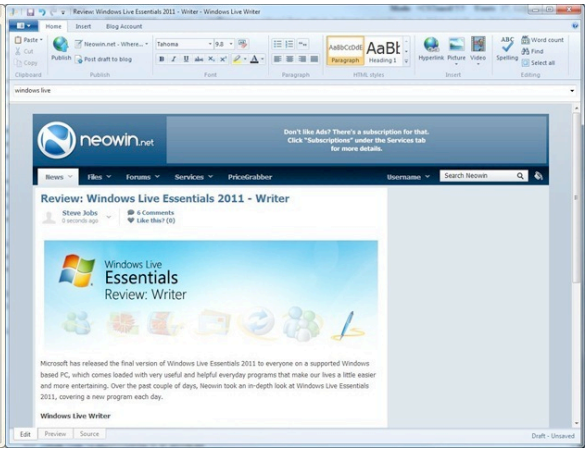
Essentials

Microsoft Essential offers users Messenger, Photo Gallery, MovieMaker, Writer, Mail, Sync and Family Safety in a single download. Photo Galley allows users to share pictures with Flickr and SkyDrive, tag friends or groups, locate pictures geographically. Sync allows users to manage content in more than one computer, synchronizing content between computers and to SkyDrive. Sync provides remote administration of machines configured to the account.









Pros(+) and cons(-) new/interesting aspects (☆):

General:
+ Complete feature deep productivity suite
- Some application only run installed on a computer

Hotmail:
+ Open Office documents from within Hotmail
+ Intuitive spam filter
+ Server side anti virus
+ Easy to organize inbox and messages

Messenger 7:
+ Tabbed interface
+ Integrate with social network
+ Share user status to any social network with one click
+ Share pictures and videos to social networks
+ Share documents and files to contacts
+ Instant messaging, audio and video chat
+ Customizable interface
- No display names
- Force users to use their real names
- No contact block option
- Small cluttered toolbar

SkyDrive:
+ 25GG free online cloud-based storage
+ Share or backup pictures, documents, videos

Essentials:
+ Package with interesting tools
+ Sync allows synchronization of folders and files to a multiplicity of devices
+ Writer allows users to create documents and blogs and share them easily
- Requires download and installation

Office:
+ Web-based version of Microsoft Office suite
+ Create, edit and view Word, Excel, PowerPoint and One note documents
+ Share Office documents easily and access them within Hotmail

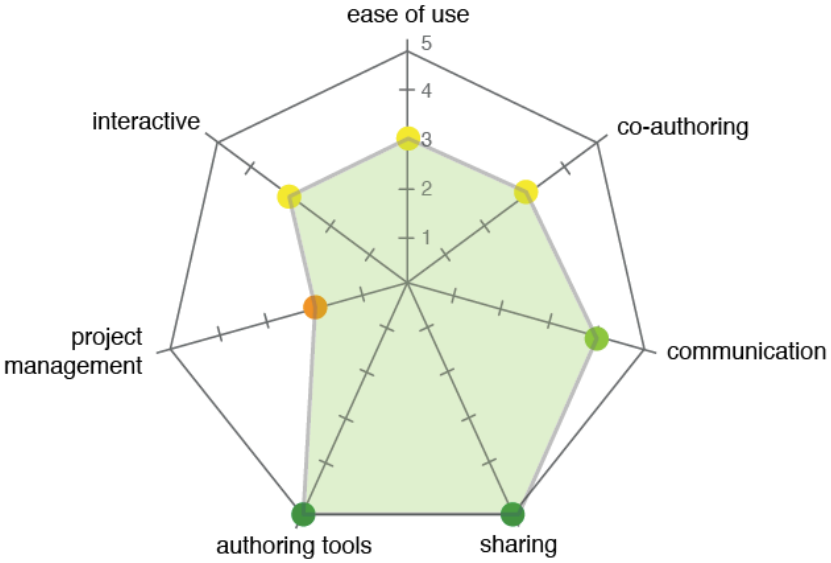
Mobile:
+ Check email, IM and free video chat
+ Manage photos, blogs and compose documents
+ Get updated from social networks

iPhone and *iPad*:
+ Messenger Live application is well implemented with easy access to contacts and view of chat bubbles
+ Access email, view inbox, compose emails, search and delete messages
+ Social network updates and view
+ Clean crisp interface
+ View any photos from Windows Live Blog and organize them into albums

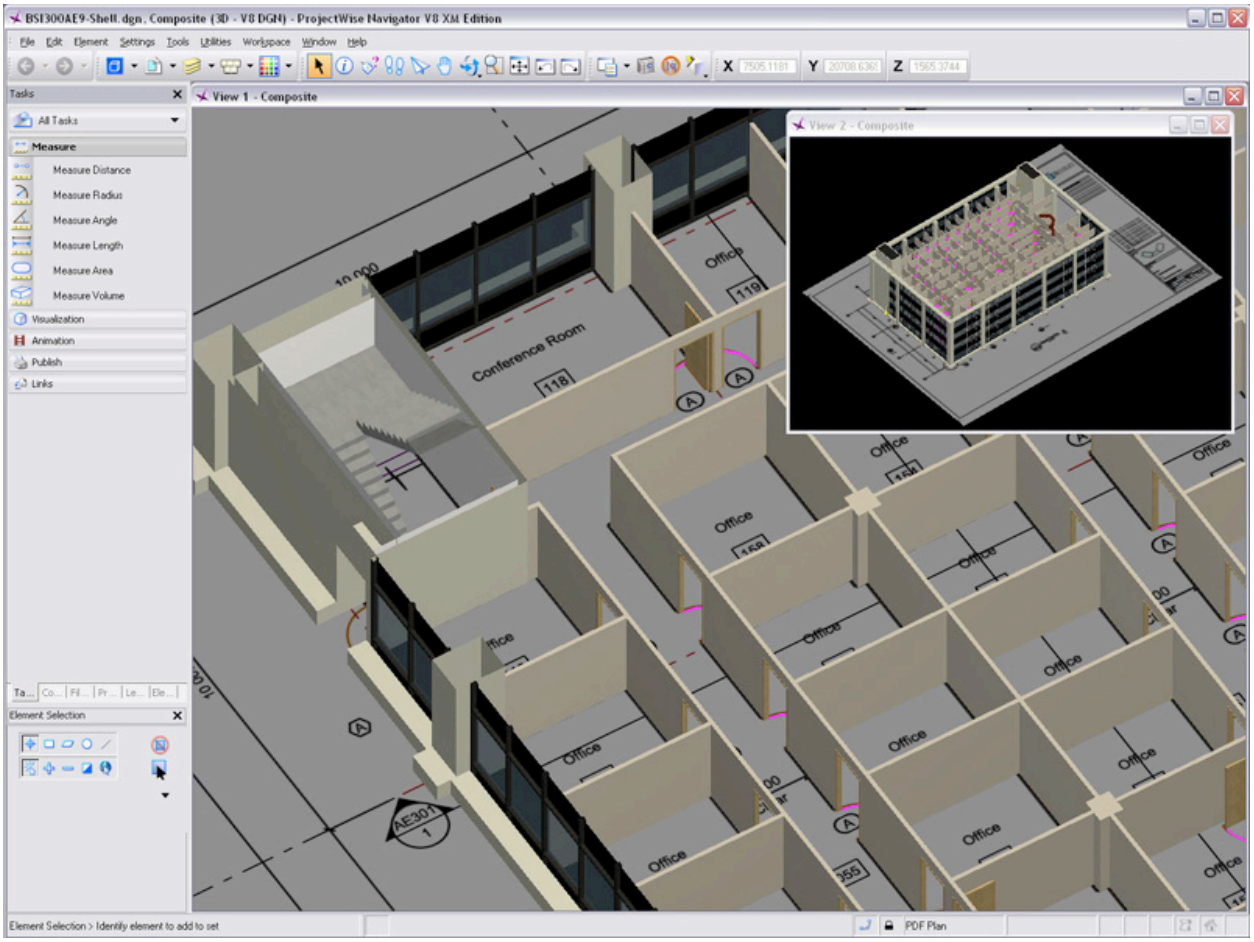
SWOT analysis:

Strengths	Weaknesses
Complete productivity suite Cloud-based storage Full featured communication Web-Based Microsoft Office suite Mac OS and iPhone support	Individual modules need more refinements No real time collaboration within Office Live
Opportunities	**Threats**
Any individual or small company in need of a complete set of productivity tools	Not specialized enough for more profession settings

Overall conclusions:
Windows Live is a sep forward to a complete online productivity suite that offers users many great features for free. SkyDrive offers 25GB free storage space and 5GB sync space. Windows Live Messenger integrates most social networks effortlessly with status updates to a number of different networks with one click, besides instant messaging and video chat. Essentials offers users a package for download and installation of desktop with a variety of tools such as Writer, Sync, Messenger and Mail great for productivity.



Summary:
ProjectWise is an integrated suite of desktop and server software for content management, content publishing, and design review indicated for engineering project team collaboration focused on helping teams improve quality, reduce rework, and meet project deadlines. ProjectWise delivers integrated solutions for content management, content publishing, design review, and asset lifecycle management. ProjectWise is optimized for real-time collaboration across distributed teams and can be accessed at your office or online as a hosted managed solution.
Bentley ProjectWise Dynamic Plot V8i has taken the Anoto pen technology and created a collaboration software that creates intelligent paper plots and digital models for the benefit of distributed project teams. ProjectWise Dynamic Plot V8i is a software service that creates an intelligent link between paper plots and digital models, so that paper plots and digital models are always in sync and error-free. ProjectWise affords integration with software specifically targeted for the engineering domain and supports specific types of content.



Pros(+) **and cons**(-) **new/interesting aspects** (☆):

General:

☆ Anoto pen support and markup synchronization

\+ ProjectWise StartPoint provides an entry-level collaboration for small organizations and small projects

\+ StartPoint has a simple interface and is web-based, provides version control and reference file management

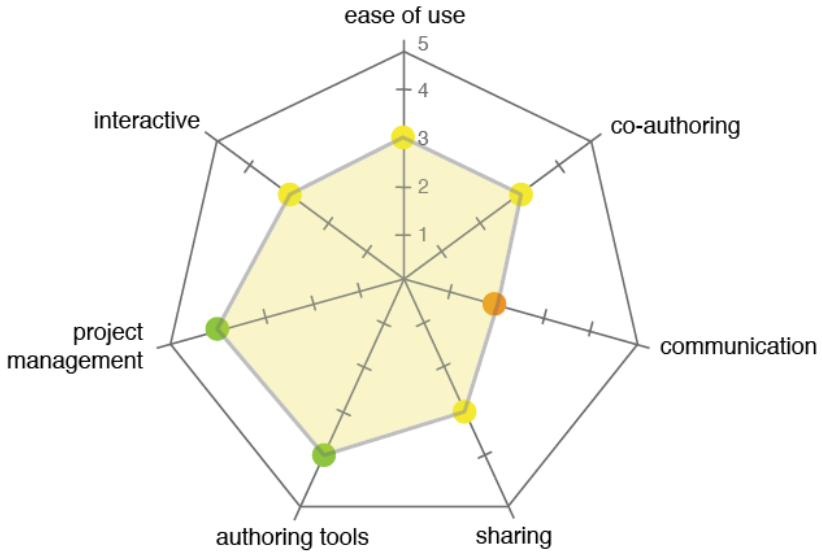
+ ProjectWise Navigator focuses on visual collaboration, enabling users to assemble, review and analyze designs.
+ ProjectWise Integration Server connects people and information across distributed teams

+ ProjectWise Web Server allows people to connect to ProjectWise managed content using SharePoint web interface
- Navigator is a desktop only application
- No mobile phone support
- No iPhone or iPad support

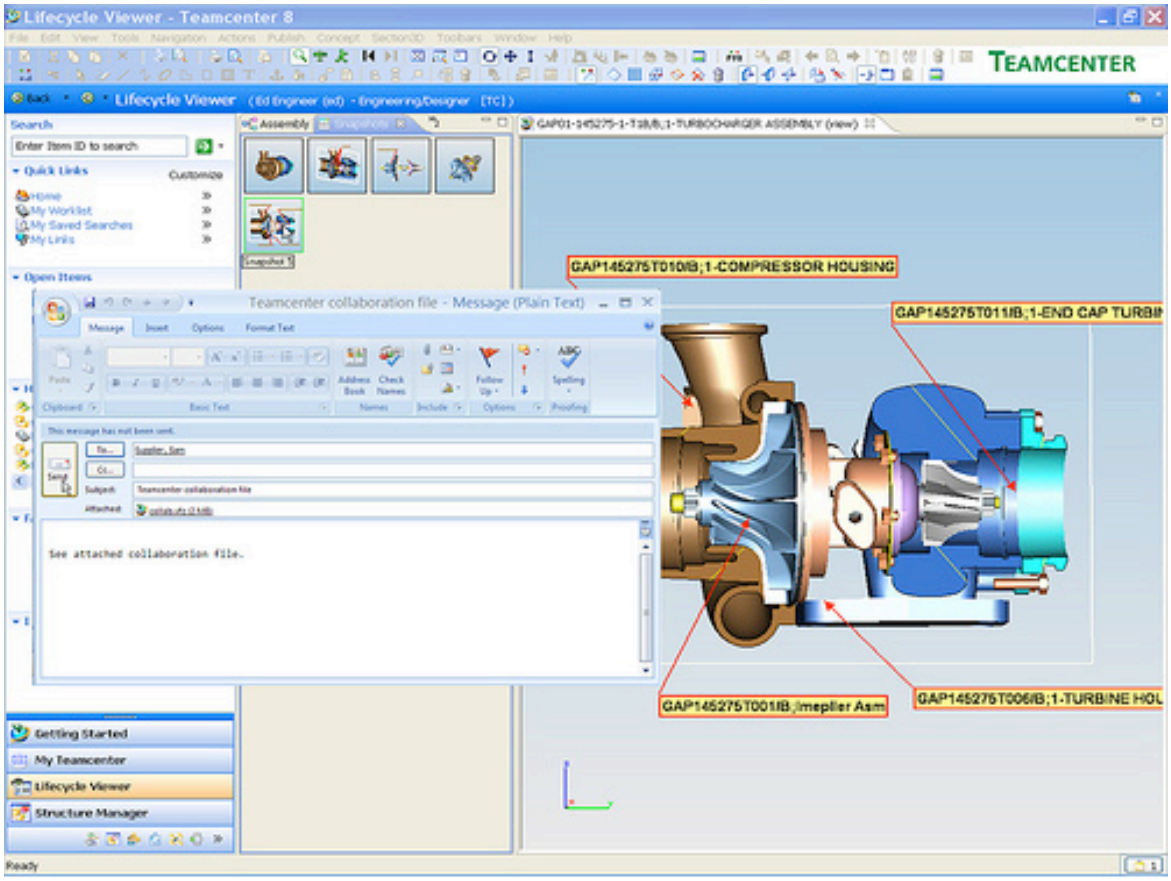
SWOT analysis:

Strengths	Weaknesses
ProjectWise Dynamic Plot with Anoto pen simplifies reviewers activity by synchronizing automatically paper markups to ProjectWise digital documents Complete project management suite	No synchronous communication between users
Opportunities	**Threats**
ProjectWise suites any size of organization in need of an engineering specialized project management and reviewing tool	Similar suites that offer inter-user interaction and realtime collaboration

Overall conclusions:
ProjectWise is a complete specific engineering project team collaboration suites that affords content management, content publishing, and design review. ProjectWise's different modules offer specific features tailored for possible team needs, as ProjectWise Dynamic Plot V8i that has taken the Anoto pen technology and created a collaboration software that synchronizes paper markups to the same digital documents stored within ProjectWise. This featured greatly helps Reviewers keep their work synchronized and simplify markup sharing and storage.



Summary:
Siemens Teamcenter is a Project Lifetime Management (PLM) software that combines portfolio management and project management to help increase mid-size companies productivity, keep information and personnel organized and on task. Teamcenter allows users to take advantage by providing portfolio and project management in one program with the convenience of web-based software. Teamcenter affords integration with software specifically targeted for the engineering domain and supports specific types of content as 3D models.



Pros(+) **and cons**(-) **new/interesting aspects** (☆):

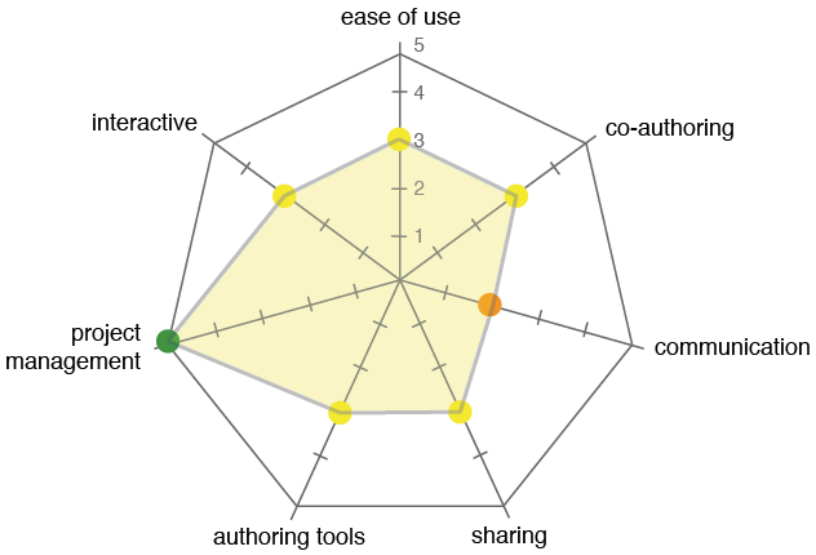
General:

+ Teamcenter portfolio and project management are web-based
+ Integration with Microsoft Office Outlook and Microsoft Project
+ Allows tracking of task dependencies
+ Build project schedules through collaboration
+ Email employee notification of updates
+ Capture ideas formally
+ Collaborative workflow features
- No synchronous communication
- No real-time collaboration on a design
- No mobile support
- No iPhone or iPad support

SWOT analysis:

Strengths	Weaknesses
Web-based project and portfolio management tool 2D and 3D visualization of designs from within Teamcenter interface	No synchronous communication features No mobile support
Opportunities	**Threats**
Mid-sized organizations that work intensively with CAD drawings and have remote teams that need synchronization some means for collaborative work	Similar suites that offer inter-user interaction and realtime collaboration

Overall conclusions:
Siemens Teamcenter is a complete project and portfolio management tool that allows users to collaborate, view 2D and 3D renderings of CAD designs and increase engineering companies productivity.



State of Art research

Physical devices and systems.

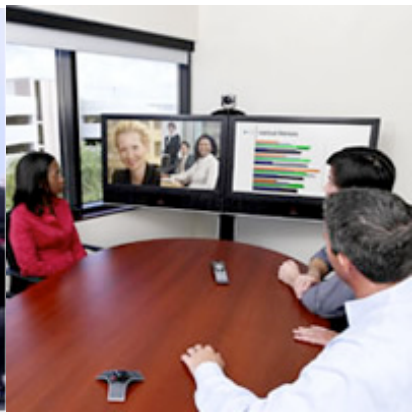
1. Polycom

Summary:
Polycom is the worlds' leader in unified communication. Polycom provides telepresence, audio and video conferencing solutions for specific contexts. Polycom offers solutions for a vast range of usage settings and corporate environments and divides these solutions into 3 main categories: Industry/Business solutions; Small Medium solutions; and Service Provider solutions.

Polycom's Industry/Business solutions are tailored for each individually supported industry, and focuses on enabling unified collaboration as supporting infrastructure and management tools.
Polycom's Small and Medium Business solution focuses on improving ease-of-use, productivity, enhance corporate images, afford faster decision making processes and reduce costs.
Polycom's Service Provider service focuses on conferencing and IP telephony solutions and products. These offer innovative, compelling, and profitable solutions to enterprises.

Description:
Polycom offers a vast range of products for an even wider range of usage settings and contexts. For this state-of-the-art research for our RemotePresence project, we chose to focus on the most relevant and interesting products offered by Polycom that suit our problem setting and project context.
Some of the offered products that we chose to study fall into: Telepresence solutions, video conferencing system, management application, conferencing infrastructure, and recording and streaming.





