RM-78-49

COMPUTER ASSISTED PANEL SESSIONS (CAPS): REVIEW OF AN EXPERIMENT IN ACCELERATED INTERNATIONAL TELECONFERENCING

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Preface

Because of IIASA's general interest in computer networking on the one hand and international team research on the other, a number of attempts have been made at IIASA to employ the former as an aid to the latter. The most ambitious of these was a four-nation teleconference conducted by IIASA in July 1977 in the form of a highly structured set of computer-linked expert panel sessions. This activity, known as CAPS ("computer-assisted panel sessions"), differed from conventional teleconferences in a number of ways, notably its extremely short time duration and intricate agenda of group tasks. The present memorandum describes what was done and the problems which were encountered--some of them quite serious--and derives guidelines for improvement of future activities of this kind.

A second memorandum related to the CAPS experiment is being issued simultaneously,* to provide conceptual, historical, and cost-analytic background for such uses of modern telecommunications technologies in support of international scientific collaboration.

A large team of IIASA scientists took part in the organization and performance of the CAPS experiment. The main workshop organizers were G.M. Dobrov and W.D. Rauch; inspiration for the teleconferencing experiment came from W.D. Penniman and R.H. Randolph; technical arrangements for the computer connections were made and financed by IIASA's Systems and Decision Sciences Area (A. Butrimenko, U. Sichra, and V. Dashko--who also prepared most of Figure 1, below); Olaf Helmer prepared and supervised the panels' substantive activities. All of us on the team are grateful for the help and patience of our colleagues who served as panel members, without whom the experiment would have been impossible, and to the other IIASA staff members who contributed to the project in many ways. Special thanks are also due to R.C. Tomlinson and H.A. Linstone for their incisive comments on earlier drafts of this memorandum.

This memorandum is to be published soon in the journal Technological Forecasting and Social Change.

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* G.M. Dobrov, R.H. Randolph, and W.D. Rauch, Alternative Communication Modes in International Team Research, RM-78-48, (Laxenburg, Austria, IIASA), 1978.

Abstract

A complex set of telecommunications links was used to permit eight geographically separated expert panels (in Austria, Poland, USSR, and USA) to participate in a Delphi-type exercise conducted in connection with an IIASA workshop on "Systems Assessment of New Technology: International Perspectives". No significant technical difficulties were encountered in creating and using this communication mechanism, but a number of socio-psychological and procedural problems arose, which were serious enough to prevent substantively useful results from being obtained. It seems clear, however, that if such an activity were to focus on questions agreed to be worthwhile, with participants and an agenda structure truly suitable for resolving these questions, then a number of relatively minor organizational and informational adjustments should permit "Computer Assisted Panel Sessions" to become a useful tool for international scientific cooperation.

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Computer Assisted Panel Sessions (CAPS): Review of an Experiment in Accelerated International Teleconferencing

1. INTRODUCTION

On July 18-21, 1977, the International Institute for Applied Systems Analysis (Laxenburg, Austria) conducted a workshop entitled "Systems Assessment of New Technology: International Perspectives". Part of this workshop was an experiment in which electronic communications media were used to link eight geographically separated sub-panels: one panel in Wroclaw (Poland), one in Kiev (USSR), one in Menlo Park (California, USA), and five other panels located at IIASA itself (simulating other remote sites). The main purpose of this experiment was to determine whether it is possible today to carry out effective common workshop sessions involving remote panels which are situated on different continents and in Eastern as well as Western countries and which have been chosen without regard to the technical facilities available. In addition, we hoped to gain insights into the problems and prospects of extremely short-term teleconferencing activities as contrasted with the longer-term conferences more commonly encountered.

Of course we were aware that the time for making such an experiment is still very early (not only on technical grounds) and that we would be confronted with many problems in conducting this experiment. Also, we knew that this particular exercise would be somewhat artificial, since it was in fact only incidental to a normal face-to-face workshop. That is, the participants, group procedures, etc., were not chosen in accordance with a genuine need for group results--as would certainly be the case when such teleconferencing methods are used in actual team research situations. Thus it was clear from the start that our findings would have limited external validity (applicability to other situations).

As we shall see, the main result of the experiment was to demonstrate that the most important difficulties in conducting team activities over such long distances are not technical ones anymore. Much more important are the socio-psychological and above all the procedural requirements of conducting a joint activity between geographically separated groups of experts, compounded by the effects of extreme time constraints and by the fact that this kind of group interaction may in reality be suitable only for certain limited kinds of subject matter. Special preventive measures must therefore be taken if such accelerated teleconferences are to produce substantively meaningful results.

At least some of the difficulties we encountered were plainly caused by the artificiality of the situation, and so there are grounds to expect that these difficulties may not arise when similar computer-assisted panel sessions are conducted in actual practice.

2. INFORMATIONAL NETWORK

Because the workshop was schedule to last only four days, it was necessary to establish fast and reliable communication channels among the involved panels. Travel and mail could only be used in the preparatory stage of the experiment, and even then only in limited ways. The bulk of the interpanel communication would have to be of some other form.

The location of the three remote panels had been determined by personal conditions (in Kiev, Wroclaw, and Menlo Park we knew scientists who were interested in our work and who were willing to cooperate in this experiment). The first stage of the preparation for the CAPS experiment was therefore to determine what communication channels we could use. To each of the three foreign panels and within IIASA quite different communication methods turned out to be necessary. The international part of the communication network that was finally established (i.e., the part outside IIASA) is shown in Figure 1. Notice that between all nodes of this system at least two parallel communication lines existed: the print-oriented communication channel we used during the experiment, and a normal telephone line which we used mostly during the setting-up of the network. During the running of the experiment, the telephone connection was used only in case of emergency, because the main communication channels were in general faster and more reliable.

2.1 The Communication Within IIASA

Within IIASA headquarters at Schloss Laxenburg, the five local panels communicated through a computer program named WORKSHOP which had been developed by Ulli Sichra from IIASA's computer group. This program was implemented on IIASA's PDP-11/45. Each panel was equipped with a terminal which had on-line access to the program through the time-sharing operating-system UNIX.

