

Effective Teleconferencing: An International Investigation of the Factors Influencing the Effectiveness of Distributed Meetings

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Abstract

With businesses becoming global in their reach, the use of distributed meetings and associated conferencing technologies is at the core of their successful and efficient operation. However, the actual effectiveness of these meetings is thought to vary enormously. This paper reports on a multi-country investigation into the factors that make for an effective distributed meeting in everyday practice. The results are based on a survey conducted with 400 professionals supported by 40 interviews with experienced teleconferencing users. Ten interviews and 100 survey responses were obtained from each of the following four countries: Australia, China, the UK, and the US.

The results indicate that a wide range of factors need to be optimised to ensure the most effective distributed meetings. The most influential factors were good sound quality and reliable conferencing technology, but other important aspects included having a good chairperson and attentive participants. The survey also identified some differences between countries, particularly between China and the other countries surveyed on issues such as speaker identification and the barriers to adopting new conferencing technology.

Keywords: *distributed meetings, teleconferencing, audio conferencing, usability, distributed working*

1. Introduction

Modern telecommunications technology has opened up the potential for business meetings to be held over multiple locations rather than face to face. These distributed meetings can reduce travel costs and save both money and time. However, it is a matter of some debate whether and in what circumstances such meetings can be as effective as meetings held face to face (Driskell et al., 2003; Powell et al., 2004). It is also clear that the level of effectiveness is not uniform across distributed meetings but can be influenced by a wide range of factors. Understanding more about these factors can help organisations and individuals work more effectively in a distributed manner.

Previous research has examined how different aspects of teleconferencing impact the effective-

ness of meetings. However, much of this work was based on studies of small numbers of teams, often examining particular aspects of distributed meetings (c.f. Powell et al., 2004). For example, Chidambaram and Jones (1993) compared face-to-face and distributed meetings with respect to social presence and perceptions of communication effectiveness. Such studies are often conducted in fairly controlled conditions (e.g. Bordia, 1997), although there have also been field studies (e.g. Olson and Olson, 2000). Several authors have reviewed a number of these studies to produce models, identifying a range of issues impacting the effectiveness of distributed working (e.g. Powell et al., 2004; Prasad and Akhilesh, 2002). This work is useful for understanding how teleconferencing is used and what impacts its effectiveness.

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There has been limited work examining what the users themselves think. Users' perceptions are very important in any system that depends on user uptake and response (Zhang and Li, 2005), including teleconferencing. Furthermore, users' opinions can often provide important insight into what is actually working and not working in everyday practice in the real world.

There have been a few studies of users' opinions. For example, Yankelovich et al. (2004) surveyed users about the problems that they currently face in distributed meetings, identifying many issues that reduce meeting effectiveness. Although they surveyed a large number of people (over 1,700), they were from a single company. There are many different kinds of companies that use teleconferencing, with wide variations in the technical competence of staff and in meetings' aims. This suggests that attitudes towards teleconferencing may vary between companies, and a single company may not represent general attitudes. Attitudes are also likely to vary between countries, as working practices and general perceptions are often highly influenced by prevailing culture.

Furthermore, teleconferencing technology has changed markedly in the years since Yankelovich's study, particularly with the rise of free Videoconferencing facilities. This might be expected to change attitudes towards teleconferencing and the kinds of problems faced in meetings. For example, technological improvements may reduce the importance of technical aspects like sound quality.

Thus, our study expands on previous work by surveying people from a wide range of companies across multiple sectors and countries. This provides a broader view of the situation and allows cross-country comparisons. The sample included 400 professionals, with some experience with distributed meetings, evenly spread across four countries (Australia, China, the UK, and the US). The survey examined how a range of factors influence the effectiveness of distributed meetings and investigated some issues of specific relevance to distributed meetings.

The survey was part of a wider study that included interviews with five experts and 40 professionals. These interviews informed the survey design and questions but are not described in detail in this paper. This paper focuses on the survey results, as these provide a wider, more representative view of

distributed meetings. However, some data from the interviews is used to back up and add depth to the survey findings.

This paper first examines the current state of knowledge, describing the factors influencing distributed meetings identified in the literature and by interviewed experts (Section 2). Section 3 then details the methods used in the survey. The results are presented in Section 4 and discussed in Sections 5 and 6. Section 5 focuses on the commonalities across the countries while Section 6 discusses the differences.

This was an independent study commissioned by British Telecom (BT) and Dolby Laboratories, Inc. (Dolby). With this in mind, it should be noted that special efforts were taken to be impartial. For example, the survey asked about the whole range of factors identified from the literature, not just the technological factors of particular interest to the sponsors. All factors were emphasised equally, and they were presented in a randomised order to prevent order effects that might prioritise one above another. Participants were only told about the particular technical innovations from the sponsors at the end of the survey, as this might bias their responses.

Some of the key results for the individual countries have been previously published by BT and Dolby in a series of technical reports (Mieczakowski et al., 2013a, b, 2014).

2. A Review of the Factors Influencing the Effectiveness of Distributed Meetings

There have been many studies examining different factors that influence the effectiveness of distributed meetings. A factor refers to any tangible aspect (including both technology and people's behaviour) that improves, or reduces, the effectiveness of a meeting.

To gain an initial understanding of these factors, we conducted a literature review. This was backed up by interviews with five experts from a variety of domains, as described in the technical reports (Mieczakowski et al., 2013 a, b, 2014).

2.1 Types of Factors

The literature identifies many different factors that influence the effectiveness of a distributed meet-

ing. To assist in identifying and analysing these factors, it is useful to organise them into categories. There are various categorisations proposed in the literature (e.g. Powell et al., 2004; Pye and Williams, 1977; Yankelovich et al., 2004). However, none of these cover all the factors identified in the literature in a clear and concise manner. Therefore, the following categorisation was developed based on an examination of the set of issues as a whole. The categories were chosen to reflect the different areas that a company or individual can influence.