Telepresence solution:

Description and functionalities:
Polycom's telepresence solutions falls into 3 categories:
•Immersive telepresence

Polycom immersive telepresence solutions provide a natural, "across the table" experience where every meeting participant is shown in true-to-life dimensions.
•Room telepresence

Polycom's powerful high definition solutions for room environments expand real-time knowledge sharing and drive faster, more informed decisions.
•Personal telepresence

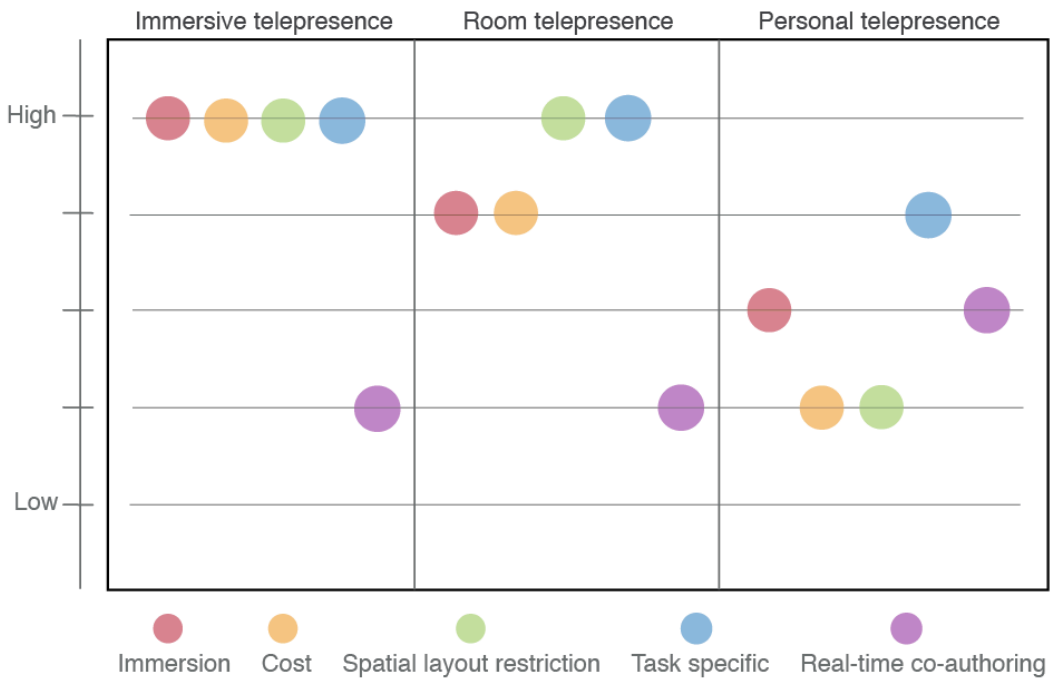
Polycom Personal Telepresence solutions seamlessly extend clear, high definition video to home offices, mobile users, branch sites, and beyond.

Pros(+) and cons(-) new/interesting aspects (☆):

Immersive telepresence:
☆ True to life dimensions allow people to make eye contact, read expressions and gestures
+ Real-time meeting collaboration
+ Possibility for side conversations
+ High definition video and high quality audio with 50% less bandwidth
+ Touch screen interface as the control device
+ Interoperability with other Polycom solutions
+ Native integration with other UC partners
- Very expensive room furniture and hardware
- Requires dedicated rooms, devices and spatial layouts

Room telepresence:
+ Powerful content sharing capabilities such as: images, documents and multimedia in native resolution
+ Tailored for lectures and meetings
+ High quality video and audio
- Expensive hardware

Personal telepresence:
+ High definition audio and video
+ Content sharing (spreadsheets, multimedia and documents)
+ Mobile support
+ Move beyond the room-based boundaries
+ Web-browser support
+ Share screen
+ VoIP or analog speakerphone support
- Still requires specialized device as monitors and web-cameras



Video conferencing systems:

Description and functionalities:
Polycom's video conferencing systems fall into 2 categories:
Room systems
Polycom video conferencing systems for conference rooms allow groups to meet naturally over distance, enabling more productive meetings and real-time decision making.
Personal systems
Polycom solutions for the personal space combine ease-of-use with standard definition communication, allowing individuals and teams to interact across various environments.

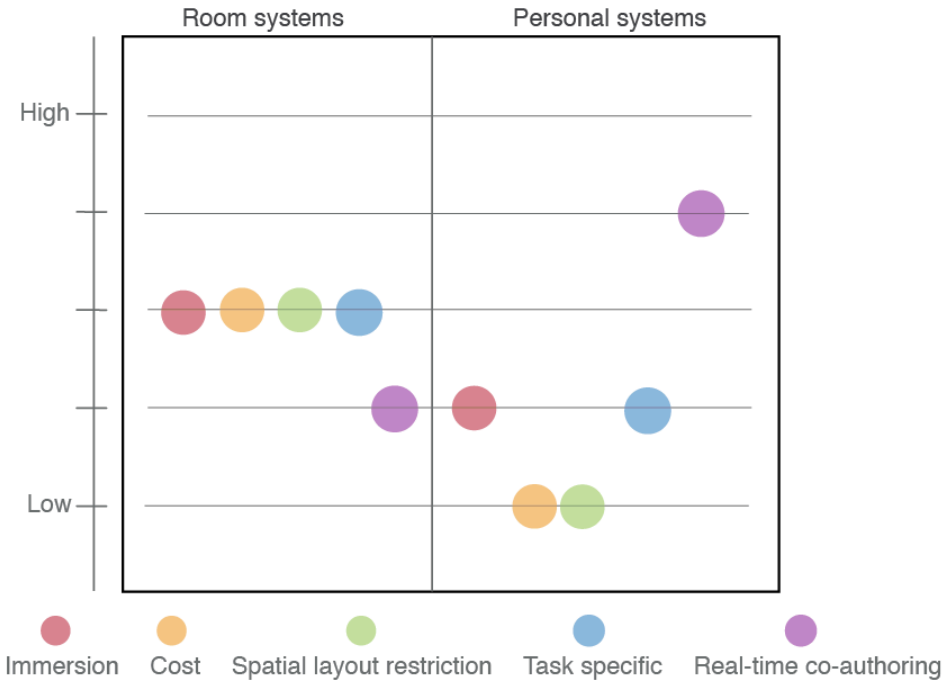
Pros(+) and cons(-) new/interesting aspects (☆):

Room systems:
+ Adaptable to any room
+ Does not require a fixed layout
+ High quality video and audio
+ Supports small group-to-group meeting context
+ Integrate and seamlessly connect to other video conferencing or telepresence solutions

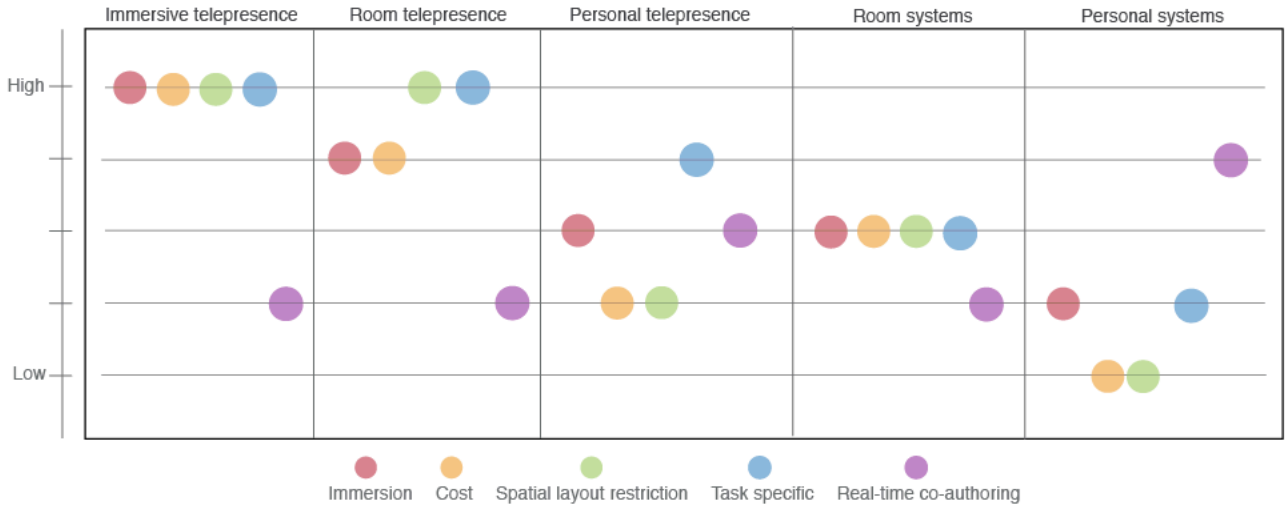
- Costly (microphones, controls and hardware to support the communication through the TV)
- Only one optimum layout setup
- No co-authoring support
- No access to central repository of information
- Dedicated and task specific devices