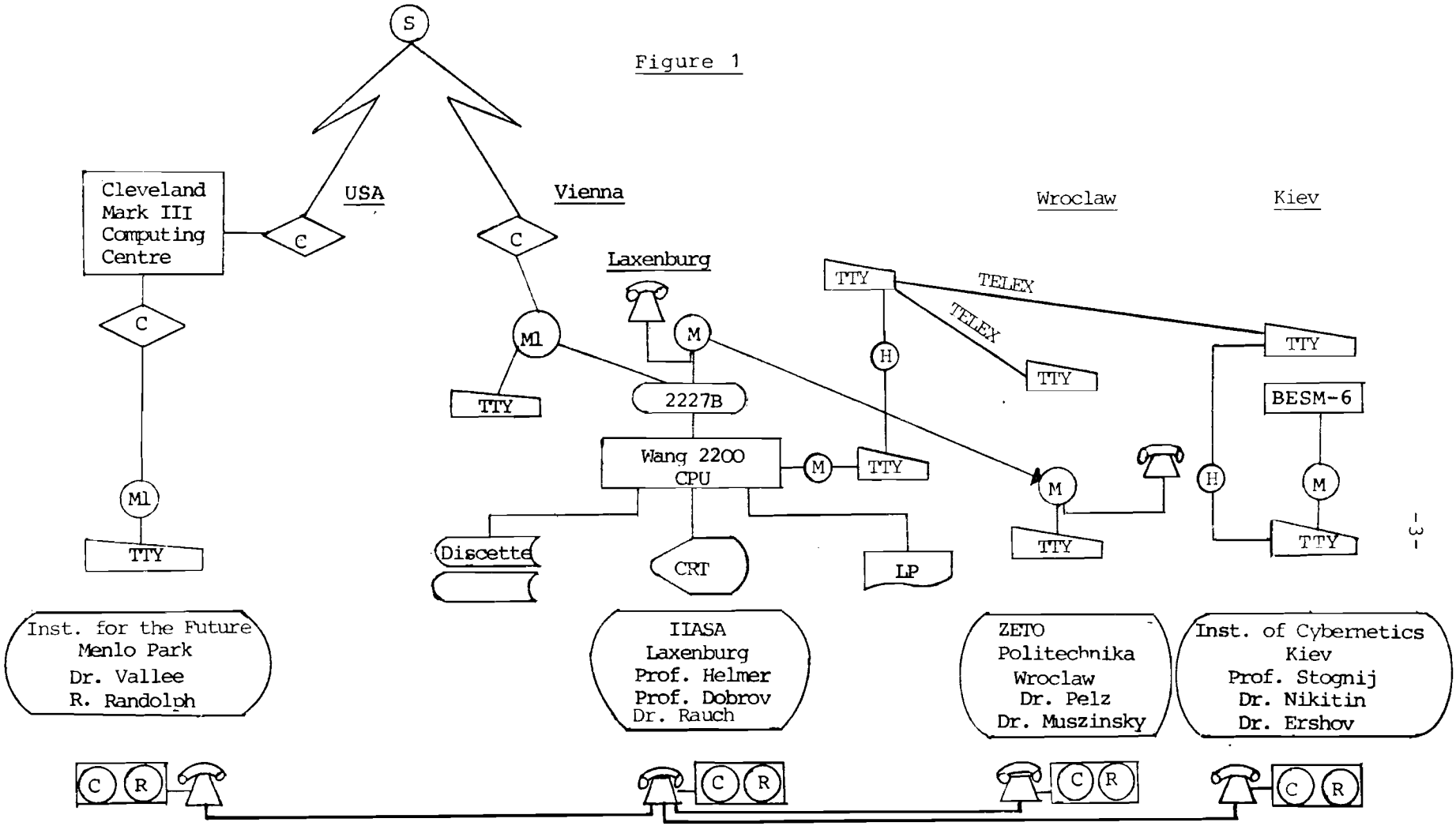
This computer-program had two main functions:

(a) it served as a calculation tool for all numerical operations needed during the panel sessions; and

(b) it stored the results from each group and calculated the necessary statistical values for all panels together.

In each of the five groups located at IIASA, there was one panel member who had already had some experience with computer terminals. This scientist was given brief instructions on the operation of the system and later managed all input/output procedures for his panel.

Figure 1



Notation:

- S - Satellite for data Communication
- C - Concentrators of MARK III Network
- TTY - Remote terminal (teletypewriter)
  Most displays can be used in TTY modes also
- CR - Casette recorder
- CRT - Cathode ray tube (Display)
- M1 - Low speed modem (up to 300 lps)
- M2 - Asynchronous modem 600/1200 lps
- M - Any of M1 and M2 can be used
- 2227B - Buffered asynchronous interface for WANG 2200
- Wang-2200 - Minicomputer with 32k Bytes core memory
- CPU - Central processing unit
- LP - Line Printer
- H - Human interface

This part of the network caused no problems, because the use of interactive terminals within IIASA is already routine, and in case of minor problems professional help was available immediately. As may be seen from Table 1 there were almost no direct costs involved (other than 34 AS for the internal telephone lines), but almost 200 manhours for developing and running the system.

2.2 The Channel to Kiev, USSR

The panel in Kiev was located at the Institute for Cybernetics of the Academy of Sciences of the Ukrainian SSR. In this Institute, Professor Stognij, Dr. Nikitin, and Dr. Ershov acted as leaders of the panel. After considering different possibilities of data transmission, it turned out that a simple telex connection would bring best results. The results from Kiev were sent through the telex system and fed into the local IIASA computer off line. This caused a little time delay, but the connection was very reliable and produced satisfactory results during the sessions. The expenditure on this line was approximately 700 AS, telex costs (see Table 1).

Table 1 COST ESTIMATION OF THE CAPS-EXPERIMENT

ITEM (units)	MARK III	WROCLAW	KIEV	PDP	TOTAL
CPU (AS)	8000 AS	free	-	free	8000 AS
TELEPHONE (AS)	246 AS	4172 AS	-	34 AS	4452 AS
TELEX (AS)	-	700 AS	700 AS	-	1400 AS
COMMUNICATION MANPOWER (hrs)	14	20	-	-	34 hrs
MANPOWER RUNNING (hrs)				54	54 hrs
MANPOWER DEVELOP (hrs)				120	120 hrs
MANPOWER FINALS (hrs)				20	20 hrs

TOTAL HOURS :	228
TOTAL AS :	13,852

2.3 The Channel to Wroclaw, Poland

Our partner in Poland was the Forecasting Research Center of the University of Wroclaw, under the leadership of Professor Karol Pelc. The connection to Laxenburg was conducted with the assistance of the ZETO Computer Center in Wroclaw. With the help of Dr. Muszinsky in Poland, and Dr. Wagner, who came from Poland to assist us in Laxenburg, we were able to establish a dial-up connection between a WANG-2200 Minicomputer (located at IIASA) and the ZETO network in Poland.

Despite some problems with the extremely busy telephone lines between Austria and Poland the connection was successful and guaranteed good cooperation with the expert group in Poland.