- a. Technology (issues to do with the conferencing technology):
 - Usability and ease of set-up
 - Sound quality
 - System quality
 - Technology features
- b. Management (issues to do with how the project and meeting are managed):
 - Project management and the wider organisation
 - Meeting facilitation
- c. People (issues to do with the people involved in the meeting):
 - Participant and team characteristics
 - Participant behaviour

2.2 Technology Factors

Technical issues can have a large impact on the effectiveness of a distributed meeting (Olson and Olson, 2000; Yankelovich et al., 2004). They are associated with a range of different factors, particularly those described below.

2.2.1 Usability and Ease of Set-up

The ease of use of any system influences how effectively it is used in practice (Norman, 1998). For distributed meeting technology, this includes the ease of setting up a meeting as well as operating the technology during that meeting.

2.2.2 Sound Quality

The quality of the audio and video in a distributed meeting also has a large impact, with audio quality

being a particular challenge. Previous surveys of problems with distributed meetings found many complaints about audio quality, including lack of audio clarity, background noise, problems with speaker identification, and difficulty understanding when more than one person speaks at the same time (Nilssen and Greenberg, 2013; Olson and Olson, 2000; Yankelovich et al., 2004). Similar issues are also raised in many other papers (e.g. Raake et al., 2010). Yankelovich et al. (2004) found that such issues were highly correlated with meeting effectiveness.

2.2.3 System Quality

System quality relates to other aspects of technical quality. These include difficulties with managing multiple pieces of equipment and problems with lighting and microphones (Grenville et al., 2000). Olson and Olson (2000) also found complaints about difficulties getting people online. System quality also includes factors related to the reliability of the technology and the stability of the connection.

2.2.4 Technology Features

The choice of technology, including the choice of communication medium, is another important factor. Studies have shown that good quality video can improve meeting effectiveness for some types of tasks and situations while audio-only solutions are as effective in other situations (Johansen, 1977; Olson and Olson, 2000; Williams, 1977). There are also additional technology features that can improve certain types of meetings. These include facilities to share documents and visual materials (e.g. Cisco WebEx), icons that identify the current speaker (e.g. Colburn, 2001), and lists of who is currently on the call (e.g. Ding et al., 2007; Kellogg et al., 2006). Specialist improvements to audio, in addition to improving basic sound quality, can also be considered technology features. One example is spatial audio, which makes speakers' voices appear to come from different locations in space around the listener (e.g. Raake et al., 2010).

2.3 Management Factors

How a meeting and the wider project are managed also have a large impact on the effectiveness of a distributed meeting.

2.3.1 Project Management and the Wider Organisation

Project management plays an important role. Ding et al. (2007) note the large amount of work “going on behind the scenes – by moderators, individuals, and organizationally defined subgroups – to create a coherent and productive meeting”. In particular, the scheduling and organisation of meetings is important, with short and regular distributed meetings proving most effective (Johansen, 1977; Powell et al., 2004). It is also important to choose the right type of meeting for the right task, as studies show that distributed meetings are more effective for some types of tasks, such as information transmission and brainstorming, and not very effective for others like negotiation (Colburn et al., 2001; Johansen, 1977).

The expert interviewees added that the choice of meeting size is important, explaining that bigger distributed meetings (with over six participants) were noticeably more challenging to manage.

2.3.2 Meeting Facilitation

The meeting facilitator or chairperson can do much to improve a distributed meeting (Barkhi et al., 1999). However, such leadership is not easy and requires good social and leadership skills. In addition, Grenville et al. (2000) note the high cognitive demands involved in leading in a distributed meeting while also managing the technology.

There are some recommendations available for chairpeople, such as polling the group, using participants’ names, and giving a commentary for remote listeners (Interaction Associates, 2007) as well as checking for audio problems and preparing adequately in advance (Yankelovich et al., 2004).

2.4 People Factors

The people in a distributed meeting can also affect the meeting for better or worse.

2.4.1 Participant and Team Characteristics

The choice of people in a distributed meeting is important. They should be ready to work in a distributed manner and with the technology required (Olson and Olson, 2000). Their ability to cope with technology-related challenges and their attitudes towards such technologies and practices can have a big influence on the meeting outcomes

(Powell et al., 2004; Prasad and Akhilesh, 2002).

Good team cohesion is also very important (Ehsan et al., 2008). Teams with common ground (Olson and Olson, 2000) and pre-existing strong social bonds (Millard and Gillies, 2012) often work more effectively. There are measures that can be taken to improve team cohesion, such as providing opportunities to socialise (Prasad and Akhilesh, 2002), using team-building exercises, and meeting face-to-face at the start of a project (Powell et al., 2004).

2.4.2 Participant Behaviour

The behaviour of individual participants also has a large impact. Yankelovich et al. (2004) found that not following good meeting behaviours caused problems. These include identifying oneself when speaking and making sure to include remote participants. However, this was not as highly correlated with meeting effectiveness as audio or technical problems.

Another problem occurs when participants do not concentrate on a call. One expert explained that in big groups, “people just tune out because it’s difficult to listen to what’s going on”. A particular problem is multi-tasking—when participants do other tasks (e.g. checking e-mail) while taking part in a distributed meeting. This impedes their memory and knowledge retention (Edwards and Gronlund, 1998), thus decreasing the effectiveness of the meeting.

3. Methods

3.1 Overall Methodology

This paper focuses on a survey of users’ opinions. However, the survey took place as part of a wider study on the factors influencing distributed meetings, which involved four complementary methods:

- a. A literature review
- b. Semi-structured interviews with five experts from different disciplines
- c. Semi-structured interviews with 40 representatives of multi-sector companies with substantial conferencing experience
- d. A survey of 400 professionals with some experience in distributed meetings

The literature review and expert interviews provided an initial understanding of the issues involved in distributed meetings (see Section 2). They informed the interviews with company representatives, identifying questions to ask and issues to probe further.

