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Review & Critique

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A Management Overview Methodology For Technology Assessment

Including

Three Retrospective Applications to OTA Assessment Reports

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R&C

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Management Methodology

A. Efficiency and Effectiveness

The methodology should encourage:

Efficient use of time and money; no unneeded work.

Effective use of in-house and outside participants.

Optimum use of panels, workshops, consultants, etc.

Communication across internal administrative boundaries.

Techniques and criteria for checking the convergence of a study towards completion.

Progress in the "organizational learning curve" including development of well-cataloged material for future studies.

Development of an early warning system to suggest needed studies in anticipation of client needs or requests.

B. Adaptability

The methodology should encourage:

Early formulation of a tentative final report and study work plan.

Monitoring techniques which facilitate redirection of work as the assessment developes.

Accommodation to the inevitable uncertainties in the prediction of the time and budget needed.

Adaptability to meeting unanticipated deadlines (e.g. easy production of useful interim reports).

Modularity (i.e. the ability to produce valid and useful assessments covering limited aspects of an issue with speed and modest cost).

The Report

C. Completeness, Objectivity and Soundness

The report should:

Address all important issues, options and points of view.

Consider the levels of uncertainty of the analysis (with "worst credible" cases treated for crucial issues).

Separate analysis and value judgments (with the latter minimized).

Justify or support expressed analysts' opinions with specific analysis.

Identify any value trade-offs made by the analysts and also those to be considered by the client.

Stand up to severely critical review.

Clearly identify remaining unresolved questions and outstanding controversies.

C. User-Oriented Reports (As Distinct from Producer-Oriented Reports)

The report should:

Enable the user to easily find specific information or topics treated within the report.

Have as standardized a format as practicable given the different natures of subjects treated.

Avoid shrouding uncertainty or controversy in vagueness (leads to dull as well as confusing reports).

Contain a compact and well-organized display of policy options and their anticipated consequences.

Present relevant technical issues in manners which balance comprehensiveness and intelligibility to the users.

Avoid presentations of excessive material of little or no use to the major audience.

Provide a bibliography or references to other material likely to be of concern.

To a large extent, the methodology for technology assessment we develop herein to achieve the above characteristics is simply organized common sense. It is, without doubt, reproduced at least in part by the current OTA approaches. With these disclaimers, we describe our proposed overview methodology in rather concise terms with the assumption the the readers are experienced analysts who will supply the appropriate caveats and details.

Section II below describes the nature of the Focus Questions, which form the keystone of the R&C Methodology.

Section III discusses four Fumdamental Concerns (the foundation of the R&C Methodology) to users of assessments, and how explicit attention to these can play a significant role in technology assessment.

Section IV presents the R&C Methodology for Management Overview.

Section V is a Utilization Plan for OTA's employment of the R&C Methodology.

Acknowledgment: While the methodology we present was initially formulated for other purposes prior to our contract with OTA, its further development was greatly aided by comments from OTA staff during our two extended visits. Material provided to R&C related to the work of the OTA task force on Methodology and Management was particularly helpful. These interactions expanded our insight and helped produce a document which we trust will be useful in the OTA context.

II. FOCUS QUESTIONS

The Keystone of the R&C Methodology

In the R&C Management Overview Methodology, the Assessment Management makes formal contact with the Study Groups through the formulation of a set of "Focus Questions" or study topics which specify the information to be acquired and the analysis to be done.[1]

Focus Questions, which preferably, but not necessarily, will be in interrogatory form, serve to define the areas of investigation. They not only explicitly determine what should be studied, but, by implication, (the questions not asked) they announce what is beyond the scope of the study. These questions (actually ordered groups of questions) serve to focus the effort of the Study Groups on that material which is needed for the Final Report, or needed for additional background the OTA requires for talks, testimony, etc.

The mechanism for the development of the Focus Questions and how they fit into the R&C methodology will be discussed in

1. As was pointed out in the Introduction, in the interest of conciseness we trust the reader to add appropriate qualifications and caveats to our statements. In this one case, for example, the "Assessment Managers", as individuals, may also participate in the "Study Groups"; there will, in any case, be communication links in addition to Focus Questions. By "Study Groups" we mean to include in-house studiers, outside contractors, consultants, panels, conferences, workshops, etc.

detail in subsequent sections of our report, and some examples will be given. Here we just mention some prominent features of their use.

At some early stage of the assessment, the Focus Questions become the basis for the assignment of staff work, contracts, etc. The Focus Questions are never rigidly set. Rather, they are modified and developed in an iterative process as the assessment proceeds; they become the joint responsibility of the Assessment Management and the Study Groups.

Another feature of the iterative development of the Focus Questions is that it becomes the basis for establishing checkpoints for periodic review of the progress of the assessment. As "answers" develop to the Focus Questions or as the unavailability of answers (within the time and budget constraints) becomes apparent, the convergence of the study can be assessed. Eventually the Focus Questions become the basis for the Final Report and for the addressing of unanswered, important Focus Questions to other agencies or other times for consideration.

III. THE FOUR FUNDAMENTAL CONCERNS

The Foundation of the R&C Methodology

A Modular Approach to the Management of Assessment: The explicit development of Fundamental Concerns is part of the technique for the generation of Focus Questions, but it is actually more basic to the entire R&C methodology. The concept was developed to enable the synthesis of assessments from specific consideration of those basic issues which are of enduring concern to those for whom the assessment is prepared, Congress in the present case. Organizing the thinking of the assessors in terms of the Fundamental Concerns provides a mechanism whereby an essential completeness of the study is greatly facilitated. Furthermore, the separation of major value judgments from analysis becomes quite natural. It also turns out that structuring a management overview in terms of Fundamental Concerns makes particularly good use of intellectual resources and psychological tendencies. We elaborate on these points subsequently.

Four fundamental and relatively enduring concerns can be defined to encompass all societal issues. While the choice of our particular set of concerns is not unique, their scope is complete and they adapt well to the issues addressed by Congress and by OTA. Essentially any assessment question can be completely analyzed in terms of its direct impact on these four "Fundamental Concerns:"

I. Economy
II. National Security
III. Environment
IV. Social Equity and Other Social Concerns

Each broad assessment topic will have aspects within each of the Fundamental Concerns. For a given topic one or two Concerns will generally deserve major emphasis. To be specific, consider the subject of a recent OTA assessment, Technology and Steel Industry Competitiveness. The following are examples of sub-issues which would then arise under each of the Fundamental Concerns.

I. Economy

- a. The health of the domestic steel industry.
- b. The potential impact of imported steel on the US balance of trade.
- c. The cost of EPA regulations to the steel industry.

II. National Security

- a. The requirements of steel for armaments.
- b. The military/political implications of a strong (or weak) domestic steel industry.

III. Environment

- a. Pollution caused by the steel industry.

IV. Social Equity and Other Social Concerns[1]

- a. Justification for any special treatment of the steel industry by the government.

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[1] The steel industry analysis is not a very good example to illustrate the rangeof problems we intend to be included under the "Social Equity" rubric. The steel industry corresponds to an infrastructure already in place and only incremental changes could be expected from government action, and, consequently, the social implications are limited. If we had chosen the assessment "Energy from Biological Process" as our example, the social implications under this Fundamental Concern would include, e.g. revitalization of rural economies while avoiding the "boomtown" syndrome, changes in food prices, land ownership, lifestyle changes, and various ethical considerations.

b. Effect on steel workers (and, say, auto workers) of large amounts of imported steel.

We emphasize the completeness of these four Concerns. With proper interpretation, all basic aspects of any technology assessment are completely addressable with such an allocation. We also note the (quasi) enduring nature of these Concerns. While the emphasis our society gives to each will vary, they will remain an appropriate set to consider for the foreseeable future.

Nevertheless, there are some issues which, while crucially important to the assessment -- will not arise as aspects of the Fundamental Concerns. They will however, be addressed by the R&C methodology. Generic examples of this would be "will something work?"; e.g., will a particular technological item or a particular regulation perform its intended function well? The item or the regulation are not fundamental concerns of the clients of the study, important as they may be. They are means rather than ends, and it is the societal ends that the Fundamental Concerns encompass.[2] Such "means issues" will inevitably arise for consideration as the implications of the policy options to be discussed later.

Separation of Analysis and Value Judgments: Each of the Fundamental Concerns is readily identified with just those goals or principles people take seriously. Individuals often relate

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[2] Occasionally overenthusiastic technologists or advocates of a particular social or economic idea become so fascinated by their "thing" that it becomes for them a fundamental concern. For society at large, however, it is still a means rather than an end.

with particular fervor to one or another of the Concerns. Societal trade-offs between the Fundamental Concerns involve personal values and consideration of such trade-offs can be emotionally charged. Trade-offs of disbenefits within one Concern in return for benefits within another are not readily analyzable in a convincing way. (Such are the "guns vs. butter" decisions.) The R&C management overview approach is designed to confront this issue at the outset of an assessment and actually turn tendencies to identify with these Concerns to an advantage in the management and conduct of assessment.

In spite of the value-laden aspects of trade-offs between Fundamental Concerns, people do find a strong need to present an analytic argument to support their views and to convince others. Incompleteness of an assessment by omission of some appropriate analysis for each of the Fundamental Concerns leaves the conclusions of the assessment open to challenge from the basis of that unanalyzed Concern. A biased, or even invalid, analysis put forward by a special interest can then achieve substantial status by default and can discredit an assessment.

Although trade-offs between Fundamental Concerns must eventually be decided upon, it is usually both practical and desirable to delay such decisions to the last stage of the assessment. At that point those trade-offs can be clearly identified and presented to the ultimate decision-makers. Analysis

in terms of the Fundamental Concerns thus separates major value judgements from analysis to a considerable extent.

Within each Fundamental Concern, analysis can generally proceed without the need for the immediate consideration of the most value-laden choices. A separation of facts and values can, of course, never be complete. Within each of the Fundamental Concerns there will still be problematic trade-offs, but only occasionally will these be heavily value-laden. Within each Concern the issues can, as a rule at least, be evaluated in terms of coin of the same realm.

Utilization of the Fundamental Concerns Approach: Different people or different working groups would, no doubt, use the Fundamental Concerns in different ways. We suggest, as one possibility, the use of "role-identification" as an aid to the creative and insightful development of the questions to be analyzed. Role-identification has proven to be a powerful tool in many situations in which one wishes to study another point of view. The value-laden aspects of the Fundamental Concerns make this tool particularly appropriate.

We all know (of) people fervid about one of the Fundamental Concerns (or even some aspect of one). Many of us could also visualize ourselves in the position where one of the Concerns becomes our particular responsibility. We might then develop considerable fervor ourselves. ("Where one stands depends on

where one sits.") In any event, role-identification is an available technique to use to whatever degree one wishes.

It may be valuable to encourage interested people in an organization to accept the responsibility for identification with a particular one of the Concerns for an extended period of time, even to the extent of becoming quite expert in the general area. Such people could be valuable consultants on a number of ongoing assessments. They could also have some responsibility for paying particular attention to developments in the area to alert the OTA to the possible need for yet unrequested assessments. (An "early warning system.") Advisory groups focused on each Fundamental Concern, perhaps with trans-assessment advisory responsibility, could also be very helpful for the same purposes.

The recognition and acceptance of the value-based, or otherwise strongly held, attitudes as relatively unchanging "givens" can be extended to finer-grained distinctions within the Fundamental Concerns. For example, within the Economic Concern, people might well be selected to represent certain important, but divergent, schools of economic thought.

The establishment of people (or groups) with such responsibility could presumably transcend organizational boundaries and bring about inter-divisional cooperation as an added benefit.

Interaction with Congress: The Congressional committees for which OTA assessments are prepared do not correspond to a single Fundamental Concern any more than does a typical assessment. The Fundamental Concerns nevertheless provide an excellent technique for organizing a match of an assessment with a committee or committees. Just as the sub-issues of a given assessment can be conveniently grouped and displayed by projecting them upon the Fundamental Concerns, as shown by the partly worked example above, the responsibilities of any committee can also be so projected.