The connection to Poland cost a total of 4172 AS telephone costs, plus 700 AS telex costs during the time of establishing the line.

2.4 The Channel to Menlo Park, California, USA

To the USA we used the most sophisticated but nevertheless most successful line. The group in the USA was directed by the IIASA scientist Bob Randolph, who handled also the communication activities to IIASA, using facilities generously provided by the Institute for the Future (Menlo Park). The connection was established through the MARK III computer network, which is centered in Cleveland, Ohio. It was possible to dial into MARK III through a concentrator in Vienna, which enabled us to have access to the same files as Randolph from California. After once having established this line, further data exchange caused no problems. An important advantage of this system was that the partners in the communication did not have to be connected to the system at the same time. The information was stored in MARK III as long as we needed it. The eight-hour time difference between Central Europe and the west coast of the USA could be bridged in this way.

The costs of this connection were mainly the CPU and related costs of MARK III, with a total of 8000 AS (see Table 1).

Bob Randolph, who handled the USA node of the network, did an interesting analysis of the type and number of messages sent and received by his panel during the experiment. The results of this analysis are shown in Figure 2, Table 2 and Table 3. It was not possible to do the same analysis for the other channels too, because there the messages were not recorded so exactly. But it is very probable that the behavior in all three cases was similar.

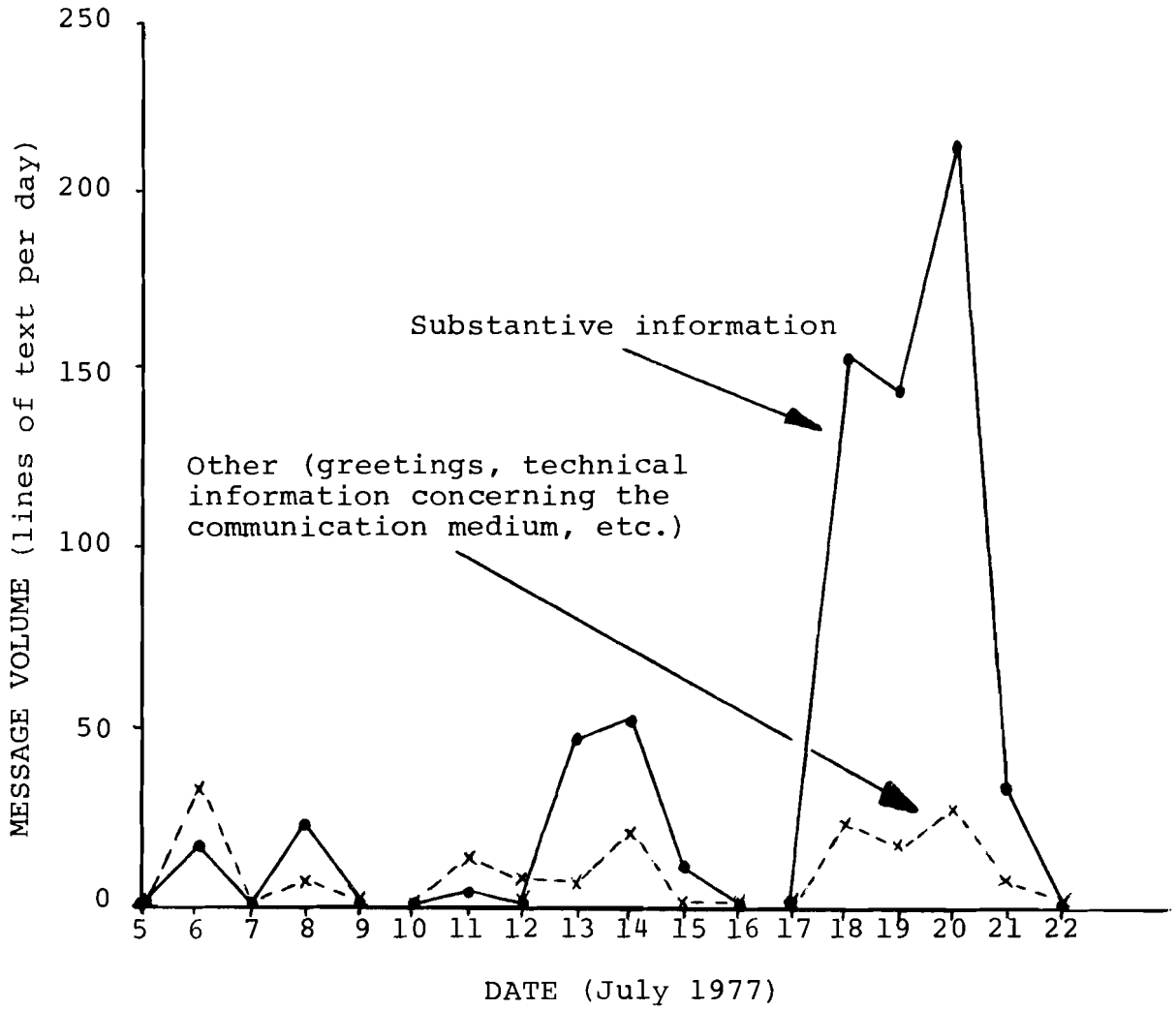


Figure 2 DAILY VOLUME OF MESSAGES IN IIASA CAITR EXPERIMENT (US-IIASA CONNECTION ONLY)

Table 2 CAPS EXPERIMENT: RECORD OF MESSAGES SENT BETWEEN IIASA AND USA

DATE AND TIME				MESSAGE NUMBER		CONTENT (NUMBER OF LINES OF TEXT)			
GMT		LOCAL		USMSG	or IIMSG	SOCIAL	TECHNICAL	SUBSTANTIVE	TOTAL
7/7	0:45	6/7	16:45	001		1	3		4
"	0:50	"	16:50	002			10	17	27
"	0:55	"	16:55	003			7		7
"	1:00	"	17:00	004			4		4
"	1:10	"	17:10	005			4		4
"	1:15	"	17:15	006			4		4
8/7	17:45	8/7	9:45	007			6		6
9/7	0:40	"	16:40	008				23	23
11/7	17:50	11/7	9:50	009			5		5
"	?	"	?		001	3	6	4	13
12/7	18:35	12/7	10:35	010		1	7		8
13/7	10:40	13/7	11:40		001A*		7		7
14/7	1:20	"	17:20	011				46	46
"	13:50	14/7	14:50		002	2	13		15
15/7	1:00	"	17:00	012			5	51	56
"	20:25	15/7	12:25	013			1	11	12
18/7	10:20	18/7	11:20		003		8		8
"	18:35	"	19:35		004	2	4	42	48
"	21:15	"	13:15	014			8	25	33
19/7	1:00	"	17:00	015			1	78	79
"	1:25	"	17:25	016			1	8	9
"	7:35	19/7	8:35		005	3	2	6	11
"	16:00	"	17:00		006	1	2	72	75
"	16:30	"	17:30		007	1	1	61	63
"	19:50	"	11:50	017		2	1	4	7
"	19:55	"	11"55	018		2	1		3
"	20:00	"	12:00	019			2		2
20/7	10:10	20/7	11:10		008	1	8	20	29
"	16:15	"	8:15	020			2	17	19
"	18:10	"	19:10		009		2	26	28
"	19:00	"	20:00		010	1	5	91	97
"	19:30	"	20:30		011		9		9
"	19:50	"	11:50	021				58	58
21/7	22:30	21/7	14:30	022			5	29	34
"	22:40	"	14:40	023				4	4
"	22:50	"	14:50	024			2		2
						Total: 20	146	693	859