The results from the literature review and all the interviews then informed the construction of the survey. They influenced the choice and wording of questions and the possible answers provided in multiple-choice questions.

The interviews and survey were conducted across four countries, with ten interviews and 100 survey responses in each country. The countries chosen were Australia, China, the UK, and the US. The UK and US were chosen because the researchers and sponsors were based in those countries. In addition, they have historically led on the rollout of the Internet and high-speed communications and are therefore of particular interest. Two countries from the Asia-Pacific region were also included to provide a more global perspective. Given the cultural diversity in this region, Australia and China were selected to provide both Western and Eastern perspectives on the way in which distributed meetings are performed in this region. Both countries are also in the process of rolling out major broadband access programmes, so they can provide insight into situations where the infrastructure for distributed meetings is less well-established but likely to become more so in the near future.

3.2 Interviews with Companies

This paper does not describe the interviews in detail, but some data from them is used to back up and add depth to the survey findings. Thus, it is worth saying something about the methods used. Forty representatives were interviewed—ten in each of the four countries. Interviewees were chosen to include representatives from both large and small-to-medium sized companies and from a range of sectors, including education, engineering, entertainment, finance, government, healthcare, manufacturing, news, retail, software, and telecommunications. All interviewees had at least one year of teleconferencing experience, and most had five years or more. They all used teleconferencing at least once a month, with almost all (35 of the 40 respondents) using it at least once a week. Most participants also had some experience chairing

distributed meetings. The interviewees were recruited through recruitment agencies and professional contacts.

All the interviews were conducted in English, and all interviewees had good levels of English language ability. The interviews were semi-structured and were analysed using General Inductive Analysis (Thomas, 2006). Further information on the interviews and their results can be found in the related technical reports (Mieczkowski et al., 2013 a, b, 2014).

3.3 Survey

3.3.1 Aims

The survey was conducted to obtain a wider, more representative view of distributed meetings than that provided by the interviews. It examined how a range of professionals use distributed meetings in their everyday work, what they feel impacts the effectiveness of these meetings, and what could be improved.

3.3.2 Sample

Approximately 750 professionals were contacted through recruitment agencies, social media, and professional contacts. The final sample contained 400 respondents, 100 from each of the four countries. Respondents were required to be competent in English, as the survey was conducted in this language.

Respondents were required to have some experience teleconferencing. Almost all respondents had at least a year's experience, but a small proportion (3%) of respondents with under a year's experience were also accepted. Most (90%) of the sample took part in distributed meetings at least once a month. Survey respondents worked in many different parts of their companies, including information technology (78 respondents), customer service (69), sales (64), marketing (62), administration (58), production (44), finance (44), research (40), human resources (37), and distribution (14). Some respondents worked in more than one area, and many (79) respondents also listed "other" areas such as education, media, and supply chain.

3.3.3 Materials

The survey was administered online. It covered various topics related to distributed meetings. Most questions were multiple choice with possible

responses drawn from the literature and interviews.

The survey first examined demographics, including respondents' experience of distributed meetings and their role within their company. It also investigated the nature of respondents' distributed meetings to provide some background on how such meetings are conducted in practice. Some of the questions are listed in Table 1 in Section 4.2.

Respondents were then asked to rate various factors according to how much they impact the effectiveness of distributed meetings (see Figure 1 in Section 4.3 for details). Factors were rated on a five-point scale (from "no effect" to "high effect"). The fifteen factors were determined from the literature review and both sets of interviews. They focused on those most likely to affect a single distributed meeting rather than wider organisational issues. However, an effort was made to cover each of the categories in Section 2.

The survey also contained some questions focusing on audio-only meetings. This is because such meetings have particular characteristics and challenges due to their reliance on a single modality for conveying information. Furthermore, they are often the only technology that is feasible to use. Multiple-choice questions examined the types of meetings that audio conferencing is suitable for, how often respondents have problems with speaker identification in such meetings, and how such meetings could be improved (see Tables 2 to 5 in Section 4.4 for question wording).

Another two questions addressed particular issues that had arisen in the interviews: how to build trust in distributed teams and barriers to the adoption of new teleconferencing technologies (see Tables 6 and 7 in Section 4). A final, open-ended question gave respondents the chance to voice their own feelings on improvements that should be made to teleconferencing, particularly audio conferencing.

The same questions were asked in all countries with some minor changes in wording to account for different word usage and spelling in different countries. In addition, some null options ("none", etc.) in multiple-choice questions were added for some of the later countries. In general, respondents seldom chose these options.

4. Results and Analysis

This section presents results from the survey. It does not contain detailed discussion of the results and possible reasons underlying them, as these can be found in Sections 5 and 6.

4.1 The Nature of Distributed Meetings

A summary of the results on meeting size, length, and technologies is given in Table 1. Most meetings tend to be relatively small with up to ten attendees (72.4% of respondents). However, larger meetings cannot be ignored, with 8.8% of respondents saying that most of their distributed meetings involve over 20 participants.

Meeting length varies. Responses in Australia, the UK, and the US were similar, with meetings often lasting between 30 minutes and 1 hour (52.9%). In the Chinese sample, meetings were often longer (Mann-Whitney, $p < 0.01$) with the main response being 1 to 1.5 hours.

Overall, the technology used regularly by the largest number of people was "video on a computer, tablet, or mobile phone". However, there were differences between countries for both this option and the telephone (Chi-squared tests, $p < 0.01$). In Australia and China, the top option was "video on a computer, tablet, or mobile phone" while in the UK and US it was the telephone.

Respondents were also asked about the features used within their distributed meetings. Document sharing was the most popular (used by 68.0% of the sample) followed by muting one's microphone (58.3%). It should be noted that not all features are available in all meetings. For example, it may not be possible to mute others' microphones when using a standard telephone. This question indicates what people currently use, not necessarily what they find useful or would like to use.