Inevitably, when a particular committee is the client for an assessment, there will be a ready identification of many of the projected sub-issues with the responsibilities of the committee. These aspects of the assessment would, no doubt, receive particular attention. There may also be important sub-issues for which there is no match with committee responsibilities, and the above projection technique alerts the analysts to this. The need for analysis of these sub-issues for the purpose of providing a reasonably complete assessment could be discussed with the client, and appropriate additional clients sought if it is decided not to limit the scope of the assessment.

IV. THE METHODOLOGICAL PROCEDURE

In this Section we present, in highly schematic form, the steps by which a technology assessment could be conducted utilizing the R&C methodology. The process is represented diagramatically in Figure 2 at the end of this Section.

Generation of "Situation, Causes and Trends" List: It is presumed that the "formal" process begins after a relatively short period of study of the basic issues under consideration. During this initial phase, which might span a few weeks, a general familiarization with the facts, opinions, and currently proposed options is acquired by reviewing the literature and conducting informal interviews. The first step of the formal process is the generation of a moderately exhaustive listing of brief statements describing the present situation, its causes and the projected trends. These would be listed under each of the four Fundamental Concerns of Section III, as displayed in Figure 1. This listing would become Step A under Initiation/ Review Process in the Flow Chart in Figure 2. For a specific example of such a list see the Appendix at the end of this section, where representative items pertaining to the OTA assessment "Technology and Steel Industry Competitiveness" are given.

Figure 1

The "Indirect Projections" on the above list arise by considering each "Projected Trend" under a given Fundamental Concern for its indirect effect within another Concern. While indirect effects are often of minor importance, some occasionally have significant impacts which should not be overlooked. A methodology should specifically alert the analyst to be aware of them.

The listing of Step A may be most effectively generated in a group meeting. Perhaps one or more members of the group would have been previously assigned some special responsibility for particular Fundamental Concerns. The interaction of several people in generating the list has decided advantages in helping

to ensure that all relevant societal issues are considered. While there is never a guarantee that some important aspect of a study is not overlooked, it is less likely to occur in sessions where several points of view, modes of thinking and degrees of emphasis are represented.

It should be emphasized that at this early stage the identification of trends and other issues will be extremely tentative. This is a first stab at defining the problem. More questions may be raised than answers accepted. Good. That is the object at this point.

Generation of Policy Options: The second step is the generation of possible actions which might be taken to address problems as identified. Some of these policy options are immediately suggested by the listing of the situations and trends in Step A. Almost inevitably, there will also be a substantial number of options that are more or less familiar initially. These would include currently proposed options whose consideration might well have helped motivate the study in the first place. The policy options are often not independent of each other. They can usually be grouped into sets of options for consideration as packages. The range of possible options is wide and the gradation between options could, in principle, be infinitely fine. For the purposes of analysis it is convenient to define a small number of "Representative Option Mixes."

The generation of the options and their collection into Representative Option Mixes is Step B under Initiation/Review Process in Figure 2. An example of such a list is given in the Appendix in Table B, again appropriate for the OTA "Steel" assessment.

Implications of the Options: A rough estimate of the implications and anticipated consequences of each of the Representative Option Mixes is worth explicit listing for each item specified in Step A. This listing of implications forms Step C under Initiation/Review Process of Figure 2. An example of such a list is in the Appendix as Table C.

The implications of the options can hardly be estimated reliably or accurately at this stage of the study. If they could, there would be little need for the study. The major object of this exercise is, again, the generation of questions, not answers. By making the best guess, perhaps only identifying the direction of change resulting from various policy options, and stating uncertainty when it exists, the stage is set for detailed planning of the assessment. Considerable insight can be gained by comparing the eventual results of analysis with the initial guesses and uncertainties. (This is a form of John Wheeler's famous law: "Never start a calculation before you 'know' the answer.")

A comment on options: It is often easiest to analyze the implications of an option which has substantial impact.

In such a case, it is valuable to outline those maximum policy actions plausibly acceptable to the decision maker as extreme Representative Option Mixes. There often need be only one of these. One or more intermediate-impact Option Mixes can then also be defined.

Since political inertia often makes the status quo difficult to overcome, the "Option Mix" representing doing little or doing nothing may well prevail. This "Option Mix" always warrants careful (and sensitive) treatment. Explicit analysis of its implications is warranted, and special attention to the effects (or lack thereof) of minor palliative measures should be given. In the R&C methodology this option mix does receive special emphasis since it is assumed as the basis for the "Projected Trends" in Step A.

Finally, special options that are not part of one of the Representative Option Mixes, and which perhaps address only a small part of the problem, should at least be collected for mention, if not analysis.

The Fast Loop Iteration: We envision the collection of the lists of Steps A, B and C to be done initially in a group meeting in a few hours after the initial period of individual study of the issues. The list of Step C, the implications of the options, followed from Steps A and B. But, of course, those implications

will inevitably suggest new items for inclusion on the list of Step A or even new policy options (Step B). While the Steps A, B and C logically, at least, take place in sequence, the sequence must be iterated to refine the results. This procedure is represented in Figure 2 by the thin arrow marked "fast loop." A time-scale for the fast loop? Hours or days, probably. Actually, even thinking of this process as a unidirectional loop rather than a jumping back and forth is an idealization. In fact both these processes inevitably and appropriately occur. As a consequence, a dose of random anarchy in thinking exists and helps avoid a narrowness of view.

We emphasize that the lists of Steps A and C are worksheets. They would never find their way into anything published. They should, presumably, indicate a great many uncertainties. They would also contain many redundancies and even irrelevancies. That is perfectly all right. The search here is for completeness. The redundancies and irrelevancies will be eliminated later.

After a very few sessions, with a small amount of individual research in between, we would expect that the lists of A, B and C would tend to "stabilize."

Generation of the Focus Questions: The generation of the "Focus Questions" is the main function of Steps A, B and C of the Initiation/Review Process. As the Fundamental Concerns are the foundation of our methodology, the Focus Questions are the keystone.

A first stab at the Focus Questions for the assessment (the first iteration) are generated by considering the worksheet lists of Steps A, B and C. The Focus Questions have their origin in the Fundamental Concerns and can, initially at least, be efficiently organized under that rubric. The Focus Questions are probably best in the interrogatory mode, but need not always be so. They could, for example, be requests that a body of information be collected and analyzed. Examples of a few first iteration Focus Questions appropriate for the OTA "Steel" assessment are in the Appendix as Table D. A more complete set can be found in R&C's retrospective study of that assessment.

Considering that the Focus Questions arise from the "Present Situation, Causes, and Projected Trends"; the "Representative Option Mixes"; and the "Implications of these Option Mixes", one expects the Focus Questions to be solution oriented rather than problem oriented. One is therefore efficiently motivated by this process to find out specifically what is actually needed for the assessment and the acquisition of appropriate background.

In the formulation of Focus Questions it is understood that only analyzable questions or information-seeking questions are candidates for Focus Questions. There may be very interesting questions raised in Steps A, B and C of such a nature that they do not warrant detailed analysis within a given study but do warrant mention in the report. They should be collected, but

they are not Focus Questions in the sense that study effort and organization must be devoted to their analysis. We note several examples in the listing of implications in Step C, Figure 2.

Parts, at least, of some Focus Questions may be of such a nature that a precise answer cannot be given; but, nevertheless, the question is so crucial that the limits of uncertainty should be explored. The statement of the Focus Question should explicitly indicate the need for such investigations. Focus Questions involving National Security are frequently of this type.

We emphasize that the first iteration set of Focus Questions is generated at a very early stage of the project.

Scope Limitation and Development of Study Groups: The Focus Questions can now form the basis for the further development of the study. Certain of them would be edited and collected into related groups for combined consideration. The Focus Questions will suggest a range of affected parties, a number of areas in which to seek expert consultants, and the points of view warranting representation. They would also enable the preliminary identification of tasks for "Study Groups" (which include contractors, panels, consultants, etc.). In particular, the first iteration Focus Questions form a solid basis for the initial panel meetings.

During the process of organizing the Focus Questions for assignment of study projects it will, no doubt, be decided that some of them, even some quite significant ones, will not receive detailed analysis. This will be true for reasons of time and

budget constraints or explicit limitations put on the scope of the study by the clients. Such significant but unanalyzed Focus Questions should appear in the final report along with at least some discussion to reflect the prevailing opinions on the issue or, perhaps, to reference other treatments and point out why the study remains valid even with these omissions. In this way the scope of the study is clearly spelled out and defended as reasonable.

Monitoring of Study Projects: The specific nature of the questions that form the basis for the study projects will necessitate a close interaction between the project director and the Study Groups. Each study project will be characterized by specific goals, which would be monitored on a fairly short time-scale. These studies would be redirected as each Focus Question is analyzed. A fairly flexible workplan should, ideally, be implemented.

Studiers are not only responsible for developing the best possible answers to assigned Focus Questions, but they should share some (secondary) responsibility for ensuring that the study questions assigned to them are the appropriate ones to address. They should have access to all of the relevant Focus Questions under study. We may be suggesting a closer relationship between studiers and project management than often exists. There would, of course, occasionally be communication breakdowns. But the worst case should be better than what often happens when a broad study contract is allowed to drift.

with increasing detail and sophistication. In this process, feedback from the Study Groups will be crucially important and the Focus Questions of the assessment will continue to evolve.

The process of feedback from the Study Groups to the assessment management and the revision of the Focus Questions to give continued guidance to the Study Groups is what forms the "Slow Loop Iteration" of the methodology as indicated in Figure 2. The time scale involved may be of the order of a month or more. In cases where assessments have been well-planned initially, and where major new problems, information, constraints, or ideas do not arise, there may actually be little modification of the initial set of Focus Questions that were assigned to the Study Groups. In other cases, there could be substantial redirections, and the methodology allows this in a well-controlled way.

One can think of the Fast Loop Iteration of the Initiation/Review Process as driving and monitoring the Slow Loop Iteration in which the bulk of the study and analysis is done.

Convergence of the Study: As time goes on, more of the studies of Focus Questions will be completed, and the set of Focus Questions will no longer change very much. This provides a terminative algorithm. Of course, some Focus Questions will resist closure, and these will have to be treated explicitly as "open" questions in the final report. The stabilization of the set of Focus Questions will be a measure of the convergence of the study to completion.

At a very early stage of the assessment, certain aspects of certain Focus Questions will probably be assigned top priority as questions whose study results might be needed at an early date. When the Focus Questions are formulated, some of them would be so designed that at least their broader aspects will converge surely and rapidly.

Establishment of Check Points: Close monitoring by the assessment management is quite explicit in the methodology, but it may be appropriate to formalize it somewhat further. The assessment can be thought of as proceeding in phases, and check points for the reporting of the progress of the assessment can be established at the end of each phase. The quasi-periodic nature of the Slow Loop Iteration allows such a procedure to be introduced quite naturally.

Exactly where one establishes phase boundaries will be somewhat arbitrary and depend on the nature of the particular assessment. It is, nevertheless, best to make such identifications early on and modify them only as necessary.

We will here suggest some generic phases with the understanding that we are considering an idealized and oversimplified assessment. The generic set can, however, be the basis for developing the boundaries which define the phases in an actual assessment.

Phase 1 of the assessment ends when the Initiation/Review Process has yielded the first iteration set of Focus Questions,

and some panels, and consultants, etc., are tentatively identified. At this point the general nature of the assessment and even of the Final Report can be tentatively outlined and foreseen, albeit, in a rather cloudy way. This is an appropriate time for an overview by the assessment team and for the invitation of review and comment by others.

Phase 2 starts with revisions resulting from the phase 1 review, and proceeds through some panel meetings, consulting, etc., and ends when the Focus Questions are developed and organized to the point that they form the basis for the assignment of work to the Study Groups, including the writing of contracts for external work. Phase 2 should include the establishment of Report Dates at which each Study Group would report their progress; the nature of the progress anticipated at each Report Date should be tentatively spelled out. (There may be a tendency to claim that the uncertainty is too great to attempt such control. Adaptable efforts at control are better than drift in the face of uncertainty. It pays to hold the rudder even when the ship is largely at the mercy of the storm.)