Table 3 CAPS EXPERIMENT: MESSAGE VOLUME (LINES OF TEXT PER DAY)

DATE	SUBSTANTIVE	SOCIAL AND TECHNICAL
5	0	0
6	17	33
7	0	0
8	23	6
9	0	0
10	0	0
11	4	14
12	0	8
13	46	7
14	51	20
15	11	1
16	0	0
17	0	0
18	153	24
19	143	18
20	212	28
21	33	7
22	0	0

2.5 The Working of this Network

It was sometimes not so easy to find an appropriate communication channel, and there were also minor problems in establishing the connections. But after having once established the connection all lines of the network both within and outside of IIASA worked without major problems and did not cause any delay in the planned procedure. We think, therefore, that from a technical point of view, team research and close working cooperation between geographically separated scientists are possible anywhere in the developed world, even if the groups are located on different continents and in countries from both East and West.

3. ORGANIZATIONAL ASPECTS

3.1 Organization of the Subpanels

Because we intended to conduct a workshop involving geographically separated subpanels, we of course had to find appropriate groups of experts who were willing to cooperate in this activity. We realized that informing expert groups in distant countries about the activity could possibly be done by mail, but that in that case it would probably be necessary for one of the workshop organizers to travel at least one time personally to the different groups involved and to find one member of each group who would agree to act as a group leader, responsible for the cooperation within the panel and for the connection to the workshop organizer. Confronted with time and budget limitations, and also recognizing that this CAPS exercise would be very largely a methodological experiment, we decided to dispense with these procedures and rely instead on panels which could be assembled in some easier way.

Because of personal contacts with scientists in Poland, the USA, and the USSR, the workshop organizers were able to establish panels in these remote sites without undue complications. In each case there was at least one responsible person from the very beginning who could be called upon to assemble a panel of interested participants, motivate and supervise his panel's activities, and deal with unexpected situations if necessary. As we saw it, the effectiveness of these group leaders would probably be high, because of their pre-existing familiarity with the workshop's organizers, the organizing institution, the workshop topics and procedures, the communication medium to be used, and even such subtilties as the probable reactions and behaviors of the partners at other sites (valuable, for instance, in interpreting what the sender of an incomplete message might have had in mind). In the course of the CAPS activity, we found that these expectations were justified and that the remote panels functioned quite well.

In addition to the three genuine remote panels, we decided to create five simulated "remote panels" at IIASA, drawn from the group of persons attending the IIASA workshop on Systems Assessment of New Technology. In retrospect, we can see that this was probably not a good decision, since the participants in these

panels had come to IIASA with no intention to participate in such an exercise, indeed were not even aware that it was being planned, and so could hardly be expected to have much personal commitment to it. These of course are precisely the main differences between such an artificial situation and the conditions which would prevail when CAPS is used in practice.

3.2 Organization of Cooperation Among Subpanels

Whereas the organization of the local panels mainly lay in the hands of the local panel leaders, relations among the panels depended on bilateral contacts between the organizers of the workshop and each of the local panel leaders.

We recognized that optimal cooperation between the different panels would be facilitated if their sessions were held simultaneously. Due to time differences, however, this was impossible if we were to avoid having panels on different continents be involved in night work.

On the other hand, we also realized that if one intends to have a truly joint activity among the involved panels, one must at least guarantee that in each session every panel has feedback from all the other panels. Furthermore, between the sessions the organizers of the workshop must perform calculations, prepare summaries, give comments, and feed the results back to the panels. This all needs time, which has to be reserved in advance. Nevertheless, the schedule should keep the time between the panels' sessions as short as possible. This is necessary to maintain the character of a connected workshop and to make it possible for all participants to attend all sessions.

Table 4 shows the time schedule actually chosen for the CAPS experiment. In that workshop, it was possible to perform a three-session activity within four days. Greater condensation was not possible because there was a time-lag of eight hours to the California panel and night sessions were undesirable.

3.3 Organization of the Work Itself

A joint activity of different panels of scientists operating under strict time constraints needs a highly structured agenda to be effective. For the CAPS experiment we used a Delphi-type structure, which had been developed by Olaf Helmer and is described in the Appendix (see especially Section 7.5). The timetable for the experiment is shown in Table 4.

Following this agenda, each task (discussion of a problem, weighting of events, setting of priorities, etc.) was at first performed separately by the various panels. The results of the discussions within the various panels were then combined into a joint result, which was fed back to all panels before the next session started. Thus each step depended strongly on the results received from all panels in the previous steps.

Table 4 PRELIMINARY TIME SCHEDULE FOR THE COMPUTER CONFERENCING EXPERIMENT:
Selection of Technologies for International Assessment

REMARKS: ⇨ stands for slow information flow, which refers to information exchanged by regular mail. This information exchange could, of course, also be conducted via a computer network, but this is not essential.

↯ stands for fast information exchange, which should be performed via computer. In the event of computer connection breakdown, it would be necessary to send this information via cable (TELEX).

The time schedule was established under the assumption that if it is noon (12 o'clock) in Laxenburg, it will be 04.00 in Menlo Park (8 hours earlier), 13.00 in Wroclaw (1 hour later) and 14.00 in Kiev (2 hours later).