4.2 Factors That Influence the Effectiveness of Distributed Meetings

Respondents rated the impact of fifteen factors on the effectiveness of distributed meetings, as shown in Figure 1.

Table 1

Characteristics of distributed meetings in % of individual country samples and overall for the whole sample. Overall results are highlighted in bold. Percentages for individual countries are not always integer values due to occasional non-responses to some questions.

%	How many people take part in most of your distributed meetings?							
	1 to 5	5 to 10	10 to 20	Over 20				
Overall	29.3	43.1	18.8	8.8				
Australia	51	27	17	5				
China	3	60	30	7				
UK	41.4	41.4	7.1	10.1				
US	22	44	21	13				
How long are most of your distributed meetings?								
	Less than 30 mins	30 mins to 1 hour	1 hour to 1.5 hours	1.5 to 3 hours	Over 4 hours			
Overall	7.8	52.9	29.1	8.5	1.8			
Australia	10	61	25	4	0			
China	1	31	47	18	3			
UK	15.2	59.6	15.2	7.1	3			
US	5	60	29	5	1			
Which of the following technologies do you regularly use in distributed business meetings? (tick all that apply)								
	Video on computer, tablet or mobile phone	Standard telephone (incl. mobile phones)	Other audio	Portable dedicated video conferencing equipment	Fixed dedicated video conferencing suite	Other		
Overall	71.5	59.3	43.8	24.3	23.0	2.5		
Australia	74	49	46	22	19	5		
China	90	42	38	28	21	0		
UK	49	59	37	16	25	3		
US	73	87	54	31	27	2		
Which of the following features do you use regularly (at least once a month) in distributed meetings? (check all that apply)								
	Document sharing	Muting your micro-phone	Indication of who is in the meeting	Indication of who is currently speaking	Instant messaging	Muting other people's micro-phones	None (not asked in UK)	Other
Overall	68.0	58.3	55.3	53.5	48.3	32.0	3.5	2.5
Australia	70	56	47	42	46	27	12	3
China	60	36	54	65	60	35	0	0
UK	59	53	41	41	29	16	0	5
US	83	88	79	66	58	50	2	2

Thirteen out of the fifteen factors were considered to have a medium-high or high impact by over 50% of respondents. There were significant differences between the factors' ratings (Chi-squared, $p < 0.01$). Good sound quality and reliable conferencing technology were rated more highly than the other factors. Taking breaks and knowing other participants well were rated lower. There were no other significant differences between adjacent factors in the graph (pairwise Wilcoxon T,

$p < 0.003$ to account for multiple tests). There were some differences between countries in the ratings of sound quality, reliable technology, being able to mute microphones, and training (Kruskal-Wallis tests, $p < 0.003$).

4.3 Audio Conferencing

Some questions focused on audio-only meetings, as explained in Section 3.3.3. Respondents felt that audio conferencing works effectively for various

types of meetings, especially regular project progress meetings, information/requirements gathering meetings, and simple problem solving meetings (see Table 2). These were rated more highly than other options (binomial sign tests, $p < 0.001$).

In the interviews, speaker identification was previously identified as a particular problem in audio-only meetings. The survey examined this further, asking participants how often they had problems with this (Table 3). There were no significant differences between Australia, the UK, and US. However, problems were more common in China (Mann-Whitney tests, $p < .001$) where 81% of respondents had problems at least “sometimes”.

Respondents were also asked to identify three interventions they believed would improve their audio-only meetings (Table 4). The top responses were high quality sound (52.75%) and reliable

technology (51.5%). These were chosen significantly more often than other options (binomial sign tests, $p < 0.001$). There were some differences between countries in the responses for reliable technology, a clear agenda, and being able to mute microphones ($p < 0.005$).

In order to capture other comments and suggestions, respondents were also given an open-ended question on improvements to audio conferencing technology. Their comments were categorised, and the results are shown in Table 5.

By far, the most common category of response was a request for better sound quality (mentioned by 30.5% of respondents). This was mentioned particularly often in China where over half (57%) of respondents requested it. Improved reliability, greater ease of use and of set up, and lower cost were also mentioned by several people.