Further Phase boundaries are established by the Report Dates established in Phase 2. At each of these checkpoints the "convergence" of the Focus Questions is reviewed and reported on. As an assessment proceeds, there will be some unavoidable getting out of step of the various Study Groups. Handling this problem

will require some pressure on the Study Groups, some reorganization of the assessment program, and good judgement on the part of the Project Director.

At each of these Phase boundaries the tentative picture of the Final Report should become clearer. The nature of this ultimate goal should always be in the forefront of checkpoint reviews at Phase boundaries.

When the study is close to completion, there is a checkpoint where the inevitable difficult decisions which have been forced by time and budget constraints -- and which tend to show up at a late stage -- are reviewed. This checkpoint should be established so that there are still sufficient resources to ensure reasonable consideration of crucial questions which have resisted complete treatment or arose late in the process.

Finally, after the contents of the Final Report have been tentatively decided, there should be a final checkpoint where a brief close-out report for internal use and perhaps for use by external review groups is prepared. At this time, recommendations for the subsequent study of open questions may be recommended.

Information Reservoir: Many of the Focus Questions will have a scope broad enough that their answers could be applied in part to other studies. They could be catalogued and referenced in a way that they and their corresponding answers are readily locatable in the Information Center or Library.

Development of Generic Types of Focus Questions: We believe, as a result of re-examining the Focus Questions we have developed on our three Retrospectives, that one could fruitfully develop generic categories for the Focus Questions that could apply to a wide range of assessments. Such a development would considerably aid the collection of the relevant Focus Questions for an assessment. We have not, however, undertaken this as a part of the present effort.

Development of the Report Format: While the methodology developed does imply a certain structure to the report, it does not force a particular format. An arrangement where the implications of the Fundamental Concerns are explicitly summarized, and the Focus Questions are used to form the basis of a substantial part of the discussion would seem natural and economical (since the contractor reports will be directed to the Focus Questions). It is, however, possible to have a number of other report organizations as well. If numbers of OTA reports are likely to be used by the same groups or clients, the advantage to the user of having a fairly standardized format is obvious.

Advantages of the Methodology: The outlined R&C management overview methodology in terms of Focus Questions, the Fundamental Concerns, and the process of iteration to convergence should enable the identification of those specific features of the methodology which bring about the "desirable characteristics" of the report listed in the introduction under IC and ID.

For example, using the Fundamental Concerns as the basis of the assessment tends to ensure that the final report will address all important issues, options and points of view; clearly separate analysis and value judgements; and clearly point out the major value trade-offs implicit in the various policy options. Addressing and continuing to review the important issues in terms of specific Focus Questions, to be answered by analysis and information collection, ensures that any opinions expressed will be justified. It further ensures that open-ended or "unanswerable" questions will be considered to the extent warranted, appearing in the final report as unanswered questions, and possibly paving the way for future studies. For all these reasons, a report developed according to the R&C methodology should be quite resistant to unjustified attack when critically reviewed.

In Section ID we discuss the "user-orientation" of reports. The Fundamental Concerns are the concerns fundamental to the user of the report, and the Focus Questions are just those questions whose answers would be of most interest to the knowledgeable user. An assessment structured along these two concepts, and developed in that spirit, should certainly result in a user-oriented report.

The interplay of the Focus Question format and the iteration mechanism provides an effective technique for checking the convergence of a study and the efficient use of time, money, and human resources. It should be pointed out that several of the

desirable characteristics we list do not specifically come about through the use of the R&C methodology as distinct from any other reasonable approach. We included them in our list for the sake of completeness.

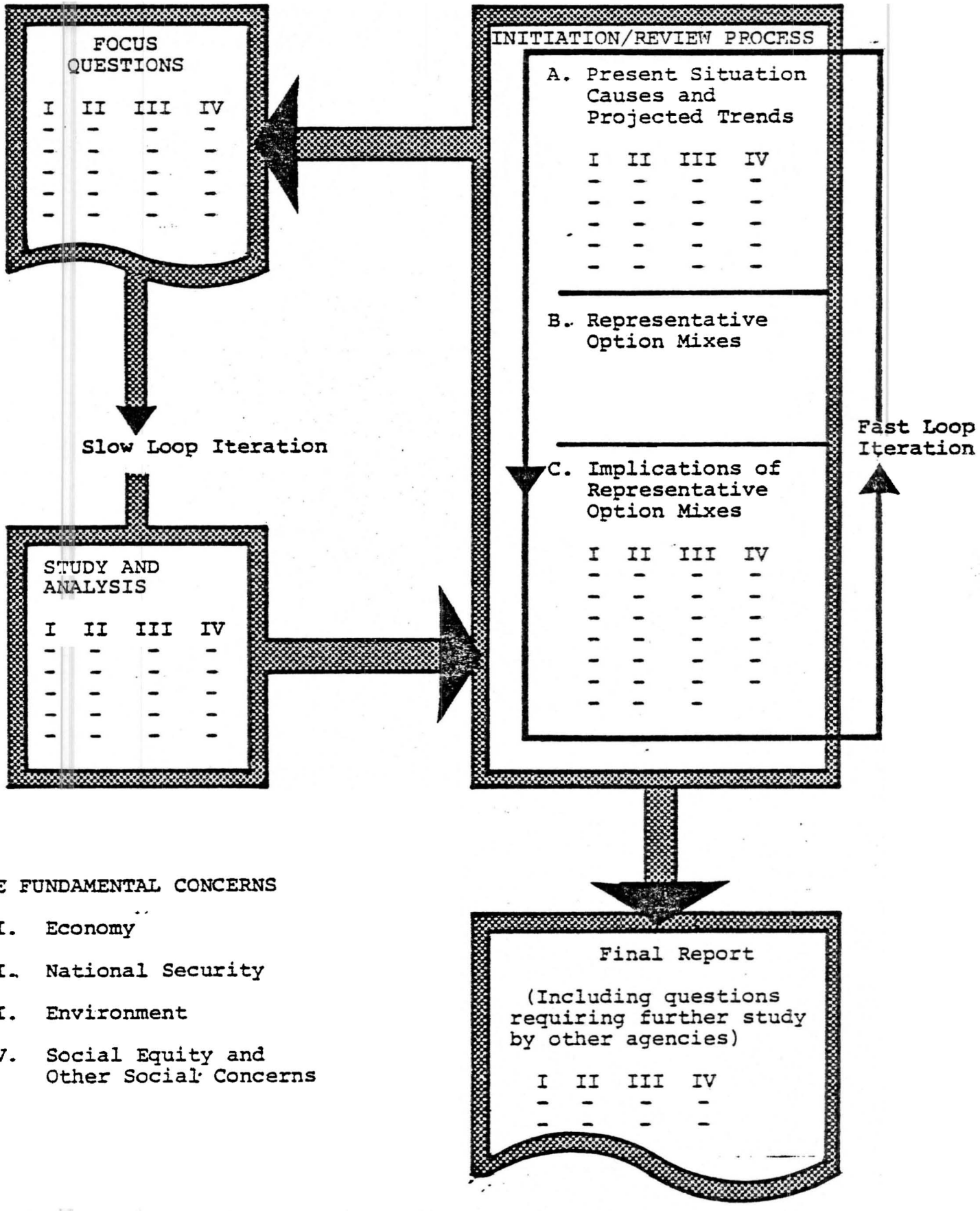
The final test of any management overview approach is, of course, its actual utility. We can say, at this point, that we have found aspects of the R&C methodology efficient and intellectually fruitful in our application of them to the retrospective study of the three OTA assessments. We hope that OTA can derive some useful insights from our description of this process.

INFORMATION FLOW CHART

for

MANAGEMENT OVERVIEW METHODOLOGY

Figure 2



THE FUNDAMENTAL CONCERNS

I. Economy

II. National Security

III. Environment

IV. Social Equity and Other Social Concerns

APPENDIX

Tables A, B, and C are abstracted and incomplete examples from the R&C retrospective study of the OTA assessment "Technology and Steel Industry Competitiveness". These Tables illustrate the output of Steps A, B, and C of the Initiation/Review Process of Figure 2. We emphasize that these tables are "WORKSHEETS" and would never appear in any publication.

Table D is a set of abstracted and incomplete Focus Questions from the same retrospective. We emphasize that they are the "first iteration" Focus Questions.

TABLE A

A. Present Situation, Causes and Projected Trends

The Fundamental Concerns

I. Economy

Present Situation (and Causes)

A. Low integrated steel profitability

B. Little implementation of new technology

C. - - - etc. - - -

Projected Trends

1. Continued decline of steel industry

2. Increasing contribution to negative balance of trade

3. Possible lower price of steel due to more efficient foreign manufacture

4. - - - etc. - - -

Indirect Projected Trends

5. Economic disruption because of need for limited domestic steel for armaments in a national emergency

6. - - - etc. - - -

II. National Security

Present Situation (and Causes)

A. Present dependence on steel for armaments?

B. - - - etc. - - -

Projected Trends

1. Potential unavailability of steel for the manufacture of armaments

2. Potential for the rise of steel cartels and the occurrence of political blackmail

3. - - - etc. - - -

III. Environment

Present Situation (and Causes)

A. Old integrated mills yield high pollution

B. Pressure to relax EPA controls

C. - - - etc. - - -

Projected Trends

1. Reduced pollution as domestic production decreases

2. Pressure to relax EPA controls on other industries if relaxed for steel industry

3. - - - etc. - - -

IV. Social Equity and Other Social Concerns

Present Situation (and Causes)

A. Steel industry hazardous and pressure to ease OSHA regulations for steel industry

B. Steel wages high compared to other manufacturing

C. - - - etc. - - -

Projected Trends

1. Increasing pressure for government to pay special attention to the steel industry's problems

2. Selective geographical economic problems

3. - - - etc. - - -

TABLE B

SELECTED POLICIES FROM REPRESENTATIVE OPTION MIXES

Rep. Op. Mix A: Little change from what is done now.

Rep. Op. Mix B	Rep. Op. Mix C
The intermediate or "Renewal" option mix	The AISI or "High Investment" option mix
Capital Formation	**Capital Formation**
- Number of government programs (loan guarantees, tax incentives, etc.) that have detailed impact on development of steel industry	- Regulatory changes to aid very rapid capital recovery (e.g., accelerated deprec.) (For steel industry alone? Yes)
- No change in present price policies	- "Free market" steel pricing; No "jawboning"
R&D	**R&D**
- Increased government support, with identification of and emphasis on "basic" research. Support given to industry, research centers, universities	- Increased government support of research with no differentiation of "basic"
- Incentives for industry R&D support	- Relaxed antitrust restrictions on cooperative research
EPA/OSHA Controls	**EPA/OSHA Controls**
- Better matched regulations between industry abilities and societal benefits. Use cost/benefit analysis	- Mandate only that needed for public health and justified on a cost/benefit basis (i.e., substantial relaxation of present controls?)
Raw Material	**Raw Material**
- Regulation to decrease the export of scrap ("embodied energy") and increase domestic use	- Allow free market forces to control scrap use and export
Trade	**Trade**
- Strict enforcement of MLT agreement to control imports	- Strict enforcement of MLT agreement, etc., for control of imports

TABLE C

IMPLICATIONS OF REPRESENTATIVE OPTION MIXES

Representative Option Mix C (Letters and numbers in this list correspond to the similarly labeled items in TABLE A)

I. Economy

- A. Sharply increased steel profitability
- B. Little short term change
- C. - - - etc. - - -
  - 1. Decline halted
  - 2. Possible positive contribution to trade balance
  - 3. Probable increased steel prices
  - 4. - - - etc. - - -
  - 5. Less chance of disruption because of increased domestic capacity
  - 6. - - - etc. - - -

II. National Security

- A. Less dependence on imported steel for armaments in short run -- none in the long run?
- B. - - - etc. - - -
  - (1) and (2) The political/military risks associated with dependence on foreign steel will be greatly reduced
  - 3. - - - etc. - - -

III. Environment

- A. Probable increase of pollution from older mills

B. Significant relaxation of EPA regulations and thereby both advantages and disadvantages of those regulations will be reduced

1. Greater production combined with relaxed regulation will result in a general degradation of the environment

2. Pressure to reduce EPA controls on other industries increased

IV. Social Equity and Other Social Concerns

A. Hazards to increase somewhat as production nears capacity and OSHA regulations relaxed

B. Effect on wages uncertain, but presumably contracts would be negotiated with less White House input

C. - - - etc. - - -

1. Response to pressure

2. Selective geographical economic problems ameliorated

3. - - - etc. - - -

TABLE D

FOCUS QUESTIONS (A FIRST ITERATION)

I. Economy

A. The Present Health of the Steel Industry

What are the causes of the steel industry's problems (i.e., the history)?