DATE	ACTION TO BE DONE AT IIASA	TIME AT IIASA	FLOW OF INFORMATION	ACTION TO BE DONE OUTSIDE	TIME IN WROCLAW	TIME IN KIEV	TIME IN MENLO PARK (CALIF.)
before July 11	Preparatory work; distribution of previous information		⇨ ⇦	Preparatory work; feedback to IIASA			
July 11 to July 14			⇦	Perform first session, send results to IIASA before July 18			
July 18 Mon	Perform first session	13.30 - 15.30					
	Prepare for second session	15.30 - 19.00					
	Send results on all first sessions as a basis for all the second sessions	17.00 - 20.00	↯	Receive results			09.00 - noon
		and					
July 19 Tue	Perform second session	09.30 - 10.30 10.00 - 12.00	↯	Receive results Peform second session	10.30 - 11.30 between * Tue 11.30 & Wed 11.30	11.30 - 12.30 between * Tue 12.30 & Wed 12.30	between * Mon 13.00 & Tue 09.00
	Receive results	17.00 - 18.00	↯	send results to IIASA			09.00 - 10.00
July 20 Wed	Receive results	10.30 - 11.30	↯	Send results to IIASA	11.30 - 12.30	12.30 - 13.30	
	Prepare for third session	11.30 - 12.30					
	Send the results to the remote panels	12.30 - 13.30	↯	Receive results	13.30 - 14.30	14.30 - 15.30	
	Perform third session	13.30 - 16.00		Perform third session	between * 14.30 - 19.00	between * 15.30 - 20.00	
	Send results to Menlo Park	16.00 - 17.00	↯	Receive results			08.00 - 09.00
				Perform third session			09.00 - 11.30
	Receive results of third sessions	18.00 - 19.00 (or Thu 08.00 - 09.00)*	↯	Send results to IIASA on the same evening (or next morning)	19.00 - 20.00 (or Thu 09.30 - 10.30)*	20.00 - 21.00 (or Thu 10.30 - 11.30)*	
	(If it is not possible to receive the results in time, they cannot be presented at the workshop, but would, of course, be taken into account in the final results)	19.30 - 20.30 (or Thu 17.00 - 18.00)*	↯	Send results to IIASA			11.30 - 12.30 (or Thu 09.00 - 10.00)*
July 21 Thu	Prepare for final presentation	Wed evening - Thu morning					
	Final presentation to the workshop	09.00 - 12.00					
	Send final results to remote panels	13.00 - 14.30 16.30 - 17.30	↯	Receive final results	14.30 - 15.30	15.30 - 16.30	08.30 - 09.30
After July 21	Send all summaries, conference proceedings, etc., to the remote panels		⇨				

* Every action at the REMOTE PANELS preferably to be done at the earliest convenience within the given time range, in order to give the IIASA team some time for managing unexpected problems and difficulties.

Because of the serious problems we encountered in carrying out the scheduled group tasks, the substantive results of the CAPS activity seem to be of minor value and are therefore not reported here. The problems themselves, however, were most enlightening and will be examined in detail in the next section.

4. PROBLEMS ENCOUNTERED

On the most overt level, the apparent problem which arose in the CAPS exercise was the reluctance of some participants to abide by the pre-designed group interaction procedures. Some scientists suggested various changes in the agenda and, when they were informed that this could not easily be done, some of them withdrew from the exercise entirely. Others remained but henceforth regarded the activity as a game (actually not an entirely wrong view to take) and participated only for fun and for gaining first-hand experience in this new type of cooperative research, rather than with personal interest in getting good answers to the suggested questions.

Upon reflection and discussion, however, it became clear that this overt difficulty was only the tip of the iceberg. Underlying it were in fact several layers of more fundamental difficulties which will have to be dealt with before future activities of this kind can hope to produce substantively meaningful results.

4.1 Socio-Psychological Problems

At first glance, the cause of the participants' reluctance to abide by the agenda appeared to be socio-psychological in nature. Whereas normal scientific discussions are extremely free and democratic in nature, with few if any restrictions being placed on the form or content of statements and with even agendas being subject to change as needed, the CAPS situation imposed restrictions which were plainly uncongenial to the participants. The iterative mode of CAPS combined with limited possibilities for communication between the geographically separated groups necessitated completely coordinated behavior of all panels. As we discovered, not all scientists are willing to renounce their scientific freedom to this extent--a perfectly understandable reluctance, but one which does in fact interfere with the orderly conduct of activities requiring strict adherence to a prearranged agenda.

Mere resentment of restrictions, however, was not the only problem on the socio-psychological level. Closely related to it (and in fact to some extent causing it) was the problem of lack of confidence. "Post-mortem" discussions with some of the panelists revealed that they had been deeply troubled during the CAPS exercise by doubts about the answerability of the questions being asked, the ability of the organizers to synthesize individual contributions into a valid group result, even the extent to which the

outcome of the enquiry might have been in some sense "predetermined" (either by bias on the part of the organizers, limitations in the informational base being used, or perhaps a tendency for the method of enquiry to exclude certain alternative answers).

4.2 Procedural Problems

The fact that such doubts and resentments on the part of the panelists could arise suggests that even more fundamental difficulties existed--for instance, on the level of enquiry organization and procedure.

It is certainly true that time constraints in the CAPS exercise clashed with a very full agenda. Also, some of the substantive materials intended for use in the group interaction (e.g., precise definitions of questions) were insufficiently clear, and yet no provision was made for accepting and dealing with the clarifying statements and queries which many participants quite rightly made. Various ways in which the enquiry procedures could have reduced these difficulties will be discussed in a later section; suffice it to say here that the need for such steps was not clearly foreseen, and they were therefore not taken.

Our conviction that procedural problems had a powerful impact on the socio-psychological situation and hence on the enquiry outcome is strongly corroborated by the experience of one remote panel, whose members took it upon themselves to modify heavily the procedures they had been asked to use within each of their sessions. The chairman of this group concurred with their desire for simplified but substantively richer group activities, provided only that the group product needed for transmission to other panels be generated within the time available. The revised procedures turned out to be spectacularly successful, with group morale remaining high and group output surprisingly rich (quantitative estimates required by the official agenda being supplemented by extensive substantive commentary). Of course, such independent action by individual panels could conceivably lead to new difficulties. But this experience does show quite plainly that procedural improvements can have a marked effect on participant satisfaction and outcome quality.

4.3 Problems of Applicability

Although improved procedures might have reduced the panelists' doubts and resentments, some questions on a still more basic level might well have remained unresolved. These questions are of the following kinds:

(1) Are the questions being asked in the enquiry worth asking at all? Are they perhaps unanswerable in any case? Or, worse, is every possible outcome of the experiment more or less randomly arrived at and therefore not to be taken seriously at all?

(2) If the questions in the experiment are worth asking, are they suitable for a Delphi-type enquiry? Are the experts involved the appropriate experts and--more seriously--are experts at all the best panelists for discussing these problems? For instance, might policy-makers constitute a better panel in this case?

