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Author
Mokhtarian, Patricia L.

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Patricia Lyon Mokhtarian

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Patricia Lyon Mokhtarian
Department of Civil Engineering
University of California at Davis
Davis, CA 95616

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AN EMPIRICAL EVALUATION OF THE TRAVEL IMPACTS OF TELECONFERENCING†

PATRICIA LYON MOKHTARIAN
Southern California Association of Governments, 600 S. Commonwealth Avenue, Suite 1000, Los Angeles, CA 90005, U.S.A.

Abstract—On February 20, 1986, the regular monthly meeting of the Southern California Association of Governments (SCAG) Transportation and Communications Committee was held as a two-way videoconference. Analysis of travel changes associated with the videoconference showed that vehicle miles traveled actually increased, compared to an average meeting held at the usual single location at SCAG offices. Although the average distance per person to the nearest teleconference site was 24% lower than the distance to the SCAG offices, the attendance at the teleconference was so much higher than average that total VMT was 29% higher than for a typical meeting held at SCAG.

1. INTRODUCTION

There is by now a large body of literature addressing the potential impacts of telecommunications technology on travel demand and, derivatively, energy consumption. A current extensive review by Salomon (1986) provides most of the classic and many of the recent references on the subject. Salomon notes the tendency of the transportation planner in particular to dwell heavily on the potential of telecommunications to *substitute* for travel, and little or not at all on its potential to *generate* travel. This lopsided emphasis is probably not only a consequence of the need to find solutions to an urban mobility crisis, but also because substitution effects seem, at this point in the state of the art, to be easier to model and predict than generation effects.

Nevertheless, the potential complementary relationship of telecommunications and travel is quite a logical one, in several ways. One aspect is the concept of a more-or-less constant personal travel time budget. Whether because of restlessness or a desire for social contact, or (most likely) both, the argument goes, people tend to want to travel a certain amount. Under this paradigm, the natural result of reducing some travel by *whatever* means, is that additional travel will be created to compensate—to fulfill the travel time budget. Telecommunications does not directly stimulate travel, in this case. but simply offers one of any number of ways of reducing travel and thereby freeing time for increased travel for other purposes.

A more direct complementary relationship between telecommunications and travel can result from the nature of telecommunications itself. By making information about outside activities and interaction opportunities more readily accessible, telecommunications creates the desire to participate in those activities and opportunities, thereby stimulating travel to engage in them. A person might, for example, attend many more plays if he/she could call up on a PC or videotex terminal all the local offerings, with plot synopses, a map to each theater, seating plans for each theater, parking, and nearby restaurant locations—complete with electronic ticket-ordering capability. Other examples abound.

Both the direct and indirect generation effects discussed above are short-term in nature. Over the long term, we might see a complex three-way relationship between telecommunications, transportation, and land use result in increased travel. An increase in telecommuting, for example, might induce changes in employment and/or residential location that would act to create longer trips. An employee living 10 miles from work and commuting five days a week drives 100 miles a week to and from work. If that employee becomes a telecommuter coming in to the office only two days a week, he/she may move to more affordable and/or more desirable housing 50 miles away—doubling the total commute to 200 miles a week.

This paper focuses on the potential (business) travel impacts of one telecommunications application, teleconferencing. A teleconference, by its nature, has different travel implications than a conventional physical meeting. Rather than converging on a single site, teleconference participants travel to one of two or more dispersed sites. Typically, the distance to the dispersed site is at most as great, and more often far less, than the distance to the single conventional meeting site would have been. Often the dispersed site is the workplace of the participant, making the marginal cost of travel zero.

Thus, on the surface, it appears that teleconferencing would inevitably reduce business travel. In the past, it was commonly attempted to justify the costs of teleconferencing solely on the basis of travel costs saved. This strategy has been notably unsuccessful and, indeed, may have significantly inhibited the growth of teleconferencing by neglecting to document its other benefits (Johansen and Bullen, 1984).