What is the present situation (i.e., rates of decline, low profitability, use of old technology, rate of capital investment, etc.)

How much do high wages contribute to the industries non-competitiveness?

B. Balance of Trade

What is the importance of steel's present and projected impact on the overall balance of trade?

What changes can bring about a positive contribution to trade balance?

C. What would be the economic benefits (or disbenefits) in allowing the international free market to determine the level of all imports in general and steel in particular?

What steel import levels would be likely?

What steel prices would be likely?

II. National Security

A. The (un)availability of steel for the manufacture of armaments.

Is the present dependence on imports negligible in this regard?

What is the potential threat of a dependence on imports? Consider this for various domestic steel capacity levels. How comparable is the situation to that of oil? Would a National Steel Stockpile be realistic?

B. Potential for cartels, blackmail and world instability if US relies on imported steel

How likely or serious would a world steel capacity shortage be?

To what extent is the situation similar to that of oil?

What sort of defense against cartels, etc., is feasible (e.g. national stockpile)?

III. Environment

A. Pollution and Other Environmental Problems of Steel Production

What are the environmental problems? What type? How significant?

What are the costs to the industry of correcting pollution to various levels? Relate these levels to present EPA standards?

What are the environmental benefits to the US of importing a major portion of its steel?

What are the environmental effects of the various options considered?

B. - - - etc. - - -

IV. Social Equity and Other Social Concerns

A. The same question as A under Environment but with respect to job hazards and OSHA regulations

B. Potential pressure for treatment equivalent to that given to Steel by other industries with situations at least *perceived* as similar to that of Steel (e.g., auto, electronics, leather)

How pervasive is such pressure likely to be? Now and in the future? Identify likely cases and give some specific justifications for treatment similar to that given steel. Emphasize the technological aspects (i.e., which U.S. industries are technologically behind other countries and which ones are likely to soon become so?)

In what ways is the Steel situation (almost) unique and therefore justifying special treatment?

What are the implications of allowing the treatment of the steel industry to apply to all industries?

Consider the above in terms of the Option Mixes considered.

(The above questions are not easy to answer with much certainty. The details of the answers are not that important. However some assessment is needed and there exist data that can be fairly readily gathered and interpreted.)

V. UTILIZATION PLAN

General Discussion

There are many ways in which the R&C Management Overview Methodology for Technology Assessment could be used by OTA. Which approach or combination of approaches would be most effective in the OTA environment can probably best be determined by experimental implementation, perhaps on a small scale, of those facets of the methodology which seem most appropriate to OTA management. Consequently, we present here a spectrum of utilization pathways which merit particular consideration.

In considering possible utilization approaches, two "management variables" or assessment process characteristics seem especially relevant: the OTA organizational level at which the methodology is applied, and the stage of assessment completion at which it is brought to bear. Of course, it may prove desirable to apply at least portions of the methodology at several levels of management and several stages of assessment completion.

Management levels at which the R&C approach could be specifically utilized are: the Project Director level, including the guidance of advisory panel and external contractor work and deliberations; the Project Manager level, focusing on a variety of project overview functions; and the OTA top management levels.

Project stages at which the methodology could prove useful

are (1) the "early warning" and project selection stages; (2) the project definition stage; (3) the operational assessment stages; (4) the final draft review stage; and (5) the project closeout/retrospective review stage.

Specific Suggestions

We present below our specific suggestions for utilization consideration.

Early Warning

A small group of individuals (2-4) with appropriate broad interest and expertise should be formed dealing with each of the Four Fundamental Concerns. Non-OTA government experts and/or outside consultants could be used if necessary. The purpose of these groups would be to alert OTA top management to critical events or emerging issues which might require OTA attention, either with respect to ongoing assessments or possible new ones. The level of effort required to do this job well would be quite low since the assigned role would occupy a small fraction of each individual's time.

Project Selection

In selecting the assessments it undertakes and allocating its limited resources among them, OTA must choose among many alternatives. We suggest that the R&C methodology be applied in

first iteration to candidate projects before they are selected for full-scale assessment. This would result, for each candidate project, in the generation of a first-cut list of Focus Questions in each of the Four Fundamental Concern areas. The purpose of this exercise would be to enable a good estimate to be made by OTA management of the range of issues, types of expertise, and depth of analysis which would be required to do a good assessment job in the case of each candidate project. This would in turn result in better budget and staff requirement estimates, and fewer big surprises. We think a good job could be done for perhaps $2,000 -- $5,000 per candidate project, depending on the complexity involved.

Project Definition

Probably the most critical decisions made in any assessment are those in the early stages which delineate the scope and depth of analysis. Among the results of a successful project definition activity will be:

- An initial but rather complete overview of the sub-projects which the assessment will entail.
- Suggestions of appropriate consultants, panelists, contractors, etc.
- First-cut study plans and an approximate estimate of the time and budget needed for various aspects.
- Arrival of the assessment at the first checkpoint of the R&C Methodology.

Although the OTA system of using panels of experts and involved parties is an excellent one for the purpose of surfacing issues, it is still quite possible to miss an important issue because its connection to the assessment is not initially obvious. Since parties at interest on the panels will want to focus on their particular concerns, it is not clear that important underlying issues of, e.g., long-term national security or supply-side economics, will be spotted unless someone on the panel is directly concerned. What we specifically suggest is that the Focus Questions (or key study issues) for each assessment be reviewed before final definition by expert representatives of each of the Four Fundamental Concerns. The role pictured here would be advisory to both the project management and OTA senior management, and this "scope review group" could well be the same which we proposed under "*Early Warning*." The level of effort required here would again be quite low.

Project Monitoring

The aspect of the methodology employed here is once more monitoring at checkpoints as described in the Methodology. This review and critique of the ongoing assessment would take place using the current results of the assessment, but could be quite independent of the actual conduct of the assessment. It would correspond to the checkpoing monitoring envisioned in the R&C methodology. This could be done by mid-level management, possibly

with the aid of external reviewers.

In any one application of this monitoring technique, the time involved could be comparable to that in the *Project Definition* activity described above -- on the order of a few person-days.

This type of Project Monitoring provides management with an effective and systematic procedure for evaluating the progress and comprehensiveness of the study at any stage, including final draft review. In so doing, surprises are avoided, missing issues are spotted, appropriate redirection is facilitated, and the degree of convergence toward completion can be checked. The operation of this monitoring technique presumes (and perhaps enforces) a reasonable degree of interaction with the Study Groups. Project Monitoring done in this way meshes nicely with the previously discussed *Project Definition* activity.

Full-Scale R&C Methodology Test

A full-scale test of the R&C methodology could rather easily be tried in OTA for a new assessment project by assembling a trans-divisional team for this purpose, though this is by no means the only way to implement such a test. If this approach were taken, the team manager (part-time) would overview the activity of four (part-time) project area directors who would be responsible for conduct of the assessment process in each Fundamental Concern area. The flow of the process and the use

of panel and contract support would be as described in our methodology section, and level of effort in each area allocated in accordance with project needs. The team manager could report to any appropriate Division Director. The purpose, of course, would be to try to identify any improvements in cost effectiveness or quality which might result, in comparison with the OTA's normal management scheme; or to derive new insights which could be helpful in the conduct of OTA's work.

Our interaction with OTA indicates that full utilization of the R&C methodology could be implemented with few or no organizational changes within OTA, although its application could suggest some possible changes for management consideration.

Final Draft Overview

We believe it would be useful for OTA's top management to have a brief but insightful review conducted at the final draft stage of each project, using the R&C approach. This could be done externally, or internally by the same groups suggested previously for the *Early Warning* and *Project Definition* functions. Last minute problems or difficulties in project synthesis could be caught here, at an appropriate level for remedial action.

Project Closeout

Finally, our retrospective analysis of OTA reports has convinced us that the R&C approach can be used to provide

constructive analytical review of completed project reports, and these, together with synopses of project execution history and lore, could provide a basis for continued evolution and improvement of the OTA process. One important goal of this activity is the identification of problems of a generic nature to improve future assessments. This would appear to be a cost-effective and worthwhile undertaking.

"TECHNOLOGY AND STEEL INDUSTRY COMPETITIVENESS"

A Retrospective Analysis

Note added in Final Draft

These retrospective reviews were developed by R&C with little detailed information regarding the process by which each assessment was done and the constraints of time, budget, and scope which were imposed on the assessment staff. It seemed most appropriate and useful for R&C to develop its retrospective reviews on the basis of the published report.

In later discussions of our draft report with the assessment managers, the above constraints and limitations were specifically pointed out to us. We viewed these constraints as severe, and recognize them as causes of many of the aspects of incompleteness we identify in our report.

Introduction

It is not our task here to conduct a comprehensive review and critique of OTA's report on steel. Rather, our task is to "determine the changes in treatment, emphasis and presentation which would have occurred" had the original assessment been done using the R & C methodology for management overview.

The changes we identify are all considered by us to be improvements. Our retrospective study will therefore appear to emphasize negative features of the report; such a result is inevitable. The R & C methodology has been refined throughout the study of several OTA assessments. As a natural result, it is designed to produce reports containing the most useful features and approaches we have discerned in OTA's reports. These very desirable properties of the OTA reports are, of course, not identified in our search for "changes." Moreover, our analysis makes no allowance for OTA's constraints of time and budget.

The "Steel" study was chosen as the first on which to refine our previously developed methodology for the following reasons: there was a substantial amount of highly-specialized technology to consider; there was a firmly established infrastructure (the Steel Industry) which could not easily or rapidly be changed; there was a wide range of interests and affected parties, with divergent "hard" issue concerns and ideological points of view; there was a significant impact on a national scale. Furthermore, we received it first in the mail. It would be a difficult and challenging assessment to do by any methodology.

Our retrospective analysis has been developed by comparing the OTA report with appropriate aspects of the "Desirable Characteristics of Procedures and Reports" which are in the Introduction to the R & C methodology in the previous section of this report. In particular, our checklist is based on paragraphs C and D of Part I, since they are the ones that explicitly deal with the desireable characteristics of the reports themselves. All our retrospective analyses contained herein are most usefully read after the preceding section on our methodology.

Conclusions drawn regarding the differences between the present report and one which might have been prepared with the R & C methodology are supported by citing specific examples, where useful. However, no attempt is made to exhaust such examples.

Explanatory Note

As part of this retrospective comment on "Steel," we include a list of first iteration Focus Questions organized by Fundamental Concern and generated by application of our methodology. This list follows our discussion of identified "changes," and we refer to them herein by number. In Appendix A to this "Steel" retrospective, we include the lists called "Present Situation, Causes and Projected Trends." In Appendix B, the list of "Representative Option Mixes;" and in Appendix C, the "Implications of the Representative Mixes." The process which generated these three appendices was described in the preceding section on our methodology. We do not refer to these appendices explicitly in this retrospective. They are worksheets, and are included as illustrations of the mechanics of our approach. They would not appear in any published form of an assessment report.