Personal systems:
+ Devices afford some mobility and flexibility
+ High definition audio and video
+ Content sharing
+ Integrate and seamlessly connect to other video conferencing or telepresence solutions

+ Available software product for laptop and desktops
+ Desktop sharing
+ Polycom CMA Desktop is cross-platform
- Still requires to purchase specific hardware



Conclusion:
Polycom offer a vast number of products and solution for almost any context or setting in need for an immersive and high quality communication.



Polycom's Telepresence solutions focus on providing participants with ultra-realistic settings as extensions of the table or the room, providing the most immersive experience possible. This ultra realistic and high quality communication come at high cost. Expensive specific devices and dedicated rooms with fixed spacial layouts are required.
Polycom's video conferencing systems come at a lower cost than their telepresence solutions. Smaller, more affordable devices, that provide users with high quality audio and video for the best communication possible. These systems can be setup in virtually any room, but some of the Room Video Conferencing systems continue very task specify and communication focused. Polycom's Personal Video Conferencing systems are the cheapest of the range, and provide users the possibility to use their own laptops by providing Polycom CMA Desktop software. This allows users to share screens and collaborate with other users form their own device, wherever they are.

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3. User Needs analysis

Researched User Needs (taken from internship at Alcatel-Lucent Bell Labs Summer 2010)

The following user needs were analyzed through user observations within the context and while performing their activities and questionnaires and were divided into Presenter's needs and audience needs.

3.1. Presenter

Outcome	*User Needs*	*Priority (1-5)*
Easier communication and higher understandability	High quality audio and video for remote communication	4
Easier, fluid, seamless communication and transitions between material	Control over presentation and media	5
Easier adaptation to the audience by the presenter, and thus tailor the presentation to their needs	Audience situational feedback	3
Presenter has more control and can manage his presentation	Presentation feedback (time, next slide, notes)	4
Less interruptions and setup time	Easy device setup	5
More productivity and less headaches	Efficient collaborative tools	5
Participants are more engaging in activities and can read other's reactions	Situational awareness (remote party)	5
Less disruptive and more organized than email solutions	Complete sharing tools	5
Less disruptive and more productive (faster than asking to change slide manually)	View and synchronize view of slides (between parties)	4
Diminishes gaze loss and enriches communication	Correct positioning of devices	2
Clearer, easier communication	Quite environment	2
Augments the visual slide with interaction and enhances communication and understandability	Support gestures and pointing	4

3.2. Audience

Outcome	*User Needs*	*Priority (1-5)*
Easier communication and higher understandability	High quality audio and video for remote communication	4
More attentive and engaging audience	To be "entertained"	3
Augment in participants understanding and more productive	View/synchronize slides clearly	4
Less interruptions and setup time	Easy device setup and connection	5
More engaging audience	Multimedia support	4
Closer community and proximity. Augment social awareness	Knowledge of who the participants are	4
Key activity in these contexts	Note taking/sketching	5

These identified user needs were in context with Bell Lab's "SlideWorld" project[4]. While not being exactly the direction in where RemotePresence is heading, nevertheless, these user needs are important in RemotePresence's goal to support more engaging meetings and presentations for the involved participants.

Identified User Needs (from the State-of-the-art research and literature review—phase1)

The following User Needs were identified and analyzed from a state-of-the-art research and from literature review in CSCW, electronic document management, project management and collaborative environments.

The state-of-the-art research (see phase 1 document) was performed on popular software applications and web-services, identifying their focussed user needs is a value since they might have implications with the popularity of the service or application.

3.3. State-of-the-art

Outcome	*User Needs*	*Priority (1-5)*
Minimizes learning curve and increases productivity and enhances user experience	Ease of use	5
Increases productivity. No need for manual file or information updating throughout various devices	Information and file synchronization	5
Increases productivity and minimizes delays	Easy and effective sharing of content and information	5

[4] For an in-depth report on the internship at Alcatel-Lucent Bell Labs Belgium and the SlideWorld project, please access the internship report "Internship report ALU_ML Clinton - final" and appendix.

Outcome	*User Needs*	*Priority (1-5)*
Increases productivity and integration between colleagues and teams.	Cross-platform support	4
Increases productivity and minimizes file conversion and incompatibility	Support Export/Import of popular file formats	5
Increases productivity and engages participants for team work	Support collaboration	5
Increases collaboration and productivity	Easily invite other participants to participate in activity	5
Minimizes the need to manually share latest versions to colleagues and participants.	Keep information up to date	5
Better protection of private information and non-discloser projects	Be secure and reliable	4
Minimizes learning curve and adaptation to new software or service	Familiarity	4
Minimizes users need to constantly review actions and identify reactions	Provide feedback (of task, activity and interaction)	4
Increases productivity, collaboration, immersiveness, interactivity, participant engagement and social awareness	Communication	4
Seamless transitions between presenters, content, medias. Fluid presentations	Control (over presentation)	4
Ease communication and provide situational feedback	Situational awareness	4
Support mobility and device affordances	Support a multiplicity of devices	4
Increases productivity, ease information retention	Active reading tasks (in certain activities)	5
Easy access, cross-platform and support different devices	Web-based services	3
Increase productivity, collaboration, faster decision making	Real time collaboration	5
Ease communication and participant management	Shared scheduling	4

Outcome	*User Needs*	*Priority (1-5)*
Ease navigation and minimize learning curve throughout different devices (same application or service)	Consistent interface throughout the suite (application or service)	4
Increases productivity and organizes information for easy access of multiple participants	Manage information and documents	5
Less need for asynchronous communication. Faster decision making	Track changes and reviewing	4
Better overall support and increases familiarity (e.g. Google Calendar integration)	Integration with other services	4
Productivity increase	Compatibility with other popular file formats and services	5
Participants are able to review important information and discussions	Meeting recording and playback	4
Increases collaboration and decision making in small groups	Shared whiteboards	5
Increases productivity and minimizes asynchronous sharing. E.g. Attaching files via email	Central repository (information and files)	5
Natural communication increases productivity and understandability	Conferencing (video/audio multiple people)	4
Security and management of user roles	Set and manage permissions	4
Higher increase in acceptance from individual and small organization usage	Low cost (software and hardware)	3
Tailored to the users setting. Increases productivity, communication within a more immersive environment	Dedicated hardware systems	3

Some these user needs are not directly in context with RemotePresence, e.g. Dedicated hardware telepresence solutions. Interestingly these user needs, identified from the state-of-the-art research (phase 1), are closely related to the features (and feature depth) and characteristics offered by the studied cases. Similarly, ease of performing key activities and subsequent tasks, engaging qualitative communication, central repository for files and information, sharing tools, cross-platform presentation and conferencing needs can be related and traced back to the word cloud (see figure 5, page.72) represented in the phase 1 document.