There are a number of reasons why focusing on

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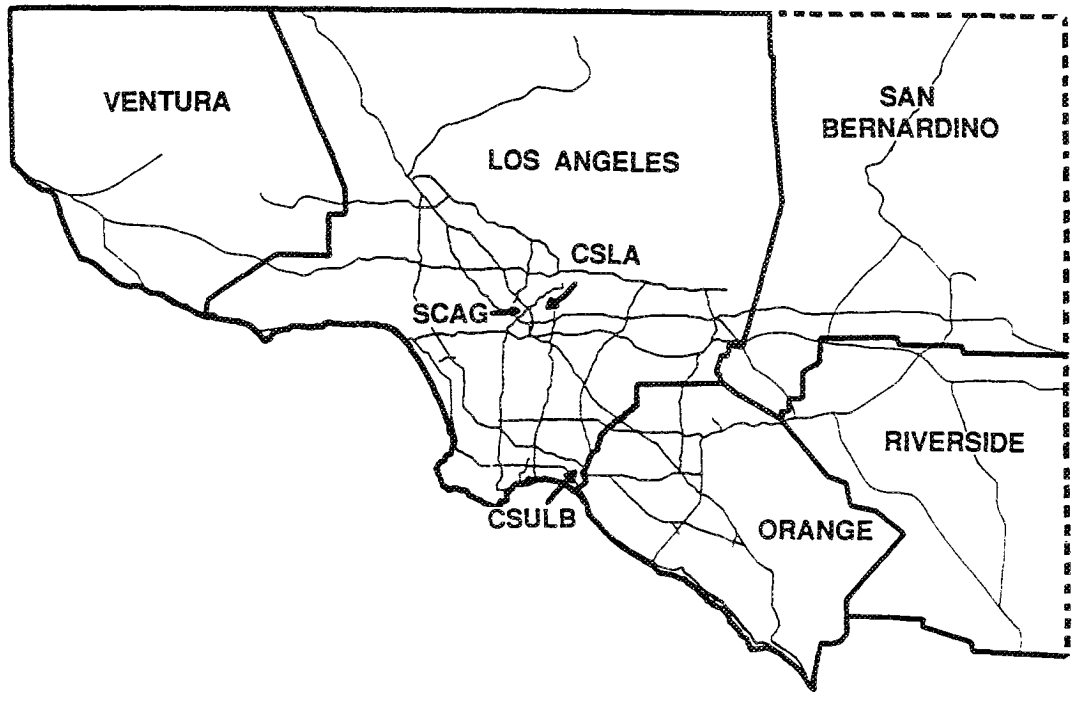

Fig. 1. SCAG region.

potential travel savings can be a misleading and incomplete justification for teleconferencing:

(i) *Travel, up to a point, is viewed positively and not negatively*. There may be purposes for traveling (e.g. personal visits, sightseeing) that are secondary to the supposed reason for the trip, but nevertheless important. Travel can be a fringe benefit or a sign of status, or simply a welcome break from the office routine. Cutting the travel budget could be interpreted as a loss of status, or a signal to shrink the budget in future years, so frequently trips actually eliminated due to teleconferencing are simply replaced by other trips. This might be viewed as the corporate counterpart of the constant travel time budget theory referred to above.

(ii) Simply because the teleconference location is more convenient, *more people may attend* the teleconference than would have attended a more distant physical meeting (Evans, 1983). While some travel could be saved on an individual basis, the aggregate amount of travel might actually be greater with a teleconference.

(iii) Organizations who have implemented teleconferencing systems find that *more meetings are held* than would take place without teleconferencing. In an analysis of teleconferencing vs. conventional alternatives, it becomes virtually meaningless to compare total travel costs when one is dealing with different numbers of meetings and different numbers of people involved.

(iv) There are many other potential benefits of teleconferencing besides a theoretically possible travel savings (Green and Hansell, 1984; Lewnes, 1985; and Joyner, 1985). The fact that it is feasible to hold more meetings, and possible for more people to attend, implies that *more effective communication* can be achieved. This is a goal *more* important, in many cases, than reducing travel costs. Regular teleconference participants report that meetings are *better organized* (they are more conscious of time and less likely to digress from the purpose of the meeting), *convey a higher quality of information* (because more of the staff directly involved with the work are able to be there with supporting information), and *convey that information directly to more people* than for similar meetings held in the conventional fashion.