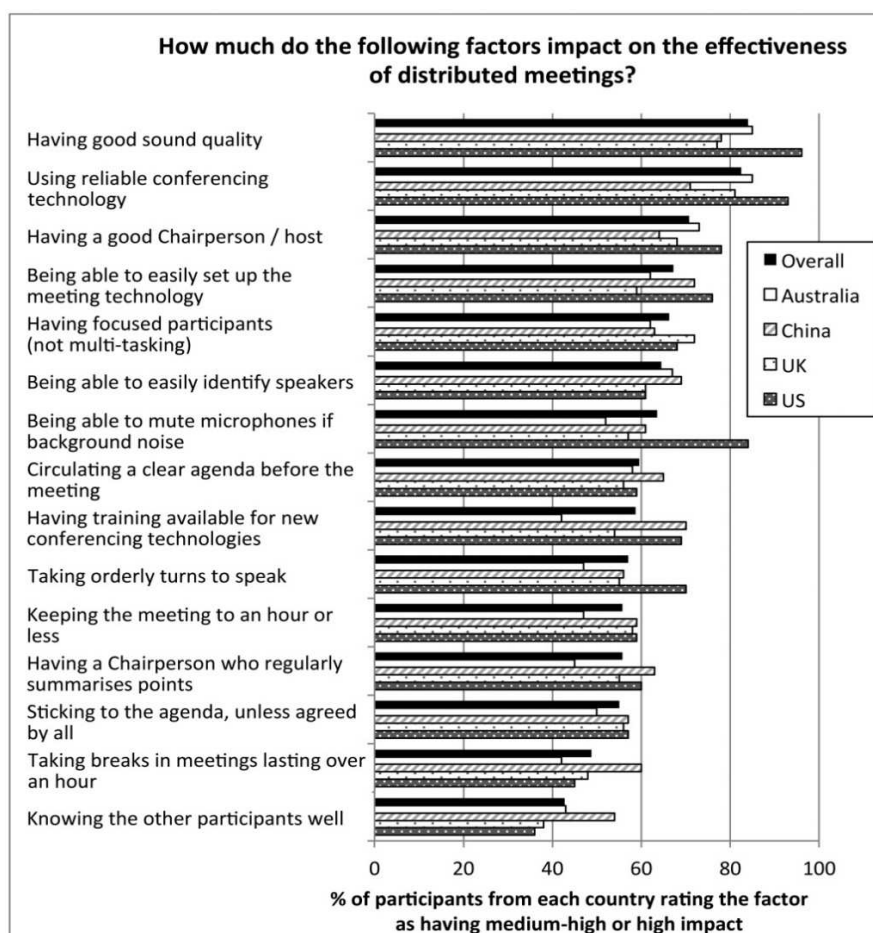


Figure 1: The impact of various factors on the effectiveness of distributed meetings

Table 2

Types of meetings suited to audio conferencing. Australia is abbreviated to Aus.

% of respondents choosing this option	In which types of meetings does audio conferencing technology work effectively?								
	Regular project progress meetings	Info / requirements gathering	Simple problem solving	Ideas / brainstorming	Quarterly / annual review	Crisis management	Complex decision making	Negotiation (e.g. contract / sales)	Other
Overall	72.3	65.8	65.0	52.0	45.3	38.0	31.0	29.5	1.3
Aus	81	71	65	52	39	35	26	23	4
China	50	54	54	41	35	32	40	37	0
UK	67	68	61	45	47	39	16	23	1
US	91	70	80	70	60	46	42	35	0

Table 3

Frequency of problems with speaker identification in audio meetings

% of respondents choosing this option	"How often do you have problems knowing who is speaking in an audio-based distributed meeting?"					
	Never	Rarely	Sometimes	About half the time	Most of the time	Always
Overall	7.8	29.0	45.5	8.5	6.8	2.5
Australia	9	34	47	7	3	0
China	0	19	47	15	13	6
UK	14	24	46	8	5	3
US	8	39	42	4	6	1

Table 4

Improvements to audio meetings. Respondents were asked to choose their top three options, but some only chose one or two.

% of respondents choosing this option	What do you think would improve the efficiency of your audio-based distributed meetings?							
	High quality sound	Reliable technology	Ability to share computer screen information	Ability to easily share documents and files	Ability to easily identify who is speaking	A clear agenda and order of speakers	Chairperson being able to mute microphones	Other (not asked in UK, China)
Overall	52.75	51.5	36.25	33.25	30.25	29	25.75	0.5
Australia	52	57	32	34	18	41	18	2
China	54	34	41	44	31	37	22	0
UK	48	47	25	20	38	18	24	0
US	57	68	47	35	34	20	39	0

Table 5

Improvements to audio meetings: responses to an open-ended question. Note that some respondents gave more than one response.

% of respondents giving a response that falls into this category	"What is the one improvement to the current audio conferencing technology that would encourage you to use it more often?"				
	Overall	Australia	China	UK	US
Better sound quality	30.5	22	57	24	19
Improved reliability	9	15	10	6	5
Easier to use	7	5	8	7	8
Cheaper/free	5.5	3	7	7	5
Easier to set up	5.25	6	4	5	6
Other things to do with people	5	6	4	8	2
Other technology features	4.75	3	11	1	4
More/faster connections	4	5	7	3	1
Reduced background noise	3.5	2	6	2	4
(Improved) ability to share documents	3.25	3	4	0	6
Better video quality	3.25	12	0	1	0
Speaker identification	3	3	3	4	2
Addition of video	3	5	0	4	3
Other technological improvements	2.5	3	6	1	0
Integration/Able to use on different computers	2.5	4	1	2	3
Ability to mute	2	1	0	5	2
Improved security	1.5	0	1	4	1
Shorter meetings/Different kinds of meetings	1.25	2	0	0	3
Other things to do with technology	1	0	0	0	4
Screen sharing	0.75	2	1	0	0
No improvements identified	18.25	15	5	23	30

4.4 Trust

Trust is important in any working relationship, but it can be a particular issue in distributed teams where it may need to be established quickly and with lower levels of contact. As Fukuyama (1995) asserted, "A virtual firm can have abundant information coming through a network of wires about its suppliers and contractors... [however] without trust, there will be a strong incentive to bring all of these activities in-house and restore all the old hierarchies."

The survey examined some ways in which trust can be developed in this context (Table 6). Overall, "good, concise, written communication during and

after distributed meetings" (29.5%) and "meeting at least once face to face in person" (25.75%) came top, significantly above the other options (binomial sign tests, $p < 0.01$). The differences between countries were not significant (Chi-squared, $p > 0.01$).

4.5 Barriers to Uptake of New Technologies

New teleconferencing technologies may offer some of the improvements identified in the survey or address some of the problems. However, there are additional barriers to the uptake of new technology, which need to be addressed before these technologies will actually be used (Table 7).