(3) If the Delphi approach seems worthwhile, is the CAPS scheme a good way to carry it out? It could be argued that for a real Delphi you need either genuine conferencing facilities or else plenty of time for contemplation--in which case telex or even the post might be perfectly adequate.

The conference organizers had--of course--thought about these questions carefully. But due to the problems described in 4.1 and the very limited time available, it was not possible to discuss these points fully enough to resolve all disagreements and misunderstandings.

5. SUGGESTED SOLUTIONS (LESSONS WE HAVE LEARNED)

To some extent, the above-mentioned problems can probably be diminished by improved socio-psychological preparation and pre-information. The participants in a CAPS-type activity should be informed about all details of the agenda in advance and should have the opportunity to express their reactions. Insofar as possible, any suggested changes should be made, and at least the participants must be given the feeling that the workshop organizers have taken their suggestions into account even if it does not prove possible to incorporate all of them. Most importantly, it has to be clear that during the workshop itself no further changes can be made (unless, of course, the workshop procedures make some provision for such changes). All of this will need time and should therefore be started some months in advance.

A related point, according to our experience, is the need for a clear statement of the kind of results the experiment is intended to obtain, as well as of the authorship and responsibility which will be attached to this outcome. The involved scientists may well want to be named as participants, but they may not be willing to take responsibility for results which they did not personally produce. This is especially true if the procedure involved is new and unfamiliar to them. This is in general a problem for any team activity and not only for CAPS; but CAPS aggravates this problem because the range of cultural differences of the involved parties may well be wider than usual, the possibility of resolving problems in direct face-to-face contact is low, and the new media and complicated technical means may create a certain degree of uneasiness for some participants.

Such solutions have their own limits, however. In particular, no amount of advance information can compensate for faulty enquiry procedures. Many of the problems we encountered could be

eliminated or at least much reduced by such procedural and organizational changes as the following:

(a) Fuller advance work by the workshop organizers on the substance of the enquiry, with more careful attention to the definitions and phrasing of questions and, if at all possible, embedding of these questions in a well-designed research program or other series of deliberations on the part of the organizers themselves. Ideally the activity might have two or more co-organizers--at least one a specialist on CAPS-type conferencing, and at least one a fully qualified specialist in the substantive area under investigation.

(b) Better agenda design, to assure proper balance between the available time and the planned volume of work, avoid unnecessarily repetitious and stultifying "busy-work", and if at all possible incorporate explicit procedures for accepting and dealing with participants' clarifying statements and queries.

(c) Careful pre-testing of the proposed agenda with at least one small group of "stand-ins" (not necessarily real experts, but preferably not persons involved in designing the activity either), to assure that the agenda can in fact be carried out in the allotted time and by the planned methods.

(d) Scrupulous avoidance, in either appearance or reality, of any bias or other prejudicial influence on the enquiry outcome. This is a matter not so much of formal procedures as of intellectual honesty on the part of the organizers.

(e) Use of methods for thoughtful evaluation, interpretation, and synthesis of panelists' inputs, including comments, explanations, etc., rather than simple-minded arithmetical aggregation.

Finally, it is important for all parties concerned to understand quite clearly whether the CAPS-type activity is to be conducted for purposes of methodological demonstration or as a source of genuinely meaningful substantive results. If its aim is the latter, all of the basic questions posed in Section 4.3 must be carefully resolved by the organizers. Indeed they should do this before they do anything else.

6. CONCLUSIONS

From a purely technical viewpoint, this experiment was a success, and we were able to demonstrate that it is already possible to manage the connection of panels located at any place in the civilized world. Of course, no single part of the network established by us was a technical advance per se. The technical

feasibility of every single part had already been proved before. The new element was to show that this kind of communication is already possible between places which were (from a technical point of view) randomly chosen and which were located on different continents and in Eastern as well as Western societies. Also, it was found possible to integrate completely different communication facilities into one common communication-network under such circumstances.

The organizational aspects turned out to be much more difficult than the technical ones. The organization of the panels, the sychronization of the working-sessions, and the manipulation of the established network were solved satisfactorily. The organization of the work itself, however, was not successful. In future activities of this kind, far greater attention will have to be paid to the prevention of such difficulties.

7. APPENDIX--THE SELECTION OF TECHNOLOGIES FOR INTERNATIONAL ASSESSMENT: "COMPUTER-ASSISTED PANEL SESSIONS: CAPS"*

The workshop on "Systems Assessment of New Technologies: International Perspectives" to be held from July 18-21 at IIASA will include a set of three interactive workshop sessions utilizing a computer network. The subject matter of these sessions will be "The Selection of Technologies for International Assessment".

The three sessions will be held on Monday afternoon, Tuesday morning and Wednesday afternoon of the conference. Each of the local participants (probably numbering about 30 to 40) will be assigned to one of five panels of about equal size. Each panel will have a computer terminal at its disposal, and collation and feedback of the panels' findings will be processed through the computer network.

In addition to the five local panels, it is expected that three remotely situated ones (in Kiev, Wroclaw and Menlo Park) will participate via computer links. These remote panels have to operate semi-sychronously with the local panels; that is, their communications have to mesh with the day-to-day proceedings of the local panels but otherwise can be adjusted to their respective time preferences.

Some introductory material is being distributed in advance of the meeting. It includes:

- Introductory remarks on the subject matter of the interactive workshop sessions, i.e., on the selection of technologies for international assessment.

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* This Appendix is a slightly abbreviated version of the workshop agenda which was distributed to all participants. The agenda was mainly written by Prof. Olaf Helmer.

- Supplemented notes on selection of technologies;
- A "starter list" of technologies;
- A copy of the evaluation form to be used for rank-ordering and rating;
- The agenda; and
- Detailed instructions on conducting the workshop sessions and timing the computer communications.

7.1 Introductory Remarks on the Selection of Technologies for International Assessment

The assessment of a prospective technology is an exercise in normative forecasting. It is concerned with the determination of the societal consequences, both direct and indirect, that the introduction of the technology is likely to entail, and the principal effort is directed toward ascertaining whether the new technology will be advantageous or detrimental, or what variant of the technology may be expected to be relatively most beneficial or relatively least harmful. The ultimate purpose of such an assessment is to obtain a basis on which to judge whether to promote or discourage the introduction of the technology and, if so, how, through appropriate intervention, to guide its development most beneficially.

The assessment of the societal utility or disutility of a technology clearly depends on what societal segment it is whose welfare is under consideration, and it is in this sense that the forecasting and planning effort which constitutes a technology assessment must be considered a normative one. In the case of a national technology assessment, it is the benefits accruing to certain groups within the national population that must be examined. These groups may include, for instance, the nation's farmers, businessmen, laborers, housewives, racial minorities, pensioners, and so on.