This paper presents empirical evidence of a complementary effect in teleconferencing. Specifically, when a regular monthly meeting was held as a two-way videoconference at two locations, travel associated with the meeting was greater than for the typical meeting held at its usual single location. Section 2 gives the background for the videoconference, Section 3 presents the evaluation results related to travel, and Section 4 contains some concluding remarks.

2. BACKGROUND

The Southern California Association of Governments (SCAG) is a Metropolitan Planning Organization covering 38,000 square miles. The SCAG region consists of the Counties of Los Angeles, Orange, Ventura, Riverside, San Bernardino, and Imperial (see Fig. 1, showing the first five counties). It is governed by an Executive Committee and several

specialized-area policy committees, each composed primarily of local elected officials of SCAG member cities and counties. For these committee members, attending monthly meetings (usually held at SCAG offices two miles west of downtown Los Angeles) may involve a round trip of 200 miles or more. For many, travel time to and from a meeting at SCAG is longer than the meeting itself. Further, at least one leg of the trip normally takes place during the peak period.

The inconvenience of travel is certainly one factor in the relatively low level of participation of committee members. A study of one year's attendance records for meetings held by SCAG's Transportation and Communications Committee (TCC) showed that on average only 14 out of 45 (32%) of the committee's members and alternates attend its meetings. The year's attendance of members/alternates ranged from a high of 19 (42%) to a low of 9 (20%). Beyond the reduced participation of existing members, it is unknown to what extent the inconvenience of travel inhibits elected officials from volunteering to serve on SCAG's committees in the first place.

Thus, in exploring the potential of teleconferencing as a means of conducting meetings, SCAG has four motivations:

(i) To increase attendance of members;
(ii) To make it more convenient (less expensive, time-consuming) for members to attend;
(iii) To make it more convenient for agency staff and members of the public to attend; and
(iv) To broaden the representativeness of the committee by attracting new members from areas of the region which are currently underrepresented.

In view of these motivations, the TCC decided to conduct a pilot teleconference to test the feasibility of using teleconferencing on an ongoing basis for SCAG meetings. Specifically, the pilot was designed:

(i) To evaluate the proceedings in terms of ease of use, effectiveness of communication, and attendance level; and
(ii) To compare the cost of conducting the teleconference with savings in travel time and cost.

At a more general level, an additional purpose of the teleconference was to pioneer the use of this particular area of telecommunications technology, as an example to the public-sector agencies in the region and elsewhere.

Accordingly, the regularly scheduled February 20, 1986, meeting of the TCC was held as a two-way videoconference on two campuses of the California State University system. The Cal State system was chosen because it was interested in pioneering videoconferencing applications of its instructional television microwave network, and the cost to SCAG was far lower than it would have been with a commercial provider.

The two campuses selected for the meeting were Los Angeles and Long Beach, about 12 and 35 miles, respectively, from the SCAG office (see Fig. 1). The two locations were chosen based on an analysis of where the most committee members lived. It would have been desirable to have a location further east than the Los Angeles campus, but technical considerations removed candidates such as the California State Polytechnic University at Pomona (in eastern Los Angeles County) and Cal State San Bernardino. Nevertheless, even a location as close to SCAG as Cal State L.A. offered the considerable advantage of eliminating the trip through downtown Los Angeles for those people coming from the east.

The videoconference experience was evaluated by means of a written survey distributed to all those in attendance. The survey sought to document:

(i) Attendance patterns, both currently and hypothetically with regular teleconference meetings;
(ii) Travel distance, time, and cost changes due to the teleconference; and
(iii) The perceived effectiveness of this meeting in particular and teleconferencing in general.

This paper focuses on changes in number of miles traveled due to the teleconference, and on attendance patterns as they relate to travel changes. The complete analysis of the evaluation survey is found in SCAG (1986), along with additional information on types of teleconferencing, other government uses of teleconferencing, analysis of alternatives for the SCAG teleconference, and advance preparation for the videoconference.