Table 6

Ways of building trust in distributed teams

% of respondents choosing this option	Which of the following is the most effective way to build trust in distributed teams?					
	Good, concise, written communication during and after distributed meetings	Meeting at least once face to face in person	Everyone fulfilling their agreed actions on time	Conducting distributed meetings using video as well as audio	Taking time for an informal chat at the start or end of distributed meetings	Other
Overall	29.5	25.75	16.25	16.25	12.25	0
Australia	25	32	15	16	12	0
China	39	17	8	24	12	0
UK	28	28	20	10	14	0
US	26	26	22	15	11	0

Table 7

Barriers to uptake of new technologies

% of respondents choosing this option	What is the main thing stopping you from adopting new teleconferencing technologies?						
	Additional cost	Difficulty in integrating with existing technologies	Don't know	Understanding the benefits of a new technology	Difficulty in learning a new system	Security concerns	Other
Overall	37.5	17	14	11	9.75	7.5	3.25
Australia	35	12	18	15	10	4	6
China	19	34	1	15	18	13	0
UK	53	6	13	7	10	8	3
US	43	16	24	7	1	5	4

The main barrier identified in the survey was “additional cost” (identified by 37.5% of respondents). This was the main concern in Australia, the UK, and the US, and was significantly higher than the other barriers (binomial sign tests, $p < 0.01$). However, this was not as big a concern in China (Chi-squared, $p < 0.05$) where the top response was “difficulty integrating with existing technologies”.

5. Discussion:

Issues that are the same across Countries

The survey identified many issues that are common across the surveyed countries. In this section, we discuss these issues further. Some of the interview data is used to elaborate on and deepen the understanding of the issues.

Interviewee numbers are provided to indicate the origins of quotes, with prefixes indicating the interviewees' countries. A refers to Australia, C to China, UK to the UK, and US to the US.

5.1 Complementary Factors

Figure 1 in Section 4.3 presents the survey results on the impact of various factors on distributed meetings. Figure 2 shows the overall results again, this time with the factors categorised according to their main types: technology, management, and people (as identified in Section 2).

The results indicate that most (13 out of 15) of the factors were considered to have a medium-high or high impact by over 50% of respondents. This indicates that many different factors are important in ensuring an effective meeting and that focussing just on the top factors may not be sufficient.

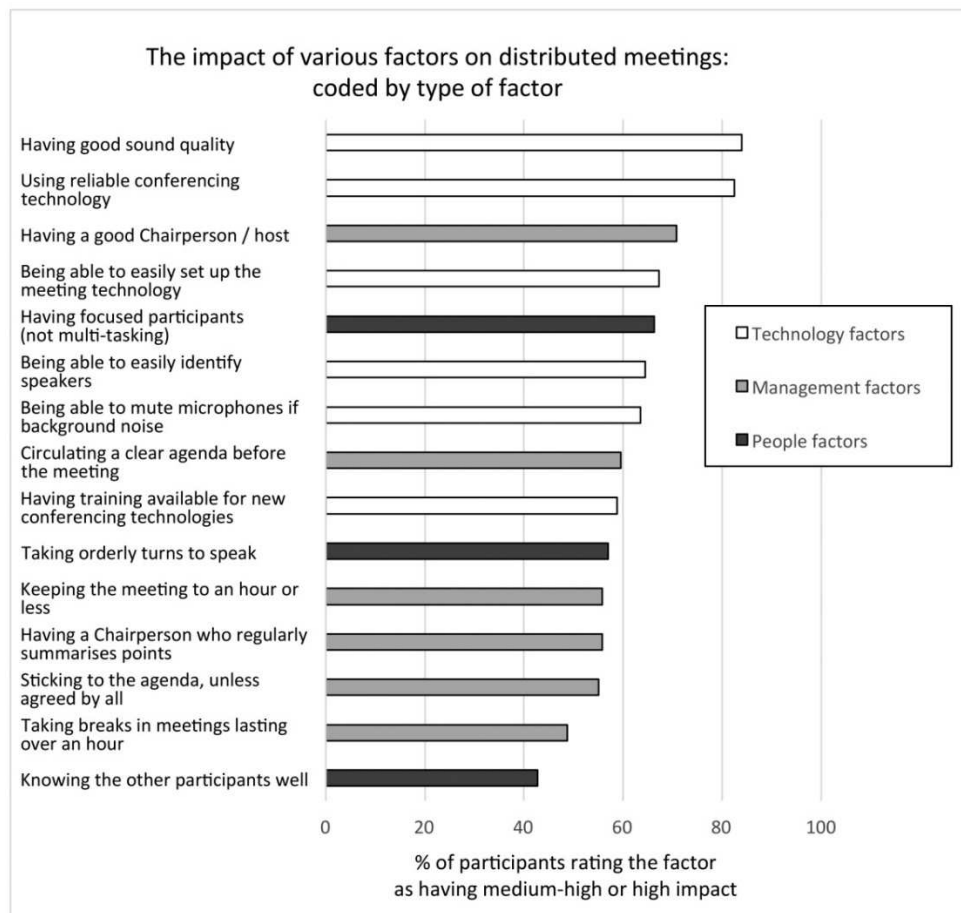


Figure 2: The impact of various factors on the effectiveness of distributed meetings: coded according to the type of factor

Looking at the distribution of the different types of factors in the graph, it may seem that technology factors tend to be rated more highly. However, the differences between the ratings in the middle part of the list are small. Furthermore, the question focused on a single meeting. As a result, respondents may have been less concerned about the impact of wider organisational or team issues. Therefore, it is not appropriate to conclude that technology factors in general are of greater importance. Further investigation comparing different types of factors is required to address this question.

What can be seen is that all three types of factors (technology, management, and people behaviour) are important to ensure an effective meeting. In particular, the top five factors include a factor related to management (a good chairperson) and a factor relating to people (focused participants) as

well as factors related to technology. This is echoed in the findings from the interviews where several interviewees explained that good technology without good management (and people behaviour) is ineffective. For example, one person said, “Good technology without good management: you’re not going to be successful” (US8). Similarly, good management without good technology is also inadequate. “If you’ve got poor technology, no matter how good the management of the meeting, it’ll be an unsatisfactory experience” (UK1).

This is in keeping with much of the literature in which a wide range of factors is identified as important (e.g. Powell et al., 2004; Yankelovich et al., 2004). However, it is in contrast to the implications sometimes made that a certain intervention will by itself create an effective meeting.