3.4. Literature review

Outcome	*User Needs*	*Priority (1-5)*
Sensors can extrapolate facial expressions, body posture, and biometric information. This feedback may increase engagement in communication	Multimodal interaction	4
Increase in participant engagement and presence	Interactivity	5
Increase in productivity	Non-verbal collaboration (sharing)	4
Help retain sporadic information and organize it for later reviewing	Annotations	5
Social feedback and higher conversational engagement	Situational awareness	4
Increases productivity and inter-participant interaction	Co-authoring	5
Increases productivity and keeps tasks up to date	Frequent communication	5
Wider environmental workspace range	Mobility	4
Easier to organize and manage tasks with many participants	To-do list	4
Less overhead	Progression awareness (post updates and changes)	4
Aids the understanding and transmission of a visual message. Increases collaboration	Sharing whiteboard images	5
Information access and planning	Support different information awareness levels (personal, informal, group and workspace)	4
Unified annotation model that minimizes the unnecessary overhead in the write-review-edit workflow	Meta-commentary	3
Less overhead and faster reviewing	Track editing sessions	4
Less overhead and faster reviewing	Easy way to incorporate changes (reviewing task)	5

Outcome	*User Needs*	*Priority (1-5)*
Easier to access certain key timestamps or access specific information	Intelligent post-processing of recorded meetings	3
Increases productivity. Minimizes traveling expenses	Remote participation in meetings	5
Help transmit a message with aid of different medias to improve topic comprehension	Present content to others	4
Seamless transition of content or presenter. Synchronization minimizes participants attention load (for controlling and keeping up with presentation slide change)	Presentation control (and synchronization)	4

These identified user needs are somewhat more specific to certain chosen contexts (e.g. meta-commentary). This results from the authors of the reviewed literature, performing user evaluation and testing on some of these mentioned user needs and concluded that they were accepted and made some positive influence for the user. As interesting some of these user needs are, most of them derive from academic projects and might not be adequate for RemotePresence users.

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4. Haagse Hogeschool User Study

4.1. Researcher instructions

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Repertory Grid technique

Instructions—researcher

RGT

1. Show the presentation videos to the subject. Order: deck A, B, then C.
    a. Randomly assign Audio, Video, Pointing styles to the decks.

2. In front of you are three cards. Each card represents a specific type of presentation that you have seen in the videos—slides only; video and slides; and pointing and slides.

3. Please select any two cards
    a. Ask the following questions of variants of—to obtain constructs that are important from his or hers perspective.
    b. In which ways are these two visualizations similar and therefor different to the third?
    c. Name the differences of the pair related to the third
    d. How is the third element different to the other two?
    e. How is the third element similar to the other two?

4. Please provide another construct that is a contrast/opposite to the previous construct

5. Please score your constructs on a 7-point sliding scale where:
    a. '1' relates most to the construct on the left
    b. '7' related most to the construct on the right

Note: At times, the interviewee is unable to answer a question or suggestion. To ease the questioning process some authors suggest that:

- The subject "...be encouraged to say whatever comes into his mind and not be concerned if he gives repetitive responses later in the procedure"
- "You can say 'I think I understand what you mean, but, just to make sure, would you please say what you had in mind again?' Very often, in repeating the discrimination, the person will be able to tighten up his construing and rephrase the construct"
- "If you are in doubt whether or not you understand a construct, the stated opposite pole of the construct will often clarify it for you"
- "If in doubt, or you feel the words are too vague, you can ask whether he is really saying X, when you are pretty sure that X is not the case. By being given an indication of what a construct is not, the person is often able to tighten sufficiently to tell you what is really is".

4.2. Researcher guide semi-structured interview

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Semi-structured interview

Here the researcher has the opportunity to approach and discuss any test subject elicited constructs and get more details or to provide constructs and have the subject comment on them.

1. Which presentation was the easiest to follow?
2. Which presentation did you prefer most?
    a. Why?
3. Which one helped you understand?
4. During which presentation did you feel more connected to the presenter?
5. Was the pointing helpful?
    a. How so?

4.3. Three cards shown to subjects

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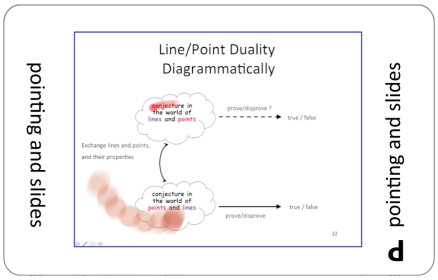
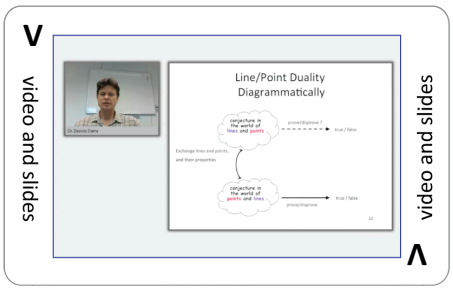
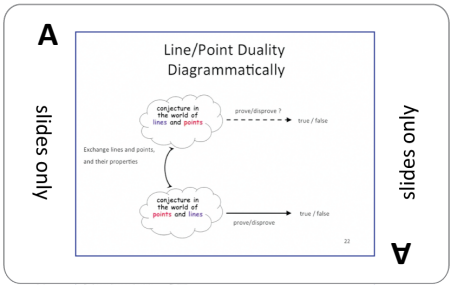
Repertory Grid technique—element cards







4.4. Matrix sheet for subjects to score the elements

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Repertory Grid technique—test subject—

Please fill in your personal understandings (attitudes, beliefs, concepts, assumptions and/or understandings).
Score your constructs in relation to the elements by inserting the element id in the respectable construct row and column (score). By inserting an element id in the 1-3 range that element is related to the construct on the left. By inserting an element id in the 5-7 ranges that elements is related to the construct on the right.

Element id: slides only (**A**); video and slides (**V**); pointing and slides (**P**)

Test Subject: _____ Background: _____

Construct A	To a great extent	Somewhat	Very little	undecided	Very little	Somewhat	To a great extent	Construct ¬A

4.5. Results from subject: Just

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Repertory Grid technique—test subject—

Please fill in your personal understandings (attitudes, beliefs, concepts, assumptions and/or understandings).
Score your constructs in relation to the elements by inserting the element id in the respectable construct row and column (score). By inserting an element id in the 1-3 range that element is related to the construct on the left. By inserting an element id in the 5-7 ranges that elements is related to the construct on the right.