In our preceding methodology description, paragraph IC addresses the general question of the "Completeness, Objectivity and Soundness of the Report." The creative tension generated, e.g., in a group discussion, by the identification of issues raised by the four Fundamental Concerns tends to ensure the consideration of all important study aspects. The consolidation and sharpening of these Focus Questions as they converge to their final form makes it highly likely that no important issues will be missed. Below we give some examples of where the OTA "Steel" report falls short of attaining specific desirable characteristics.

Completeness

In our methodology, three first-iteration Focus Questions

arose (17, 19, and 20 of the attached list) which respectively relate to the importance of a steel shortage on armaments production, the possible mitigation of a shortage by a "National Steel Stockpile," and the likelihood and probable impact of cartels, etc. Although the answers to these questions are not known to us, they seem questions that can reasonably be analyzed. They are not addressed in the OTA report. This omission occurs in spite of the fact that the report repeatedly stresses a healthy steel industry as being "vital" to the national security. There is, in fact, almost no analysis to support this assertion, and yet it forms a cornerstone of the rationale for the OTA "Renewal Option." An analogy with the situation of oil is explicitly assumed, but no analysis is given exploring the similarities and differences between Oil and Steel, and thereby possibly demonstrating the appropriateness of the analogy.

Focus Question 11 (Free Market) would have forced the discussion of the important economic point of view that free market forces should be allowed to prevail. Such an argument would disagree with aspects of the OTA "Renewal Option." Free Market considerations were important in, say, the discussion of the loan guarantees for Chrysler and would probably be raised in discussions of the Steel Problem. While extensive analysis of various economic theories is not called for in a technology assessment, such views warrant mention and summarizing. We have not seen the AISI document referred to in the OTA report, which forms the basis of the "High Investment Option." Perhaps it included such economic thinking? The OTA report would have been significantly more complete had it included some brief summary of the AISI document, which was so significant for the report. We do understand that there was a problem here in

that the AISI document was being prepared simultaneously with the OTA report.

Focus Question 10 (Dislocations) would have produced a consideration of specific economic and geographical dislocations that would come about in a decline of the steel industry. Such apparently readily developable information does not appear in the OTA report. (One would think such data would be of considerable interest to Members of Congress.)

Focus Question 13 (Effect of Policies on Prices) would stimulate an analysis of steel prices that would be likely under the various options. Question 24 (Equitable Treatment?) would require a more complete analysis of the justifications for singling out Steel for special treatment. Specifically, and probably of considerable interest to certain Members, would be some study of other industries which would at least perceive themselves to be in a similar situation. Neither of these two issues is treated in any detail in the OTA report.

Because of the lack of completeness of approach, some important policy options were also not raised. Since the analogy to oil was implied, why was the question of a National Steel Stockpile (like our "Strategic Petroleum Reserve") not raised -- at least to dismiss, if that would be appropriate? It would not have been out of order to at least mention the possibility of legislation restricting diversification out of Steel (as has been proposed for Oil). Are the steel industry's problems actually so unique? (e.g. how is the automobile industry really different?) Perhaps

some options that apply to all or many industries would be appropriate. What is the prospect of encouraging industry/worker or industry/worker/government partnerships that seem to function well in other countries? These options seem to be somehow ruled out in the OTA report, but analysis supporting exclusion of such policies is absent or weak. These options would all be raised for specific analysis by our methodology. If they could not be analyzed, that fact, in itself, is important information.

We believe that the report could treat most of these areas of incompleteness without being significantly larger, in bulk, at least. Some of them seem important enough to be included even with a very tight budget and time scale. If the treatment of some of these topics was limited by the original scope of the report, that fact, and reasons why a report with so limited a scope is useful, should certainly have been made clear.

Perhaps the most serious aspect of omissions of relevant analysis is that it leaves the report open to unwarranted attack and discrediting. Weak or invalid analysis can readily prevail over no analysis.

Uncertainty:

It is possible that some issues were not treated in the OTA report because it was felt that the associated uncertainty was too great. If that were the case, such could be mentioned (and it would help protect the report against criticism accompanied by bad analysis of the same issue). In some cases where uncertainty exists, the issue is so important that "worst case" scenarios ought to be presented. These are explicitly suggested in the R & C methodology

for difficult, but crucial, Focus Questions (e.g. 17 and 20).

Analysis and Value Judgments:

While there is no guarantee that any methodology will eliminate the introduction of implicit value judgments, a major aspect of the R & C methodology is the projection of the issue onto the Fundamental Concerns. This will minimize the occurrence of value judgments buried in the depths of the report. One would, of course, hope that an attitude of neutrality would prevail in the analysis to a considerable extent.

The major way in which the OTA report displays a strong value judgment is its favoring of the OTA-generated option, the "Renewal Option." Further, the favoring of the "Renewal Option" by a large number of subtle study decisions results in the perception of a biased treatment of the other options. The inadequate treatment of the negatively-named "Liquidation Option" is perhaps the major example. The "High Investment Option" was also never developed as clearly as the "Renewal Option." Any such favoritism shown the OTA option makes one leery of accepting the report at face value. The R & C methodology forces neutrality in such a way that significant bias is hardly likely.

Support of Opinions By Analysis:

Focus Questions force explicit analysis,or the admitted inability to analyze, every important opinion expressed by the analyst. We see many examples in the OTA report of unanalyzed opinions expressed by the analyst. The importance of the steel industry to national security and the analogy with oil are two important ones that we have detailed earlier in another context.

Identification of Trade-offs:

A natural consequence of the attention to each of the Fundamental Concerns is that all important trade-offs will be surfaced for consideration by the ultimate decision makers. This is not so in the OTA report. For instance, the effects of policy options on steel prices, and the consequences of the government adopting a special steel-sector policy are alluded to, but they are not analyzed in any detail. These trade-offs therefore do not appear in clear view. The effect of the various options on pollution is mentioned as "... not ..... thought unimportant." But it is not treated "because of the scope of this study... ." It would appear to us that in the debate to take place in Congress, issues such as these will be important. Statements about these trade-offs in the OTA report would make it a far more valuable resource in such a debate. The data required do not seem the kind that would be difficult to acquire and analyze. The fact that such data are missing allows the effects to be exaggerated. Their absence also makes the OTA report seem more slanted toward the OTA "Renewal Option."

Severely Critical Review:

Many of the points we have mentioned above would subject the report to damaging attack without the need for a firm basis for that attack.

Unresolved Questions:

The R & C methodology's Focus Questions are generated from the Fundamental Concerns, and their prominence does not depend on their answerability. Those that turn out to be unanalyzable or just unresolvable within time and budget constraints would be

explicitly presented as remaining unresolved questions. They would appear in the report as such, and, perhaps, directed to other agencies for appropriate investigation. In the OTA report we see some such unanswered questions listed as "policy options" which call for study. Other important ones are missing.

Paragraph ID of our list of desirable characteristics addresses several aspects for the "User-Orientation" of the report. We now discuss ways by which this desirable general characteristic would have come about had the report been prepared by the R & C methodology and compare this with the present report.

Enable Easy Access to Information:

A report prepared by the R & C methodology could have a wide variety of formats. However, the collection of Focus Questions under the Fundamental Concerns presents the organizer of the report with a natural arrangement of material that largely reflects user interests. If the report reflected that organization in some way, easy access to specific material of concern to the user would be a consequence. We do not understand why the OTA "Steel" report is organized the way it is, but it is certainly difficult to locate the material one seeks. The first few chapters, at least, have a great deal of overlap and even repetition. Because of this, one is never quite sure when reading about a specific issue in the report whether that was the definitive statement on that issue, or whether another important aspect will crop up elsewhere in the report. At other times one may look for a treatment of a certain point for a long time without ever being sure that it was not missed somehow.

Avoidance of Vagueness:

Focus Questions demand specific analytical answers or the gathering of specific information. Questions which cannot be answered would be so identified and the reasons for that inability given. A report based on such questions would not be vague -- and would probably not even be dull.

The OTA report is not generally written in vague language. However, statements which are not vague are often unsupported by analysis, or the analytical support is hard to locate. Important material is so widely distributed with a not-easily-fathomed organization, and so mixed with unimportant or repetitive material, that there is a sense of vagueness.

The policy options of the assessment as stated in the summary of the chapter entitled "Policy Options" would presumably form a crucial part of the report. Several of the "bulleted" options listed (pages 27 and 28) as those the OTA's analysis considers are vaguely stated, but this is perhaps a quibble.

Well Organized Display of Options:

The options for Congressional action which have been developed and analyzed must form one of the most important outputs of the technology assessment. We would expect them to be explicitly displayed in one place, or at least organized in some other accessible way. However, we find "options" distributed in many places throughout the OTA report. This is partly due to the multiple meaning of the word "option" as used in the report. In the R & C methodology, all options are collected and refined in Step B. They would be

clearly displayed in some appropriate location in the report.

Include Only Relevant Material:

All the information analysts, consultants, etc. are to provide is to be addressed to specific questions. The responsibility of the analysts includes ascertaining that the assigned questions are, in fact, the appropriate ones, and to ask for changes when they find such warranted. But there are always specific questions in front of the analyzer. This tends to preclude the presentation of less-than-relevant material by the analyzers.

We see a considerable amount of material in the OTA report that does not appear, in any direct way, to answer any important question. The material we refer to is not connected by any followable argument presented in the report with the Congressional options presented. We cannot imagine that any substantial amount of such data presented in the report was analyzed by the OTA. If so, the rationale for doing it is not evident. It therefore does not seem appropriate to "stuff" a report primarily prepared for Members of Congress and their staffs. Mere background information that might be of interest for someone doing a more detailed study than was done by OTA could well be referenced in an OTA report, but need not be presented. At most, such information could be included in an appendix and isolated from the material of immediate concern. It is very expensive to the user of a study to have to wade through material he finds extraneous. The elimination of such material would certainly allow many of the important omissions to be considered without increasing the bulk of the report (but, perhaps, at more expense).

Compact Treatments of Technical Aspects:

A desirable characteristic for an OTA report in the list in our Methodology Section was: "Present relevant technical issues at the appropriate level(s) ... ". There is nothing in the R & C methodology, per se, which addresses this problem explicitly. But the central thrust of the methodology was very much addressed to match the needs of the intended audience, and we do not expect that this need would be difficult to meet.

The OTA report on Steel treats technical issues well in the appropriate chapters. The treatment is, however, more extensive than one which would be avidly read by the principle audience. There are a few good short technical treatments in the main body of the report. The OTA report would be enhanced by the addition of more small diagrams, each with a short paragraph or two, describing technological aspects. They could be set off in boxes, as is done in NEWSWEEK and TIME, for example, to indicate that the main text is readable independently of these. Such a presentation would emphasize the technological aspects of the questions treated by OTA. As it is now, the OTA reports could be perceived as dealing primarily with political and economic issues because the Congressional audience probably emphasizes those chapters.

"Contents" and Index:

We believe that the value of the report would be so greatly enhanced by the addition of a comprehensive table of contents and an index that the extra cost would be well worth while. The lack of a comprehensive table of contents and, especially, an index, was particularly troublesome in the Steel report, where the chapters

tended to overlap with each other. We often found ourselves spending time seeking a piece of information we had previously seen in the report.

FOCUS QUESTIONS (A First Iteration)

References in italics refer to the lists in Appendix A

I. ECONOMIC

1. The present economic health of the steel industry (*from Econ a thru h and 1*)

   What is the present situation (i.e., rate of decline, use of old technology)?

   What are the causes of the steel industry's problems (i.e., the history)?

   What is the amount of diversification out of Steel?

   Why is so little capital presently attracted to Steel? (E.g., return on investment relative to other basic industries)

   Present an economic analysis of the possible introduction of new technological processes (E.g., what would be the return on investment of a continuous casting mill with today's conditions?)

   How much do high steel wages contribute to the industry's poor health?

2. The attraction of new capital to Steel (*from Econ. d,1*)

   What must be done to attract more capital to Steel? What return on investments will be required? What other assurances might be needed? (E.g., stricter enforcement of MLT-agreements?) (These questions might be answered in part by soliciting the opinions of potential investors in Steel.)

   How effectively do the option mixes considered attract new capital?