3. EVALUATION RESULTS

3.1 *Attendance analysis*

It is important to compare the attendance at the videoconference to attendance at a "regular" TCC meeting not only in view of the objective of increasing attendance, but also because the attendance naturally affects the overall travel pattern.

Looking at the recorded attendance shown in Table 1, the number of members present at this meeting is compared to the historical record described above. Having 23 members/alternates present at the teleconference considerably exceeds the average attendance (14) and the attendance in the same month of the previous year (15). It is in fact 21% higher than even the maximum (for the 12-month period studied) attendance of 19.

On the surface, then, it appears that teleconferencing can certainly help achieve the objective of increasing attendance at TCC meetings. In reality, it is not clear how much of the observed increase can be attributed to the genuine increase in convenience of the two locations, how much was a fluke that would have happened anyway, and how much was due to the novelty effect of the technology.

Three questions attempt to assess this issue. Ques-

Table 1. Comparison of recorded attendance with number of surveys returned

	Los Angeles	Long Beach	Combined
Recorded attendance			
Member/alternate	12	11	23
SCAG staff	10	6	16
Other	13	3	16
Total	35	20	55
Number of surveys returned			
Member	8	8	16
Alternate or member representative	3	1	4
Regular nonmember	3	—	3
SCAG staff	2	2	4
One-time observer	1	1	2
Total	17	12	29
Response rate (surveys/attendance)	49%	60%	53%

tion 8 of the survey asked, "Would you have come to this meeting if it had been held at SCAG, as usual?" Eighteen of the 20 members/alternates returning the survey said "yes," one said "no," and one did not respond. Taken at face value, this implies that the high attendance experienced would have occurred regardless of whether there had been a teleconference or not.

To examine, at least subjectively, whether attendance could be expected still to be higher after any novelty effect that there may be wears off, the answers to Questions 3 and 11 of the survey are compared. Question 3 asked how often the respondent currently attends TCC meetings, and Question 11 asked how often the respondent would attend if teleconferencing were used regularly. Five members/alternates (29% of the 17 responding to both questions) felt their attendance would increase to a higher frequency category with teleconferencing. Twelve members felt their attendance would stay in the same category, which may or may not involve an increase of one or two meetings a year. Thus, some long-range increases in attendance could reasonably be expected to occur with regular teleconferencing.

Two questions, one real and one hypothetical, dealt with increasing attendance of city staff and others due to teleconferencing. Question 2 asked, "Did someone come at your invitation who otherwise would not have been at this meeting?" Three members and one regular nonmember replied "yes," for a total of five (3 staff and 2 "other") guests. These guests constituted around 9% of the total attendance. Thus, a not insignificant increase in nonmember attendance is observed.

Question 12 dealt with long-term increases in nonmember attendance if teleconferencing were instituted regularly. Of 20 members/alternates and regular nonmembers responding, 7 (35%) stated they would encourage additional staff to attend occasionally or often (between 4 and 9 times a year).

Overall, it seems that solid, if not overwhelming, increases in attendance (among both members and nonmembers) could be expected from implementing teleconferencing on a regular basis.

3.2. *Travel analysis*

Question 4 of the evaluation survey asked how far and how long the round trip to SCAG is for the respondent. These are compared with the responses to Question 7, asking distance and time to and from the teleconference site attended. First, the responses to each set of questions are discussed (only the distance results are explicitly tabulated), and then the differences are analyzed.

Table 2 shows that the average round trip distance for a respondent attending a meeting at SCAG is 61 miles. While 26% of the respondents have trips of 10 miles or less, 42% face round trips of more than 70 miles. As for travel time, the average round trip to and from SCAG is 1 hour and 40 minutes. Seventy-two percent of the respondents travel more than an hour to attend a SCAG meeting, and 17% travel more than two hours. This underscores the com-

Table 2. Round-trip distance to SCAG (members, alternates, and regular nonmembers only)

Number of miles	Number (%) responding
0–10	5 (26%)
11–20	1 (5%)
21–30	2 (11%)
31–40	2 (11%)
41–50	1 (5%)
71–80	4 (21%)
111–120	2 (11%)
121–130	1 (5%)
270	1 (5%)
	19
No response	4
Total responses	23

Average distance for those responding: 61 miles.