An international technology assessment differs structurally very little from a national assessment, except that the societal segments taken into consideration in this case must be those which can be regarded as globally significant. They might include the populations of the developed countries with market economy, of the developed countries with planned economy, and of developing countries. Other global subdivisions, cutting across these three categories, may of course also be considered significant in this context.

Since there are a vast multitude of potential technologies that, in principle, might well be subjected to assessment, any systematic effort at technology assessment must, of necessity, begin with a survey of candidate technologies, followed by a selection process based on some rank-ordering of these candidates reflecting the urgency of their assessment.

The exercise proposed for the interactive workshop sessions, which are part of the IIASA conference on Systems Assessment of New Technologies, is aimed precisely at that task. It will begin with the compilation of a list of candidate technologies, from which a subset of the thirty most important will then be selected. These thirty will then be evaluated from various points of view, such as the imminence of their large-scale adoption, the character and intensity of the societal impact they are likely to have if adopted, and the commonality of interest regarding them for different interest groups. Finally they will be rank-ordered according to the priority which their assessment is thought to deserve.

The outcome of this workshop, it is hoped, will provide some future methodological as well as substantive guidance for any organizations (possibly including IIASA itself) that may venture into the field of international technology assessment.

7.2 Supplemental Notes on the Selection of Technologies for International Assessment

7.2.1 Past Experiences

In 1973, the US National Science Foundation sponsored four studies to determine the most necessary and urgent technologies for national assessment. Through questionnaires, interviews, and panel discussions, several hundred persons participated in the studies from US federal, state, and local governments; industry, academia, and institutions including foundations, professional associations and independent research centers; as well as individual experts. Excerpts from a comparative study by Linda DeAngelo follows:

GENERAL AREAS OF CONCERN (by priority)

	State Officials (Mock Study)	Ind./Acad./Govt. (Futures Group)	Fed. R&D (GW Univ.)	Expert Panels (IRT/FI)
1	National Resources and Env. Mgmt.	Food	Trans-portation	Energy
2	Energy	Energy	Management	Health
3	Human Resources	Institutions	Energy	Waste and Pollution

Worldwide Technologies Ranked by GWU Study

1. Anti-pollution control devices (B)
2. Breeder reactor program (B)
3. Hydrogen energy transport system (A)
4. Liquid sodium nuclear reactor (B)
5. Substitution of wood resources for non-renewable mineral resources (C).

(A = speculative; B = being developed; C = substantially developed).

Those who are interested in additional information about these studies may wish to read the two special issues of Technology Assessment, Vol. 2, Nos. 2 and 3, 1974, or the series of NSF reports on the subject.

7.2.2 Supplemental Considerations for ITA Ranking

While going through the eight-step procedure of the agenda (see Section 5.5) to select technologies for international assessment, each panelist may wish to consider the following dimensions, in addition to those explicitly stated in the agenda:

1. International significance:

   Please consider international technology assessment (ITA) candidates which have either global significance (involving at least two countries) or universal significance (initially within one country but eventually shared by other countries). Consider what kind of errors would be made, and how bad the errors could be (missed opportunities as well as harmful effects), if appropriate assessment were not made in time.

2. Feasibility:

   Truly international TA is difficult and has not been tried. Some people think it is impossible. The failure of the first one or two attempts could set TA back several years. When you rank your candidates (especially in step 8), please consider the technical, political, and cultural feasibility of each ITA candidate.

3. Operationality:

   TA is intended to be policy-oriented. ITA must have an international audience which can make or influence relevant policies in certain countries. The timing is also important. Since a typical TA takes about two years, please consider how timely results will be communicated to what audience(s).

7.2.3 IIASA Organization and Role

For your information (especially if you are member of a remote panel), IIASA is a non-governmental organization supported by 17 industrialized countries.* It has a matrix organization as follows:

Areas / Programs	Resources and Environment	Human Settlements and Services	Management and Technology	System and Decision Sciences
Energy				
Food				
Regional Development (Tentative)				

(Note that the two existing interdisciplinary projects--energy and food--happen to correspond to the two general areas of highest concern identified by the Futures Group.)

The result of your collective effort in determining high-priority ITA candidates will be disseminated by IIASA to all interested parties. If deemed desirable and fundable, IIASA is willing to conduct, coordinate, or facilitate a number of substantive ITAs in the future, involving scientists and policy makers in several countries.

7.3 A Starter List of Technologies

A starter list of technologies that might be considered in need of international assessment. Some of these (such as breeder reactors or the abolition of pain) are physical technologies in the usual sense, and their realization is mainly a question of achieving certain technological breakthroughs. Others (such as two-way television or submarine cities), while still requiring some technical advances, are also greatly affected by decisions based on societal preferences. Still others (such as free intra-city transportation or joint international space ventures) are what may be called "social technologies", in the sense that their adoption is primarily a matter of social or socio-political decision rather than of technological breakthroughs.

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* Austria, Bulgaria, Canada, Czechoslovaki, Federal Republic of Germany, Finland, France, German Democratic Republic, Hungary, Italy, Japan, Netherlands, Poland, Sweden, United Kingdom, USA, and USSR.

(The candidate technologies were listed in the form shown below. The actual items included in the "starter list" are not reported here because they were only randomly selected and are not significant to the present discussion.)

7.4 Evaluation Form

No.	Technology	Rank-Order (or Rating)
1		
2		
3		
4		
5		
6		
7		
24		
25		
26		
27		
28		
29		
30		

7.5 Agenda

First Session:

Local panels: Monday, July 18, 13.30-15.30.
Remote panels:

Step 1: Each panel to nominate at most ten technologies for assessment.

Suggested procedure: The panel selects a chairman. The panel members then nominate technologies (which they may, but need not, select from the "starter list" of technologies that has been provided). The nominated technologies are recorded by the chairman on a blackboard and numbered consecutively. Each panel member ranks the technologies, using a copy of the Evaluation Form, assigning Rank 1 to what he considers the most important technology to be assessed, Rank 2 to the next most important technology, and so on. (Note that a supply of Evaluation Forms will be provided.)

The ranking should be carried out on the basis of an intuitive appraisal as to the importance of assessing the technologies, either because they seem to be in urgent need of international management, promotion, or control, or in view of the promise they hold of furthering international collaboration.

The forms are then collected by the panel chairman who determines the median rank received by each candidate technology and records that median number on another copy of the Evaluation Form. In case of a tie, the sum of the assigned ranks is used to break the tie if possible; in case of remaining ties, the technology listed first is given precedence. The technologies are then re-ranked 1, 2, 3, ... according to the order thus established, and all but the first ten are eliminated.