   How do various amounts of new capital into Steel affect the industry? How is such capital likely to be used?

3. Foreign competition (*from Econ i, 1*)

What is the present world position of the U.S. steel industry?

What are the differences in foreign steel industries that produce advantages (and disadavantages) for them relative to the US industry?

How is the world position of the US steel industry likely to be affected by the options considered? Address the particular question of steel used in the US.

4. New Technologies (*from Econ. 15, f, j*)

What are the characteristics of new technologies which are currently implementable?

> Economy of production? Energy efficiency (e.g., consider various types of energy and economic implications)? Pollution produced? Adaptability to changing markets? Size of plants needed? The cost to implement various kinds? Quality of product? Etc., etc.

What are the characteristics of technologies on the horizon?

> The answers to the questions asked above for existing technologies should be reasonably estimable for the ones to become implementable in a decade. At least a best guess should be possible and useful.

What are the implications of various scenarios for the implementation of new technologies? What longer term options are precluded by steps the industry might take in the near future.

Discuss these questions in terms of the option mixes considered.

5. Research and Development (*from Econ. h, 1*)

How much R&D is done in the Steel industry (compared to, say, the auto, copper, and electronics industries)?

Is there good reason to believe that more R&D would help the industry? Is the industry prepared to make use of it?

If R&D would be valuable, why is there is so little done?

Is it largely tradition and attitude?
Are there bad past experiences with little payoff on R&D?
Is the R&D needed the kind that would help the industry as a whole but does not accrue to the benefit of the particular company paying for it?
Are there legal impediments to joint research, etc?

What are the specific impacts to be anticipated from research and development? (In an area as applied as steel production R&D should have reasonably assessable outcomes.)

What types of research programs are reasonable? (Lab work on metallurgy? How important is this inexpensive type of work? How important are expensive pilot plants?)

How can a more effective use be made of R&D elsewhere, e.g., Japan (including the already accomplished R&D)?

How might government regulations improve the kind and amount of R&D done? How is R&D affected by the amount of capital available to Steel?

What would be the effect of the various options on R&D?

6. To what extent is steel replacable by other materials?

What is situation now and in the foreseeable future?

How do possible increased steel prices change things? (E.g., plastic pipe is finally getting really big.)

7. Balance of Trade (*from Econ i, 1*)

What is the importance of Steel's present and projected negative impact on the overall balance of trade?

Is there a potential of a significant positive effect on the balance of trade of a modern U.S. steel industry?

How effective would more capital into steel, as options suggest, be in bringing this positive effect about (or reducing the negative effect)?

Include the effect of specialty steel in this analysis.

8. Scrap use and scrap exports (*from Econ k, 1*)

How much of our "abandoned" steel do we utilize? Consider this by types of use (e.g., cars, buildings). What considerations determine the use of scrap? How would these be affected by a more modern steel industry?

How much "embodied energy" are we exporting as scrap? What kind of energy is it effectively? (Does it replace oil or coal or electricity?)

How does scrap situation develop under the options considered?

Export restrictions on scrap: What kinds of restrictions? How effective? Do they exist for other products of this nature, i.e., advanced computers and uranium restrictions have different rationales.

9. Consequences of a heavy reliance on imported steel and the possible occurrence of an international steel shortage (price rises from unavailability). (*from Econ 2,3*)

What will be the impact on the U.S. economy for various levels of shortages or price increases? (In addition to general information on this, extrapolation from the "experimental data" generated by past steel strikes and price rises might be useful).

How rapidly could our steel industry respond to supply the "missing steel"? How expensive would it be to rapidly increase capacity? (See similar question under 17 in National Security).

What is the time-scale and degree to which the options considered would eliminate this concern?

10. Unemployment and geographical economic dislocation. (*from Econ 4, 6*)

How much, where and when will it come about under the various options?

(See similar question under 25 in SE&OSC).

11. What would be the economic benefits (or disbenefits) in allowing the international free market to determine the level of all imports in general and steel in particular?

What steel import levels would be likely?

What steel prices would be likely?

What will be the general impact on the US economy of allowing free market forces to determine all imports. (This is an unanalysable question, but very important divergent opinions exist, will play a major role in the discussions, and should be summarized.)

12. "Steering" of capital to steel (and away from other industries?) (*from Econ 10*)

How much of the available capital does directing it to the steel industry take from other industries? Do the proposed options largely generate "new" capital?

(This is not a readily answerable question. The range of economic thinking on this should be outlined and the implications for the redirection of capital by the government should be briefly reviewed.) (See similar question under 19 in National Security.)

13. What are the likely effects of options considered on steel prices?

14. Restructuring of the steel industry (*from Econ 8*)

How will the steel industry be redistributed among integrated steel, non-integrated steel, and specialty steel over the next five, ten and fifteen years as a result of the various option mixes considered. (Consider likely technological changes.)

What will be the geographical implications of this? (Which areas are hurt and which helped?) (See similar question 25 in SE&OC)

15. The general impact of a declining steel industry on the nation's economy and the inflation/recession question.

What is the effect on GNP?

If the steel industry is allowed to decline does this cause other industries to benefit? (Related to other questions, e.g., 11 above).

Is this an analyzable question? Perhaps just collect some representative expert opinions.

16. Aspects of government/industry/labor partnerships in other countries.

What changes in US laws might be needed?

What changes in US attitudes might be needed?

What are the conflicts with our general philosophy?

II. NATIONAL SECURITY

17. The (un)availability of steel for the manufacture of armaments *(from Nat Sec a, 1, 2)*

Is the present dependence of imports negligible in this regard?

What is the threat of a dependence on imports? (Consider this for various domestic steel capacity levels)

When would our capacity be at the above levels if the steel decline continued? What are the present trends and effects of various option mixes?

What is the time-scale for increasing our steel capacity in a critical situation? What will be the expense and manpower needed?

It is especially important to consider the level of uncertainty in the answer to these questions.

18. Need for "National Security Steel Stockpile" if the steel industry is allowed to decline *(from Nat Sec 1, 2, 6)*

Would a National Steel Stockpile be effective?

How much, what materials, how fast and how expensive to accumulate?

What are the secondary economic benefits of accumulating a stockpile? Help put the industry on its feet? Smooth out demand for steel? Give government control over steel supply, pricing, etc.? (Government could, for example, mandate a certain percentage be made by continuous casting techniques)

What about other strategic metals? (e.g., chrome)

Compare the situation to oil.

How do the scenarios expected under various options change answers to the above question?

19. Capital requirements of defense related industry other than steel (*from Nat Sec 7*)

If the government were to adopt a policy of "steering" capital to certain troubled industries (i.e., a program which in total was larger than that for Steel) could this cause a capital shortage in certain defense related industries?

What industries might be affected and should therefore be included in capital "steering" decisions?

20. Potential for cartels, blackmail and world instability if US relies on imported steel (*rom Nat Sec 2*)

To what extent is the situation similar to that of oil?

To what extent can one evaluate the likelihood or seriousness of the problem?

What sort of defense against cartels, etcs., is feasible (e.g., stockpiles)?

It is especially important to consider the limits of uncertainties of these answers.

III. ENVIRONMENT

21. Pollution and other environmental problems of steel production (*from Env a thru 4*)

What are the environmental problems? What type? How significant?

What are the environmental benefits to the U.S. of importing a major portion of its steel? Of increased use of substitute materials?

To what extent is the environmental problem international (e.g., acid rain)?

What are the costs to the industry of correcting pollution to various levels? Relate these levels to present EPA standards and to proposed (relaxed) standards.

What are the environmental effects of the options considered? Consider also the effects of the restructuring of the industry that might come about.

What are the environmental implications of new technologies now available or on the horizon? What energy sources should be favored in this regard?

22. Environmental Research and Development (*from Env c*)

What applicable environmental R&D is now being done? Who supports it? Include what is being done in other countries and the possibility of cooperative international programs.

What types of R&D would be most useful?

What are the reasonably likely outcomes?

How broadly applicable (e.g., to other industries) would such R&D be?

How can the government stimulate appropriate R&D?

What effect would the options considered have on environmental R&D?

IV. SOCIAL EQUITY AND OTHER SOCIAL CONCERNS

23. The same question as 21 under Environment but with respect to job hazards and OSHA regulations (*from SE&OSC b, c, 3*)

24. Potential pressure for treatment equivalent to that given to Steel by other industries with situations at least *perceived* as similar to that of Steel (e.g., auto, electronics, leather) (*from SE&OSC 2*)

    How pervasive is such pressure likely to be? Now and in the future? Identify likely cases and give some specific justifications for treatment similar to that given steel. Emphasize the technological aspects (i.e., which U.S. industries are technologically behind other countries and which ones are likely to soon become so?)

    In what ways is the Steel situation (almost) unique and therefore justifying special treatment?

    What are the implications of allowing the treatment of the steel industry to apply to all industries?

    Answer the above in terms of the Option Mixes considered.

    (The above questions are not easy to answer with much certainty. But the details of the answers are not that important. However some assessment is needed and there exists data that can be fairly readily gathered and interpreted.)

25. While the major effects on employment, etc., are treated by questions under Economy, economic *inequities* which may arise warrant some consideration here as well.

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APPENDIX A

PRESENT SITUATION, CAUSES AND PROJECTED TRENDS

THE FUNDAMENTAL CONCERNS

I. Economy

Present Situation (and Causes)

a. Declining integrated steel industry

b. Low integrated steel profitability because . . .?

c. Diversification of companies out of steel because of higher returns on other investments

d. Little new capital into steel

e. Steel industry wages high compared to other industries and other countries' steel industries

f. Use of old technology and little implementation of new

g. Costly, energy-inefficient and energy intensive plants and processes

h. Little R&D because of tradition (?), high costs (?), and low payoffs (?)

i. Steel imports contribute to poor balance of trade

j. Non-integrated and specialty steels doing better

k. Scrap use small, export of scrap (and "embodied energy") because of ... (?)

l. Existing pressure for special treatment for steel industry in several respects.

Projected Trends

1. Exacerbation of the present situation

2. Possible steel shortages and resulting effects on economy

3. Higher steel prices leading to increased inflation/recession

4. Increased unemployment in steel, coal and related industries

I. Economy (continued)

5. Increased available labor supply for other industries

6. Geographical economic dislocation

7. Decrease in status of U.S. as a world power

8. Increase in foreign sales of other U.S. products because of increased available dollars in foreign countries due to our steel imports

9. Because of large scale decline in industry, rising import levels of steel is accepted, therefore lower prices and other "free market" advantages

10. More capital available for other industries

11. Improved profits for shipping industry

12. Domestic surplus (ready availability) of scrap and coke -- no coke imports

13. Restructuring of U.S. steel industry (decline of integrated companies with respect to others)

14. Increased use of substitutes for steel

15. Little new technology use in integrated steel

16. Less government control over steel prices

17. Little government involvement in the steel industry

18. Pressure to nationalize the steel industry or pressure for very great government control in order to reduce our dependence on steel imports

Indirect Projections

National Security

19. Economic disruption due to selective use of steel for armaments (from 1 in Nat. Sec.)

20. Higher defense budgets (from 3 in Nat. Sec.)

Economy

Environment

21. Economic costs and benefits of air and water pollution (from Env.) and land use

Soc. Eq. & Other Gen. Wel.

none to be analyzed

II. National Security

Present Situations and Causes

a. Some dependence on imported steel for military use?