Element id: slides only (**A**); video and slides (**V**); pointing and slides (**P**)

Test Subject: JUST Background:

PAV

Construct A	To a great extent	Somewhat	Very little	undecided	Very little	Somewhat	To a great extent	Construct ¬A
SOMETHING THAT MOVES	P	V					A	STATIONARY
HARDER TO UNDERSTAND	A					V	P	EASY 2 FOLLOW
~~UN~~HELPFUL	P	V					A	LESS HELPFUL
FOCUS		A			V	P		RELAX
TIERSUM	A	~~A~~				V/P		EASIER
UNDERLINING IMPORTANT	P		V				A	HAD TO SEARCH.
DISTRACTING		V			P		A	REST
EMOTION	V					P	A	LACK OF...
~~FACE~~								
PERSONAL	V					P	A	COLD
VOCAL EMOTION	V					P	A	NO EMOTION
EASIER TO LISTEN	V		P			A		HARD TO FOLLOW.

4.6. All the user's resulting constructs and scores

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REMOTEPRESENCE

Repertory Grid technique

Haagse Hogeschool, Den Haag, 2011

Sample size:	**13**		
Male:	8	Age range:	25-52
Female:	5	Age range:	31-45

User generated personal constructs:

	Elements			
Constructs (1/7)	**Slide only**	**Video and slides**	**Pointing and slides**	**Constructs (7/7)**
Boring	6	1	6	Interesting
Nervous	5	5	3	Calmer
Forget	7	2	7	Understanding
Humor	3	6	2	Dull
Presenter visibility	7	1	7	Invisible
Distracting	6	3	6	Focused
Difficult to understand	2	7	5	Easy to understand
Difficult to read	2	3	5	Easy to read
Connected to the presenter	1	1	6	Disconnected
Entertaining	7	1	2	Boring
Has variation	7	1	2	Has no variation
Concurrent/complex	6	6	1	Simple/sequential
Integration	1	2	7	Two-sided
Abstract	1	7	1	More concrete
Understanding	1	1	3	Misunderstanding
Concentration	1	1	7	Distracted
Easy to understand	1	5	7	Takes more energy
Subject	7	3	7	Object
Emotions	7	1	6	Intellectual
Easy to focus	1	3	7	Difficult
Free-way	2	5	7	Directing
Easy to concentrate	3	7	1	Distracting

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Unclear	5	4	7	Insightful
Old fashioned	2	6	5	Use of new media
Static	2	6	7	Dynamic
Boring	4	4	5	Interesting
Consumable	6	2	3	Stimulating/pure
Not fun	4	5	5	Fun
Distracted	7	3	3	Concentrated
Social	6	1	5	Distant business-like
Serious	2	3	5	Playful
Something that moves	7	2	1	Stationary
Harder to understand	1	6	7	Easy to follow
Helpful	7	2	1	Less helpful
Focus	2	5	6	Relaxed
Tiresome	1	6	6	Easier
Underlying important	7	3	1	Has to search
Distracting	7	5	2	Rest
Emotion	7	1	6	Lack of emotion
Personal	7	1	6	Cold
Vocal emotion	7	1	6	No emotion
Easy to listen	6	1	3	Hard to follow
Static	1	6	2	Movement
Distraction	1	6	2	More focus
Boring	1	5	2	Entertaining
Personal	7	2	7	Anonymous
Non-verbal communication	7	2	7	Blank
Messy	6	6	2	Tidy
Attention	7	2	5	No attention
Annoying	5	6	1	Pleasant
Personal	2	1	1	Wide of approach
Focus	6	2	3	Too relaxed
Feel speaker	5	1	3	No connection
Easy to follow	5	1	2	Hard to follow
Convincing	4	2	2	Not believing
Attractive	6	2	2	Ugly
Extra visual aid	3	1	1	Two–sided
Requires attention	5	2	2	Bored
Emotion of speaker	5	1	5	Plane
Small scope	5	2	2	Broad scope
Direct visualization	3	2	1	Indirect visualization
Discrepancy	6	7	7	Unity
Dynamic	7	2	1	Static
Structure	6	3	1	Unstructured
Connection	7	7	1	Open

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Guided	6	6	1	Not guided
Distraction	6	2	7	Attention
Personal	6	1	6	Broadcasted
Movement	6	3	1	Static
Understanding	3	1	2	Not understanding
Concentration	6	1	2	Distracted
Easy to follow	5	1	1	Difficult
Un-interesting	1	7	6	Interest
Connected	6	1	1	Disconnected
Focus	7	1	1	No focus
Visual concentration	6	3	1	Visual digress
Connectedness to person	2	2	7	No connectedness
Structure	1	6	6	No structure/clarity
Guidance	1	3	1	No guidance
Professional	1	6	5	Amateur
Equal	1	2	5	Pedantic carping
Distracted from topic	7	4	3	Concentration on topic
Not being pointed/directed	3	3	3	Being pointed
Freedom	1	2	6	Directed
Being critical	2	2	6	Imposed
Speaking to me	6	3	6	Not speaking to me
Easy to follow	6	1	2	Hard to follow
Gives direction	6	1	2	Without direction
Helps to concentrate	6	1	2	No help concentrating
Connects you to story	3	1	2	No connection to story
Distant	3	1	2	Close by

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5. Online web experiment

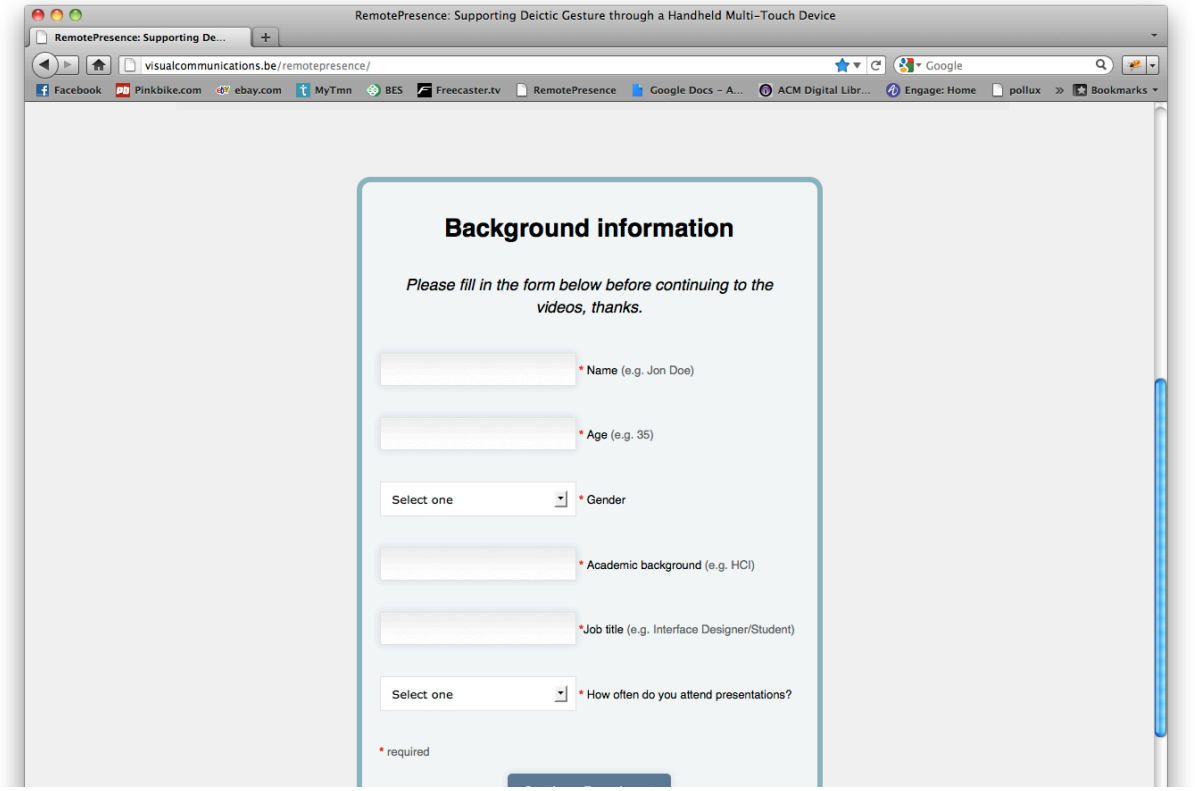

Figure 1. Demography and academic background form.