The ten remaining technologies, ranked from one to ten are the panel's output of Step 1.

Step 2: Each panel to nominate distinct world interest groups.

The groups to be nominated are to be globally significant groups that might be differently affected by the technologies under consideration and that possess some influence over the future development of these technologies. The criterion for two such interest groups being distinct should be that, among the technologies proposed for assessment by the panel, there is at least one with regard to which the groups may be expected to have definitely different perceptions as to its utility to them.

Suggested Procedure: The panel, through informal discussion arrives at an agreed-upon list of world interest groups. (Note

that a list of a few world interest groups that the Panel may wish to consider for inclusion has been provided.) The list is expected to be quite short (preferably not exceeding six items). In case of doubt--that is, if no consensus can be obtained as to whether a particular interest group should be included--it may as well be listed, unless the list is already excessively long.

Output: A list of distinct world interest groups. (Note that no rank-ordering is called for.)

Prior to the next session, the technology nominations from the participating panels will be collated by the IIASA staff, edited where necessary for clarity and conformity, and duplicates will be eliminated. From this list, thirty items will be selected for further consideration, using a procedure which will accept (a) the top-ranged items of each panel and (b) those items proposed by at least two panels for which the median rank assigned to them by their proponents is relatively highest. In addition, the world interest group nominations will be collated, and all having at least two proponents will be accepted.

Second Session:

Local panels: Tuesday, July 19, 10.30-12.30.
Remote panels:

Step 3: Each panel to rate all of the thirty technologies according to how soon they are likely to be widely introduced, using a scale from 1 to 6 as follows:

1. imminent
2. quite soon
3. during the 80's
4. during the 90's
5. after 2000
6. never.

In addition, for each of the technologies rated near either end of the scale (1 or 2, and 5 or 6) the panel is asked to supply a brief statement of the reason why the introduction of the technology is expected to occur so soon or so late (or never).

Suggested procedure ("mini-Delphi"): Each panelist, prior to any discussion, rates the technologies from 1 to 6, using the Evaluation Form. These individual ratings are collated by the chairman, who determines and announces the median rating for each technology. The panelists now briefly debate items regarding which there is a considerable lack of consensus. Each panelist then rerates the technologies, again using the Evaluation Form. The chairman determines the medians of these new ratings; they are accepted as the panel's joint ratings.

For each item with a final rating at the low or high end of the scale, the panel decides in informal discussion what reason to give why the introduction of the technology is expected to occur so soon or so late (or not at all).

Output: A rating of all technologies, on a scale from 1 to 6, according to how soon they are likely to be introduced, together with reasons for their relatively early or late introduction in the case of items rated 1, 2, 5, or 6.

Step 4: Each panel to rate all of the thirty technologies with regard to their overall degree of commonality of interest likely to be perceived by the various world interest groups, using a scale from 1 to 6 as follows:

1. highly divergent interest
2. slightly divergent interest
3. divergent in some respects, similar in others
4. somewhat similar interest
5. very similar interest
6 identical interest.

Again, in addition, for each of the technologies rated near either end of the scale (1 or 2, and 5 or 6) a brief statement of the reason is to be supplied why the technology is likely to be viewed as controversial or as representing a high commonality of interest.

Suggested procedure: Same as for Step 3.

Output: A rating of all technologies, on a scale from 1 to 6, according to their degree of commonality of interest to the world interest groups, together with reasons for their controversiality or commonality of interest in the case of items rated 1, 2, 5, or 6.

Prior to the third session, two master ratings will be computed from the panel ratings: one for imminence of introduction, the other for commonality of interest. These master ratings will be based on medians. These, together with a summary of reasons for the relatively low or relatively high ratings, will be fed back to the panels before their next meeting.

Third Session:

Local panels: Wednesday, July 20, 13.30-16.00.
Remote panels:

Step 5: Each panel reassess the ratings on how soon the technologies will be widely introduced, taking into account the reasons given for relatively early or relatively late introduction.

Suggested procedure: The panel members informally discuss the reasons for early or late introduction. Each panelist then independently reassigns a rating to each technology (using the Evaluation Form), and the chairman determines the median of these ratings.

Output: A rerating of all technologies, on a scale from 1 to 6, according to how soon they are likely to be introduced.

Step 6: Each panel to reassess the ratings of all technologies with regard to their overall degree of commonality of interest to the world interest groups, taking into account the reasons given for relative controversiality or relative commonality of interest.

Suggested procedure: Same as for Step 5.

Output: A rerating of all technologies, on a scale from 1 to 6, according to their commonality of interest.

Step 7: Each panel to assess the intensity of the overall effect that each technology would have on global socio-political and economic conditions if it were widely introduced, using a scale from 1 to 6 as follows:

1. virtually no effect
2. very slight effect
3. slight effect
4. moderate effect
5. strong effect
6. very strong effect.

Suggested procedure: Mini-Delphi (same as for Step 3).

Output: A rating of all technologies, on a scale from 1 to 6, according to the intensity of their overall effect.

Step 8: Each panel to rate the urgency of assessing the selected technologies, taking into account the previous estimates regarding each technology's imminence of introduction, commonality of interest, and intensity of effect if introduced. A rating scale from 1 to 6 should be used, defined as follows:

1. extremely urgent
2. very urgent
3. moderately urgent
4. slightly urgent
5. not urgent
6. no urgency whatsoever.

In addition, if time permits, the panels are asked, for technologies rated 1 or 2, to state briefly their reason why the assessment of these technologies is considered particularly urgent.

Suggested procedure: Mini-Delphi (same as for Step 3).

Output: A rating of all technologies on a scale from 1 to 6, according to the urgency with which they ought to be subjected to technology assessment; possibly accompanied by appropriate reasons for those considered particularly urgent.

A summary report of the findings, including master-ratings of the technologies with regard to:

(a) the imminence of their large-scale introduction,

(b) the degree of their commonality of interest to the various world interest groups,

(c) their overall socio-political and economic effect if widely introduced, and

(d) the urgency with which they ought to be assessed,

will be prepared by Thursday morning (Laxenburg time) for presenting to the local panels and transmission to the remotely situated panels.

At the local plenary session on Thursday, there will be an opportunity to follow up on the results of the interactive workshop sessions, by discussing problems of the "management" of the technologies under consideration, including:

(a) IIASA's potential role in carrying out detailed international assessments of the selected technologies, and

(b) possibilities of promoting (or discouraging) these technologies through international cooperation.