Projected Trends

1. Potential unavailability of steel for armaments
2. Potential for steel cartels and political blackmail
3. Decrease in world-wide stability because of dependence on others for critical material
4. Increase in world-wide stability because of greater trade interdependence
5. Reduced world-wide image of U.S. as a major power because of dependence on imported steel
6. Alloy component (e.g., chrome) unavailability

Indirect projections

National Security

Economy

7. Other defense-related industries may be strengthened by the increased availability of capital and labor (from 5, 10).

Environment

none to be analyzed

Soc. Eq. & Other Gen. Wel.

none to be analyzed

III. Environment

Present Situation (and Causes)

a. Pressure to relax EPA controls of integrated steel industry in order to make a more profitable industry

b. Old integrated steel mills yield high pollution

c. Little anti-pollution R&D because of high costs involved.

d. Energy inefficient processes and plants requiring more energy production pollution (e.g., coal mining)

Direct Projections

1. Relaxed EPA controls in steel leads to more pollution

2. Relaxation of EPA controls in steel may force relaxation elsewhere leading to general deterioration of environment

3. Less land use, environmental deterioration and pollution because of less steel production

4. Less (or is it more?) electricity required and associated environmental degradation

Indirect Projections

National Security

none to be analyzed

Economy

5. Inflation/recession brings pressure to relax environmental restrictions generally (from 2, 3, 4, etc. in Econ.)

Environment

Soc. Eq. & Other Gen. Wel.

none to be analyzed

IV. Social Equity and Other General Welfare

Present situation (and Causes)

a. High steel worker wages (compared to other manufacturing) because of strong union? or government involvement in establishing steel prices(?)

b. Hazardous old mills

c. Pressure to relax OSHA controls in order to make steel industry more competitive with foreign countries

Direct Projections

1. Selective (largely negative) impact on certain population sectors, e.g., unemployment, decrease in relative steel workers wagers, geographical impact

2. Inequities towards other sectors of the economy due to the possible special treatment of steel industry by the government

3. Eliminaton of particularly hazardous jobs

4. Less government involvement and subsidies for industry and other advantages of "free market" economy

5. Deterioration of national self-image because of dependence on foreign sources for an important commodity we once produced

Indirect Projections

National Security

6. Deterioration of general welfare because of perception of world instability

7. Inflation/recession impacts more strongly on certain population sectors (from 3, i in Econ.)

8. Inflation/recession brings pressure to relax OSHA regulations creating more job hazards (from 3, i) in Econ.)

Environment

none to be analyzed

Soc. Eq. & Other Gen. Wel.

APPENDIX B

SUMMARY OF REPRESENTATIVE OPTION MIXES

Rep. Op. Mix A: the "little change from what is done now" mix.

Consider a "National Security Steel Stockpile"

Rep. Op. Mix B

The intermediate or "Renewal" option (OTA's option?)

Capital Formation

- Number of government programs (loan guarantees, tax incentives, etc.) that have detailed impact on development of steel industry
- No change in present price policies

R&D

- Increased government support, with identification of and emphasis on "basic" research. Support given to industry, research centers, universities
- Changes to allow cooperative research (i.e., relax antitrust restrictions)
- Gov. support of small pilot plants
- Incentives for industry R&D support
- Government provisions for(?) reviews and analysis of foreign technology

EPA/OSHA Controls

- Better matched regulations between industry abilities and societal benefits. Use C/B analysis

Rep. Op. Mix C

The AISI or "High Investment? option

Capital Formation

- Regulatory changes to aid very rapid capital recovery (e.g., accelerated deprec.) (For steel industry alone? yes)
- "Free market" steel pricing; No "jawboning"

R&D

- Increased government support of research with no differentiation of "basic"
- Government support of expensive pilot plants
- Relaxed antitrust restrictions on cooperative research

EPA/OSHA Controls

- Mandate only that needed for public health and justified on a C/B basis (i.e., substantial relaxation of present controls?)

SUMMARY OF REPRESENTATIVE OPTION MIXES (Continued)

EPA/OSHA Controls (continued)

- Allow short-term compromises for long-term improvements with more modern facilities and techniques (e.g., EPA innovation waivers, coordinate OSHA compliance deadlines)

Raw Material

- Regulation to decrease the export of scrap ("embodied energy") and increase domestic use

  Restriction on exports

  Tax incentives to encourage domestic use

  Regulations to foster inexpensive scrap transport

Raw Material

- Allow free market forces to control scrap use and export

Trade

- Strict enforcement of MLT agreement to control imports
- Increase exports of high technology steels

Trade

- Strict enforcement of MLT agreement, etc., for control of imports

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APPENDIX C

IMPLICATIONS OF REPRESENTATIVE OPTION MIXES

Rep. Op. Mix C

(the letters and numbers in lists refer to those items in Appendix A)

I. Economy

(a) Decline halted (?)

(b) Considerably increased integrated steel profits

(c) Reduced diversification out of integrated steel

(d) Large amounts of new capital into steel

(e) Increased pressure for higher wages because of higher steel prices and profits. Could fuel an inflationary spiral.

(f) No significant change except for new pilot plants in the short run. Adoption of new technology delayed for some time (?)

(g) New modern plants should be more energy-efficient but heavy commitment to old technologies due to rapid expansion in that form (?)

(h) Increased R&D but with little emphasis in basic research

(i) Substantial decrease in rate of imports with rise in eventual net exports (?). Improved balance of trade in steel (overall?)

(j) No significant change from present

(k) No change in use of scrap or the exports of scrap (?)

(l) Pressure yielded to as specified by the integrated steel industry.

I. Economy (continued)

(1) Mentioned above

(2) Expanding U.S. steel industry--no shortages

(3) Higher steel prices, increase in inflation (?). Help reduce recession (?)

(4) Increased employment in steel and related industries

(5) No extra labor supply available

(6) Halts dislocations

(7) Halts decrease in status

(8) Fewer dollars available in foreign countries because of less steel imports, hence decrease in the purchase of other products (?)

(9) Halts decline in steel industry resulting in substantially less imported steel eventually, but with short term (?) need for trade restrictions

(10) Substantially less capital available for other industries

(11) Less profits for shipping industry

(12) Adequate scrap supply, but possible shortages of coke

(13) Little government control of steel industry's development. No large scale restructuring of the industry.

(14) Less incentives to seek substitutes (?)

(15) Some short term new technology in steel but the precluding of long term introduction of major newer advances (?)

(16) No government involvement in setting steel prices

(17) Little government involvement in the development of the steel industry other than imposing severe import restrictions and funding pilot plants

(19) Unlikely to occur

(20) This reason for higher budget eliminated

(21) Economic costs of pollution, etc., rise, perhaps substantially.

II. National Security

(a) Less dependence on imported steel for military use in the short run -- none in the long run(?)

(1 through 5) These concerns may be eliminated if Option C is adopted.

(6) Remains a concern for the specialty steel industry

(7) Capital and labor less available for other defense related industries as capital is steered to steel

III. Environment

(a) Significant relaxation of EPA regulations

(b) Old mills phased out or rebuilt--new mills yielding high (?) pollution

(c) Little environmental R&D

(d) Improved energy efficiency but little development of very modern technology

(1) EPA regulations considerably relaxed (?) and consequent increase in pollution

(2) Increased pressure to relax EPA regulations for other industries

(3) Greater production of steel may yield higher levels of pollution, increased land use and an increase in general environmental degradation.

(4) Electricity use scales with increased production. No unusual increase

(5) Lessened (?)

IV. Social Equity & Other General Welfare

(a) Even greater wage increase demands as steel profits rise substantially

(b) Old mills phased out or rebuilt

(c) Significant relaxation of OSHA controls and some consequent hazards

IV. Social Equity & Other General Welfare, continued

(1) Selective impact on certain populations centers is mostly positive, e.g., increased employment and wages. However, levels of pollution will increase.

(2) Manifest special treatment of integrated steel will have political ramifications if government stipulates that the changes only apply to the steel industry and not in general.

(3) Increase (?) of partially hazardous jobs, at least in short run (?)

(4) More of a "free market" in some respects, but not with respect to international trade, but also special (?) government treatment

(5) Lessened

(6) Lessened

(7) Lessened (?)

(8) Lessened (?)

Rep. Op. Mix B

I. Economy

(a) Reduces decline in steel industry with eventual reversal

(b) Moderate increase in steel profits

(c) Decrease in diversification out of integrated steel (?)

(d) Substantial increase of capital for steel

(e) Modest pressure to increase wages

(f) Emphasis on developing new technology in longer run

(g) Paced expansion of energy-efficient facilities to allow for development of technologies not yet available

(h) Substantially increased R&D with substantial emphasis on basic research

(i) Moderate decreasing rate of steel imports with eventual rise to net exports. Moderate improvement of balance of trade with respect to steel.

I. Economy (continued)

(j) Moderate improvement in the non-integrated and specialty steel areas

(k) Substantial increase of scrap use and substantial decrease of scrap exports

(l) Pressure yielded to but with concerns in addition to those of integrated steel's taken into account.

(1) Mentioned above

(2) Potential shortages considerably reduced

(3) Possible help in checking inflation/recession but steel prices may still rise (?)

(4) Modest increase in employment in steel

(5) No increase in labor supply availability

(6) Much less dislocation

(7) Halt decrease in status

(8) No significant change from the present (?)

(9) Slow decline in imports and eventual lack of need for trade restrictions (?)

(10) Moderately less capital available for other industries

(11) Shipping industry profits will remain at the present levels as far as steel is concerned

(12) Possible domestic shortages of scrap and, less likely, of coke

(13) Substantial restructuring of steel industry

(14) Improved R&D could lead to steel industry competing better with substitutes

(15) Phased introduction of new technology with options kept open (?)

(16) No change in price policy

(17) Substantial government involvement in setting trends (?)

I. Economy (continued)

(18) Less pressure to nationalize steel industry

(19) Less likely to occur

(20) Higher defense budgets because of this reason less likely to occur

(21) Moderate rise of economic costs of pollution, etc.

Rep. Op. Mix B

II. National Security (done by comparing each item with the corresponding one in ROMC)

(a) No change

(1 through 5) Degree of impact of these concerns all lessened

(6) Remains a concern for specialty steel

(7) Capital and labor somewhat less available for other defense related industries as capital steered to steel

III. Environment

(a) Modest softening of present EPA regulations

(b) Slow change in integrated steel pollution. Slow conversion to less polluting integrated steel facilities

(c) Considerable antipollution R&D

(d) Modest increase in energy efficiency in short term but significant long term improvement

(1) Slightly more short term pollution but less pollution in the long run

(2) Moderate pressure to adjust EPA controls for other industries, at least in short term

(3) Increased steel production will result in more pollution, land use and overall environmental deterioration

(4) Significantly greater amount of electricity required because of emphasis on electric furnaces (?)

(5) Lessened (?)

IV. Social Equity and Other General Welfare

(a) Slightly greater wage demands as steel industry becomes more profitable

(b) Old mills improved somewhat and eventual phase in of new technology

(c) Improved coordination of OSHA compliance schedules with steel industry's requirements. Perhaps slight decrease in safety in the short term but in the long run, safety will be increased because of conversion to new technologies.

(1) Small selective impact, both on the positive and negative side (?). Slight increase in steel wages and employment (?)

(2) Increased pressure by other sectors of the economy for similar "favored" treatment by the government.

(3) Slight increase in hazardous jobs

(4) Substantial government involvement

(5) Lessened

(6) Lessened

(7) Lessened (?)

(8) Lessened (?)

During his undergraduate days in Boston, one of us (PFD) had the great good fortune to hear a lecture by the renowned physicist, Victor Weisskopf. After the lecture (dealing with recent advances in high energy physics) was over, a young assistant professor penetrated the throng surrounding the great man and proceeded to describe in considerable detail his idea for an experiment which he obviously felt would provide a great leap forward. On receiving no spontaneous response from the distinguished lecturer, he pursued his quarry: "Well, should I do the experiment?"

I shall not forget Dr. Weisskopf's reply: "Vell, dot depends. Vot vould you be doing instead?"

The assessment topic of energy from biomass differs in two fundamental ways from the class of topics represented by "Technology and Steel Industry Competitiveness." First, the steel industry is a major ongoing national and international business activity. Any plausible contemplated government policy interventions could make only incremental changes in the status quo in, let us say, five years time. This is not to belittle the potential significance of any such actions; but in the case of energy from biomass, most present activities are small enough in scale that government interventions already extant or under serious discussion could plausibly change the level and scope of the ongoing activity by literally orders of magnitude, and within a relatively short time.

The second key contrasting characteristic is substitutability.