Table 3. Round-trip distance to teleconference site (members, alternates, and regular nonmembers only)

Number of miles	Number (%) responding
0–10	4 (18%)
11–20	3 (14%)
21–30	2 (9%)
31–40	5 (23%)
41–50	3 (14%)
61–70	2 (9%)
91–100	1 (5%)
101–110	1 (5%)
270	1 (5%)
	22
No response	1
Total responses	23

Average distance for those responding: 48 miles.

mitment of those who do participate on SCAG committees.

Table 3 tabulates travel distances for the teleconference. The average round trip distance for teleconference participants was 48 miles, 13 miles (21%) less than for a meeting at SCAG. The average travel time for the teleconference was 1½ hours, a decrease of 10 minutes (10%) over the time for a trip to SCAG. Directly comparing Tables 2 and 3 is complicated by the fact that different people and different numbers of people did not respond to some of those questions. Table 4 tabulates differences in travel distance for those who answered the questions both for SCAG offices and for the teleconference site.

Table 4 reveals the interesting finding that four respondents traveled a greater distance—as much as 25 miles further—to the teleconference than they would have to a meeting at SCAG. This is because someone coming from the west or northwest would have to drive past SCAG to get to the nearest teleconference site. Overall, however, 278 fewer miles were driven for this meeting than if the same people had attended the meeting at SCAG, a 24% savings. On average, respondents reduced their travel by 15 miles each. (Again, these numbers differ slightly from the calculation indicated by Tables 2 and 3, because of the different number of people in the sample. Table 3 is based on 22 responses, while Tables 2 and 4 draw on only 19 complete responses.)

As for travel time, while some participants traveled longer than they would have for a meeting held at SCAG, an overall savings of five hours of travel time was achieved. This averaged about 20 minutes per person.

Observe that Tables 2–4 apply only to members, alternates, and regular nonmembers. SCAG staff and one-time observers were not included for two reasons: (1) the convenience for the committee itself is the main focus of concern, and (2) the survey response rate was low for this group (see Table 1). A completely rigorous analysis of the total travel impact of the teleconference would account for trips generated by staff who otherwise would have remained at the SCAG offices. However, because the teleconference sites were more or less on the way to work for many staff, and because some carpooling took place, it would be incorrect to assume that every staff member traveled an *extra* amount equal to the round trip distance between SCAG and the chosen teleconference site. Overall, the evidence strongly suggests that the extra miles *traveled* by SCAG staff and one-time observers would not exceed the 278 miles *saved* by the other attendees, still leaving a net savings in travel.

The foregoing paragraphs base the conclusion of overall reduced travel on the assumption that all the same people would have attended the meeting if it had been held at SCAG. Based on the responses to Question 8 of the survey (discussed in Section 3.1), this is, on the surface, not a bad assumption. But it is of interest to compare the total distance traveled to an *average* meeting held at SCAG with that for the teleconference.

A *rough* comparison can be made, at least for members and alternates, as follows: Assume a typical meeting at SCAG is attended by 14 members and alternates (the historical average), each of whom travels (taking the average over members, alternates, and regular nonmembers to be about the same as the average for members and alternates alone) 61 miles on average (Table 2). A typical TCC meeting at SCAG would involve about $14 \times 61 = 854$ miles of travel. But 23 members and alternates attended the teleconference (Table 1). Even though each only drove 48 miles on average (Table 3), the total distance traveled is $23 \times 48 = 1{,}104$ miles, *29%* higher than the 854 miles for a meeting held at SCAG.

Table 4. Round-trip differences in distance between trips to SCAG and to the teleconference site (members, alternates, and regular nonmembers only)

Number of miles saved	Number (%) responding
−25	1 (5%)
−20 – −11	2 (11%)
−10 – −1	1 (5%)
0–10	8 (42%)
11–20	2 (11%)
21–30	2 (11%)
31–40	1 (5%)
71–90	2 (11%)
	19
No/incomplete response	4
Total responses	23

Total miles for meeting at SCAG: 1,166.
Total miles for teleconference: 888.
Total miles saved: 278 (24%).
Average miles saved per respondent: 15.