5.2 Most Important Factors

Although all of the factors are important, some are more important than others. The study specifically identified two factors that have a significantly larger impact than others and are often problematic in practice. These were consistently identified across all four countries.

5.2.1 Sound Quality

“Good sound quality” was at the top in respondents’ ratings of factors affecting distributed meetings (Section 4.3). It was also identified as a particular issue in audio-only meetings (Section 4.4). It was the top choice of intervention for improving audio-based meetings (Table 4) and was (by far) the biggest category of response to the open-ended question about how audio conferencing technology should be improved (Table 5). This was true for all the countries surveyed.

The importance of improving sound quality was echoed in the interviews, with 62% of interviewees (across all four countries) complaining of problems in current sound quality. For example, one interviewee said, “Sound quality is a really big problem and voices do go into each other. Anything that would distinguish voices from each other would be really useful, anything that makes the sound crisper” (A2).

These findings are in agreement with previous studies and expand previous results to show that they are a widespread concern. For example, Yankelovich et al. (2004) found that audio problems (and related problems with speaker identification) were at the top in their survey of problems with distributed meetings. They also found that they were highly correlated with meeting effectiveness. Another survey (Nilssen and Greenberg 2013) also found that sound quality issues were participants’ biggest concern, with many complaints about background noise, inability to understand when more than one person speaks at the same time, and lack of clarity.

Part of the issue with sound quality is indeed background noise. Several interviewees said that this is a particular problem and can even ruin a distributed meeting. As one interviewee stated, “Background noise is a constant headache. [There are] people dialling in from busy offices or ... from a car or from an airport and you get a lot of background noise or interference. That’s always a

pain and that can ruin a lot of teleconferences” (UK4).

Background noise can be mitigated to some extent by asking teleconference attendees to mute their microphones when in a noisy environment. In fact, 63.5% of respondents said that “being able to mute microphones if background noise” had a medium-high or high impact on a distributed meeting (see Figure 1). However, interviewees indicated that people do not always do this effectively and sometimes forget to turn their microphones back on when they do want to contribute. New technologies may be able to improve the situation by identifying participants with background noise and offering some noise reduction.

5.2.2 Reliability of the Technology

The reliability of the technology is also very important. It was rated the second most influential factor overall and the first in some of the countries (see Section 4.3). It is also important in audio-only meetings, being the second most identified intervention for improving audio-based meetings. It was also mentioned by several (9% of) respondents in answers to the open-ended question about how audio conferencing technology should be improved (see Section 4.4). These findings are backed up by the interviews, e.g. “It’s essential that [the technology] is reliable, it doesn’t distract people from the content of the meeting; the subject of the meeting; the objective of the meeting which unfortunately still happens too frequently” (UK10).

Reliable technology means that the technology works consistently throughout a distributed meeting, i.e. the software does not crash or do unexpected or erroneous things and connections (phone or Internet) remain stable throughout the call. The interviews show that these things cannot always be relied upon with call stability being a particular issue. For example, one Australian interviewee explained, “With people in regional areas, the Internet speed cannot maintain a reliable link and so results in cut outs, distortions, delays with the overall result being confusion and frustration” (A1). A Chinese interviewee agreed, “If the Internet access is not so good... someone says something and it stops... in the middle” (C6).

Reliability issues are not highlighted as much in the literature (e.g. Nilssen and Greenberg, 2013; Yankelovich et al., 2004). The reasons for this are

unclear. One possibility is that reliability is a growing concern as Internet-based technologies and the use of mobile phones for conference calls increase in popularity.

5.3 Other Factors

Although sound quality and reliability are important for a successful distributed meeting, they are not enough on their own. A range of factors related to technology, management, and people's behaviour are important.

5.3.1 Technology Factors

Technology factors cover usability and the availability of various technology features as well as sound quality and reliability (system quality) (see Section 2.2).

In particular, the ease with which a distributed meeting can be set up is a key factor in its effectiveness, with 67.2% of survey respondents rating it as having a medium-high or high impact. The findings from the company interviews agree, with many (30%) interviewees mentioning problems with setting up distributed meetings. One interviewee even said, "The biggest problem of all is set up... [It is very important] to have the technology, typically, always there and working at the time when the meeting is supposed to start" (UK6).

The ease of identifying speakers is also an issue. A majority of people in each country had some problems with speaker identification in audio meetings. This is often connected to the sound quality. For example, one interviewee said, "By the time the codecs have done their work on compressing the voice, you can't tell one person from another" (UK6). However, even with good sound quality, speaker identification can be problematic, as one interviewee said, "You are relying on voice memory. If you have not met the person, it is very hard" (A9). Providing help with speaker identification can make it easier to know who is talking and free up cognitive resources for the key business of the meeting. There are some technology features that can help in addition to ensuring good sound quality. Spatial audio can make it easier to identify speakers by separating the sounds from different people (Raake et al., 2010). Graphical interfaces can also be used to highlight the name or photo of the current speaker (e.g. Colburn et al., 2001; Hughes, 2008).

Technology features like these can improve the usability of the technology. Other features can enhance a distributed meeting by providing further functionality. Table 1 (Section 4.2) shows features that are currently used. Document sharing is particularly popular (68%) and was also mentioned by several people when asked about desired improvements to audio conferencing (Section 4.4).

5.3.2 Management Factors

Management factors relate to the wider management of a project and to the facilitation of a single meeting (see Section 2.3). They include aspects such as team building, the availability of training, chairing, and the use of agendas.

Chairing in particular is very important. "Having a good chairperson/ host" was rated as having a medium-high or high impact by 70.8% of survey respondents, making it the third highest factor (see Section 4.3). This is backed up by the interviews. As one interviewee said, "I think [an effective meeting] depends on the skills of the person chairing" (A2). Another explained, "[The management of the meeting] is very important, because... if you cannot make every member to focus on the conversation, we can miss so much important data and we can make many [misunderstandings]" (C1).