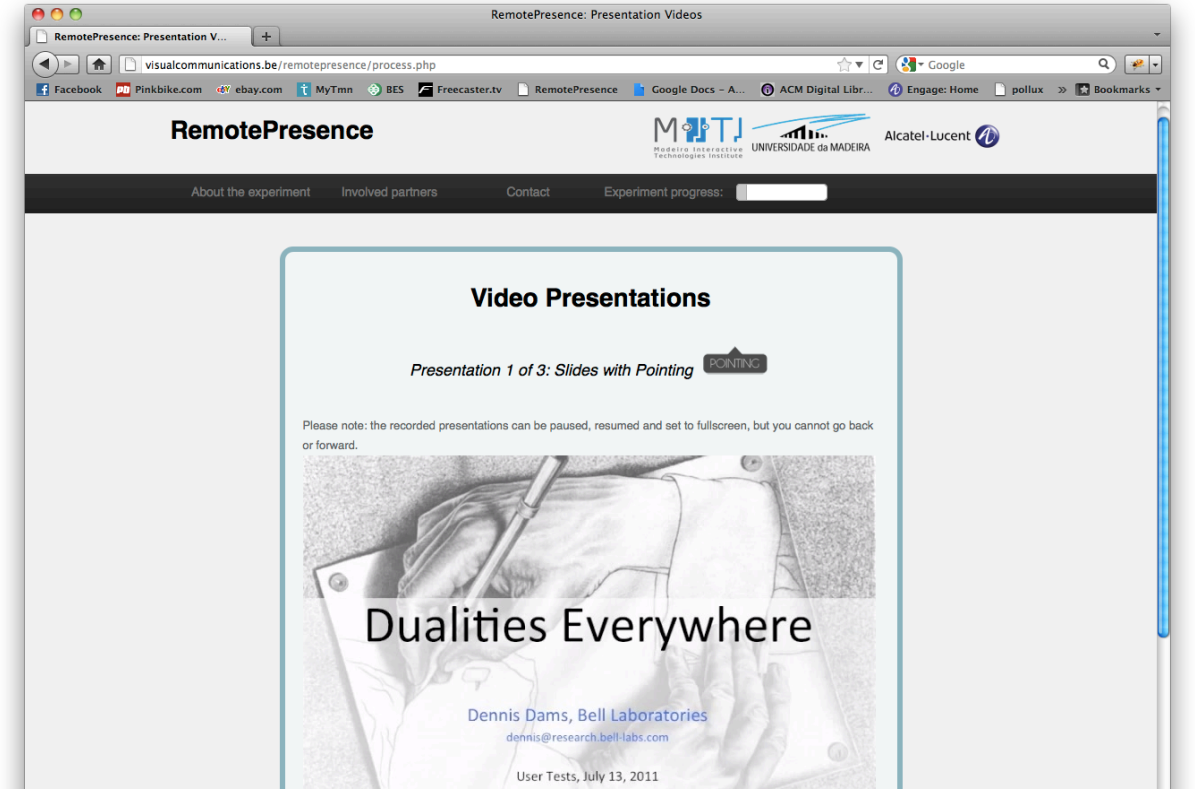

Figure 2. Displaying one of the video presentations (fullscreen available)

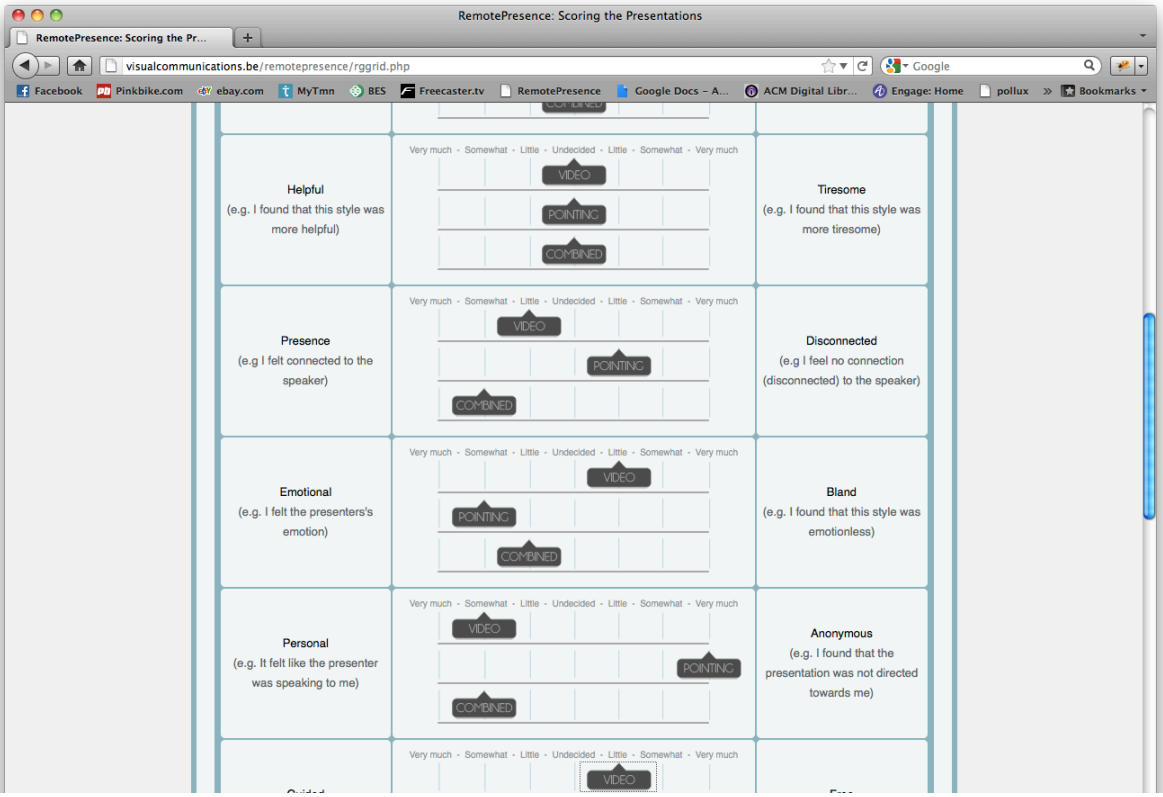

Figure 3. Scoring page based on RGT. Each slider represents an element. Sliding left related to the construct on the left.