Thus, precisely *because* attendance was higher at the teleconference (for whatever reasons), total travel increased even though the comparative distance traveled by any one person decreased.

4. CONCLUSIONS

This analysis illustrates that determining differences in travel due to teleconferencing is not altogether straightforward. On the one hand, it is evident that most individuals attending the SCAG videoconference saved time and miles (on average 18% and 24%, respectively) over making the trip to a single central location. On the other hand, there is a strong basis for inferring that in the aggregate, vehicle miles traveled (VMT) were higher for the teleconference than if the meeting had been held at SCAG as usual. Certainly total VMT (for members and alternates) was 29% higher for the videoconference than for an *average* meeting at SCAG, and certainly that was due to the higher-than-average attendance. What can never be certain is whether the same attendance would have been achieved for a conventional meeting. Ordinarily, a sizable novelty and/or convenience effect for the videoconference might be assumed, but one must give some weight to the members' assertions that they would have come regardless.

These findings, supporting the existence of a complementary relationship between telecommunications and transportation, present the transportation/energy/air quality planning community with a bit of a dilemma. Assuming congestion, pollution, and/or energy consumption are an issue, should we discourage teleconferencing on the grounds that we should be trying to *re*duce travel, emissions, and fuel consumption, not *in*duce them? Should we, at a minimum, refrain from endorsing teleconferencing?

This author believes that neither reaction is necessary, particularly in view of the ambiguity as to what the attendance for this meeting would have been if it had been held at SCAG. If having the meeting as a teleconference had little or no impact on the total attendance at the meeting, the travel savings are clear. If the teleconference *did* cause a higher-than-average attendance, however, travel may have increased as a consequence, but that is counter-balanced by the suggestion that *improved communication* took place, *more conveniently*. That is, the teleconference seemingly accomplished its purpose of making it easier for more people to attend.

On the one hand, then, it is argued that improved communications can outweigh any negative transportation impacts that might result. On the other hand, even those transportation impacts are not as negative as they appear on the surface. This is because, by and large, travel to the videoconference took place under less congested conditions than travel to SCAG would have. For one thing, the early part of a trip into the regional center is normally less congested than the latter part. Holding the meeting in locations well outside of downtown Los Angeles eliminated that latter, more congested, end of the trip. For another thing, the fact that the teleconference sites were closer to the participants than SCAG meant that they could leave later to go to the meeting, after more of the morning peak had passed.

On a large scale, it can be argued that travel may increase, but if that travel is redistributed to less congested times and/or places, then overall congestion may actually decrease, or at least not increase. The SCAG region had ample evidence of this during the 1984 Summer Olympics. A study of the remarkable lack of congestion experienced during that time documented, for example, freeway volumes 11% higher than usual on a particular day, but a 35% *decrease* in delay time. On days during the Olympics in which volumes were *at* average levels, delay time was as much as 55% lower (SCAG, 1985).

Many transportation management strategies combined to achieve this result, but one of the major factors was a dramatic increase in flex-time and modified-work-schedule implementation. Widespread changes in work start-and-stop times had the effect of flattening the peak, thereby allowing many more trips than normal to be accommodated.

A parallel argument may be made for energy and air quality impacts. Stop-and-go conditions can decrease fuel economy by up to 50% over free-flow conditions (CEC, 1987). Thus, higher levels of travel do not necessarily equate to higher fuel consumption if those higher levels of travel take place in a less-congested environment. Similarly, stop-and-go travel certainly results in higher emissions than the same amount of free-flow travel.

From a transportation planning standpoint, then, the central benefit of telecommunications technology might not be its potential for reducing travel under certain circumstances, but the increased flexibility it affords for *redistributing* travel patterns. Given a choice, many people will choose to travel at times and to places for which there is excess capacity in the transportation system. Telecommunications seems to offer the potential for accommodating a certain amount of transportation growth without a concomitant increase in congestion.

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