There is some variation between countries in what is considered a good chairperson, but key points from the interviews include managing turn-taking to ensure everyone gets a chance to speak; encouraging contributions from all participants, including time for introductions between participants; and encouraging participants to be attentive and focus on the meeting. The importance of chairing is also mentioned in the literature (e.g. Barkhi et al., 1999), but there is generally little emphasis on it. The findings from our survey indicate that this is an area that needs further investigation.

Wider management issues also impact a distributed meeting. It is particularly important to choose the right type of meeting for each task. There are some differences in opinion, but survey respondents generally agreed that audio conferencing is effective for regular project progress meetings, information/requirements gathering meetings, and simple problem solving meetings (Section 4.4). These were the top three choices in all four countries. This is in agreement with the literature

where studies have shown that distributed meetings are effective for information transmission and brainstorming and not very effective for tasks such as negotiation (Colburn et al., 2001; Johansen, 1977).

5.3.3 People Factors

People factors include team characteristics and individual behaviour (Section 2.4). The factors examined in the survey (Section 4.3) focused on individual behaviour, as it is harder to pin down the effect of team characteristics on an individual meeting since they have more of an impact on the context of the project as a whole. The survey highlighted that “having focused participants (not multi-tasking)” is particularly important, with 66.2% of respondents rating this as having a medium-high or high impact on a distributed meeting.

This issue was explored further in the interviews, with several interviewees reporting that distractions and multi-tasking can be an issue, although a few found the possibility of doing other things during a meeting helpful. A fairly representative comment is, “One of the most important things is to, somehow, make sure that you've got everybody's attention throughout the meeting. Particularly when you can't see them, and they can mute their microphone and they can start writing emails, or whatever.” (UK6).

A particular issue with team behaviour is trust. The interviews explained that trust is important but can be hard to build effectively in distributed meetings. “Rapport building between people is so important... if there is no rapport, there is no motivation or reason to be talking” (A7). Another interviewee said, “It does not help with trust when you're not in person... when you're in meetings that you're together, I think there's a different level of trust than when not everyone's in the same room” (US1).

The issue of trust was explored in the survey with respondents being asked how best to build trust in distributed teams (Section 4.5). There were some differences between countries (see Section 6.1.5), but overall, important aspects included good, concise written communication during and after distributed meetings and meeting at least once face to face.

6. Discussion:

Differences between Countries

The research showed that there were many similarities between the countries surveyed. However, there were some differences, particularly between the responses of the Chinese respondents and those in Australia, the UK, and US (the western countries). This is not unexpected given the cultural differences between these countries. However, caution should be used in interpreting the results. Given that the country samples are relatively small (100 respondents) and not random samples, these differences may be due to other factors rather than characteristics of the countries themselves. For example, the sample from one country may have more frequent teleconferencing users than another country. Nevertheless, these apparent differences are worthy of comment and of further investigation. We focus on two of the main areas of differences here.

6.1.1 Speaker Identification

The results indicate that Chinese respondents generally prefer video conferencing to audio-only and are more comfortable when they can see the other participants (Section 4.1). Similarly, the interviews indicate that they often use video cues to identify speakers. For example, one interviewee said, “I think that the [video] can help people to recognise the one ... he or she is speaking to” (C2). These facilities are not usually available in audio-only conferencing. If participants have learned to rely on them, they may struggle more when they are removed.

This goes some way towards explaining why Chinese respondents reported the most frequent problems with speaker identification in audio meetings (see Table 3 in Section 4.4). In fact, 81% of Chinese respondents reported problems at least “sometimes” compared with 57% in Australia, 62% in the UK, and 53% in the US.

Another part of the explanation for this may be language issues. The Chinese sample was the only sample without English as a first language, although all respondents had a good level of English. Thus, language barriers may appear more often and make speaker identification more difficult.

6.1.2 Barriers to Technology Adoption

In China, 34% reported that the main barrier to the adoption of new conferencing technology was the problem of integration with existing technology, whereas in Australia, the UK, and the US, the main barrier by far was cost. It is possible that the Chinese individuals involved in the research are isolated from decisions on cost or that the technology they are currently using is more complex and less flexible. However, many of the Chinese interviewees reported issues with their current technology in terms of its reliability, and it is more likely that they would need a reason to take on the perceived issues associated with integrating new technologies given that they have spent some considerable time and effort ensuring that their current systems are as stable as they can make them. More research is needed to explore this further.

7. Conclusions

A greater understanding of the factors that contribute to an effective distributed meeting is useful. It can help companies improve the practice of these meetings and can inform the prioritisation of any associated technology developments.

This paper has presented the results from a survey with 400 teleconferencing users supported by forty interviews with practitioners. The results indicate that a wide range of factors need to be optimised to ensure the most effective distributed meetings. These include the technology used, the management practices, and the behaviour of individuals in the meeting. It is important not to focus solely on particular interventions or assume that a new technology will solve all the problems.

The survey found that good sound quality and reliable conferencing technology are particularly important factors but are often also problematic in

practice. The importance of sound quality is well acknowledged, but reliability is not so widely discussed in the literature and may require further investigation.

The survey also highlighted the importance of good chairing. Although mentioned in the literature, often little emphasis is placed on the extended role of the chairperson in a distributed meeting. More research is needed on the characteristics of good chairpeople and how to train them. The study also raised issues related to multi-tasking and trust in distributed meetings. More could be done to understand how these issues can best be addressed.

The survey also identified apparent differences between China and the other (western) countries in the study. This indicates that it is important not to assume that solutions from one country can be exported to another. Some of the issues may differ between countries, and there may also be different barriers to the adoption of new technology. This should be explored further so that improvements to teleconferencing can be tailored more to the needs of particular countries.

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