Steel, as a material, is so well suited for most of its present applications, and so deeply embedded in the infrastructure of thousands of activities, that substitution of other materials is at best a lengthy incremental process -- often contemporaneous with the development of new uses for steel. Energy from biomass, on the other hand, is in all its various forms essentially perfectly substitutable for and by a wide variety of energy fuels and sources, both existing and in widespread use, and under exploratory development.

As a consequence, in order to answer with any confidence the question, "Should we push for a major increase in energy from biomass (in its various forms)?" we must first answer two other questions: "What would things be like if we did?" and "What would we be doing instead, and what would things be like then?"

In applying our management overview methodology to the energy from biomass topic, we find that most of our additions to the emphasis and content of the OTA report constitute specification of, and intercomparison with, non-bioenergy alternatives to particular bioenergy cycles--rather than specification and evaluation of bioenergy systems per se. We find that OTA did an admirably complete job in the latter area.

As in the case of our two other retrospective analyses, our task here is not to undertake a comprehensive review and critique of the OTA effort, but rather to provide a summary of the changes in content, emphasis and presentation we expect would have resulted from the application of the R & C management overview methodology

at the outset of the study.

To accomplish this task for the "energy from biomass" retrospective, we present below, with associated comment in most cases, a list of key focus questions (topics) which either were not substantively addressed in the OTA report, or which in our approach would receive substantially more detailed treatment or emphasis. These focus questions are once again, as in the case of "Steel" grouped with reference to the desirable report criteria listed in I C and I D of our management overview methodology. These key questions have been drawn from a much more extensive first-cut list of focus questions grouped under the rubric of our Four Fundamental Concerns in a manner quite analogous to the list in the preceding "Steel" retrospective. This lengthy list is not included here. Many of the questions in it were very well addressed in the OTA report.

The listing and discussion of key focus questions, which is intended to be exemplary rather than comprehensive, is followed by some rather more general comments.

The reader will readily perceive (we hope not ad nauseum) that the need for intercomparison of energy alternatives is a recurrent theme. This is simply because without such intercomparison the policy maker is left to helplessly ponder arrays of so many quads by such-and-such a year, so many tons of emissions, acres of eroded land, new towns in the wilderness, etc. If a technology assessment is to accomplish anything, it should be (insofar as possible) to provide the basis for choosing among the many alterna-

tives which at first blush seem plausible routes to the accomplishment of public policy goals. In the energy area, these routes are particularly manifold and convoluted. It is not at all clear that grouping complex arrays of energy sources, fuel forms, and conversion and utilization technologies under umbrellas like "solar," "biomass," and "fossil" is particularly helpful in the conduct of the required analysis; OTA is not likely to change that, however.

The root of this problem (presently in residence at DoE) goes back well beyond the last decade. Detailed intercomparison of alternatives is also vital for setting R, D & D priorities, most especially at budget-cutting time. The OMB has been on DoE's back about this flaw in their budget submission every year within recent memory. While we recognize that OTA must be guided by the oversight responsibilities of particular committee clients, it must also work hard to find ways to scope its projects so that their assessments have "stand-alone" policy relevance.

Key Focus Questions

Completeness

The broadest question in this category that would greatly benefit from assessment is, as mentioned before, intercomparison with other energy supply alternatives. For each major bioenergy mode considered in the OTA report (direct combustion, gasification, and liquid fuels) the big question is not whether energy from biomass is useful -- but rather how does biomass stack up against coal, lignite, peat, shale, etc. -- and conservation -- given comparable incentives. Some questions as examples:

- How will capital requirements for conversion and end-use equipment compare for biomass and other energy sources? (e.g. boilers, transport machinery, auto-engine modification, emission controls, etc.)

- As in the case of nuclear or fossil generating plant, biomass facility environmental impact statements may well require economic and environmental comparison with conservation alternatives. What is known about this? How will this tradeoff look?
- Resulting food cost escalation will limit ethanol production from grain to about 2-3% of present gasoline consumption. This would not be the case with synfuels from coal, etc. Is gasohol a target worthy of major expenditure of attention and resources? Would the same effort applied to, e.g., improved energy efficiency be more effective? Does a major federal program make sense here? (N.B. -- talent and other scarce resources are, to first order <u>conserved</u>; major programs are conducted <u>instead</u> of others, not in addition to them.) From a public policy point of view, scarce resources cannot be confidently allocated to the various bioenergy fields unless a strong case is made that each is the frontrunner among alternatives (as close as can be told). How important is the (present) public subsidy to the current surge in gasohol production? Would the industry collapse if special subsidies were to vanish? In one year? Five years? How will this depend on future cost escalations of food, construction, and fuels?
- Would the development, for export, of biomass energy technology improve our international economic and political situation measureably?

  What is the possible range of effects of gasohol subsidies on the U.S. balance of foreign payments (e.g., oil

imports vs. grain exports)?

- What do all the gasohol subsidies add up to (done only partially in the OTA report), and how do they compare with subsidies for coal, oil and gas, and nuclear power? Other forms of solar?
- To what degree are subsidies which promote lower prices for energy from biomass fighting subsidies for energy conservation (and vice versa)?
- How good an economic match will the various biomass energy cycles make to the existing energy distribution system, compared to other new (and old) energy sources (e.g. coal-based liquids, shale oil, coal itself, and other forms of solar energy)?
- In several places in the OTA report, (e.g. p.138) reference is made to end-use equipment modifications required to utilize methanol or ethanol. Conversion costs are invariably referred to as minor; but how many dollars is that, nationwide? South Africa has vast grasslands, as well as extensive coal deposits. Why has South Africa gone the Sasol route instead of the alcohol route? Even having decided to use their (cheaper?) coal, why heavier liquids (Fischer-Tropsch) rather than methanol? Could it be because of end-use costs? Are they just dumb? Is there a message for us here, somewhere?
- As we move toward the year 2000, will changing auto-engine design eliminate or greatly reduce the economic octane-boost value of alcohol, thus significantly affecting

gasohol economics?

What does the critical path look like for implementation of the various biomass energy cycles, to given levels, at stated times? What are the key uncertainties? What are the estimated needs and time distribution of capital, labor categories, transport systems, special materials, etc.?

- Are changes in government regulations needed to improve the kinds and amount of bioenergy R, D & D being done? Is there a need for cooperative private sector programs? Would there then be antitrust problems?

  Are there good opportunities for international cooperative efforts? What are they? Are they being pursued by the responsible agencies?

  How much "embodied energy" are we exporting as food, lumber, and other bioproducts? How much in the year 2000? What kind of energy is it? (Were coal, gas, electricity, or largely renewable sources used?) Should we consider any kind of export policy based in part on energy considerations? What about impact on world energy needs? Are our crops much more or much less energy efficient than those in other developed or developing nations?

- How would the inflationary impact of government subsidy for grain-based alcohol compare with a similar level of subsidy for alcohols from wood? Coal?

- How rapidly could biomass-based energy supply industries respond to an extended imported oil supply interruption? How would this response (magnitude, time) compare with

other energy supply industries?

- Would biomass energy industries (e.g. gasohol) be more or less subject to domestic supply interruption (strikes, national disaster) than other energy supply industries? How about military action and/or sabotage?
- In the area of national security concerns, liquids are the big issue. What is the most practical and rapid route to improved independence in this area? How does biomass stack up against, e.g., shale, advanced oil recovery techniques, "frontier" oil, etc.? In the long run, will biomass provide better security than coal liquefaction? Or is it a diversion?
- On the possible plus side (national security), would practical and well-located liquid-from-biomass plants likely be more geographically dispersed than fossil fuel (coal, shale, lignite, etc.) liquefaction plants, thus providing better attack resistance? Or, would biomass use fewer critical materials and other resources (including human resources)?
- Or, will the difficulty of either stockpiling or transporting large quantities of biomass (except produced liquids) result in extra vulnerability?
- Will biomass-based energy be more, or less, sparing of property rights and alternative lifestyles than other energy sources?
- Will biomass processes provide more opportunities in more geographic areas for semi-skilled and unskilled workers, or other labor categories likely to be in

oversupply, than competing energy sources or conservation alternatives?

- Bioenergy is referred to in the OTA report as "more labor-intensive." This clearly has potential advantages from a social equity point of view. But how about from an aggregated economic (GNP) point of view? It's easy to find more labor intensive ways of doing anything. How far should we go in that direction for energy supply?
- What are the demographic effects anticipated to result from extensive implementation of the various bioenergy cycles? With extensive implementation, how much of the action would realistically be in large companies like Evans Grain, Weyerhauser, etc., and how much in small operations, e.g. family farms and small distillers?
- Would a bioenergy stockpile program (wood, alcohol) make any sense, either from a national security or economic point of view? (This is under discussion for coal and shale-based synthetic liquids.) What might be the secondary economic benefits of such a stockpile program? Help develop the new industries? Help smooth the impact of bad crop years? How much would it cost?
- From an environmental impact point of view, how does each bioenergy cycle compare with other alternatives for meeting the same end-use need? What levels of emissions control, land, and water quality controls would actually be achieved and plausibly enforced in each case, in major implementation scenarios? Intercompare!
- Are the right kind and level of environmental R & D

OTA's Study Questions

In many cases, key questions presented and discussed in the report don't quite hit the policy target between the eyes. Some examples:

What are the Main Factors Affecting the Reliability of Energy Supply from Biomass? (p. 30) Better is "How Does the Reliability of Biomass Energy Compare to Alternatives?"

What is the Potential of Biomass for Displacing Conventional Fuels? (p.34) Better is "What is the Economic Potential of Biomass for Displacing Conventional Fuels."

Does Gasohol Production Compete with Food Production? (p. 39) OTA says yes -- but not very much at present production levels. A better question is "How Does Gasohol's Economic Cost (including higher farm commodity prices and reduced exports) Compare at Various Levels of Production with Alternative Liquid Fuel Sources?" It's long, but it's the policy-relevant question.

These are just examples. Application of our methodology forces similar restructuring of OTA's Study Questions on, e.g., p. 39 (Damaging the Environment); p. 43 (Social Effects); and elsewhere, scattered throughout the report.

Is the Deck Stacked for Biomass in the OTA Report?

We don't think so. But we can readily see how a hostile critic could make such a case by pointing out where (no doubt through oversight) tradeoffs are unfairly or incompletely illustrated, or particular policy approaches are urged by implication without backup analysis. A few examples:

comparative analysis while the market operates), is given short shrift. Serious analysis of this option could well provide the most credible rationale for an expanded program (though we don't want to prejudge the issue).

p. 53 f.f. -- (Generic Concerns) Environmental and Social Generic concerns are well and cogently discussed. Why not generic economic concerns? There is certainly no shortage of them, e.g., government subsidies vs. free market approaches. This and other lack of evidence of generic economic awareness might be seen by some critics as a significant flaw in the report. The relevant issues can be addressed -- but not without a special effort to do so. This is another example of something impossible to miss with the R&C "Four Fundamental Concerns" approach.

Some General Remarks

User Orientation

Most of the topical discussions in the report are very good. However, there is much repetitive and some contradictory treatment in separated parts of the report, and not enough policy-relevant focus. When reading on a particular narrow topic, one is always left wondering whether it's the last word on that topic, or whether one will happen upon a four-page detailed treatment of it later. There also is a great deal of data unassimilated from a policy point of view. Short of reorganizing the entire report, the only solution for this problem is a good index. What a help that would be! Funds for an index should be set aside at the beginning of each project.

Larger or clearer type would also be helpful -- especially in footnotes and exhibits.

In general, the R, D & D treatment is good, though often

lacking in detailed advice. The major problem here is failure to specify precisely what needs to be done in order to enable meaningful comparative assessment.

We liked the presentation in the Technical Memorandum on Gasohol very much; it is unfortunate that no policy analysis could be included. We think that the R & C methodology is exceptionally well-suited to the production of such interim reports without too much disruption of the overall assessment flow.

Finally, note that all the key economic factors for inter-comparison with coal are listed on p. 132, without analysis. Our approach would mandate focusing on them, and doing at least first-cut comparative analysis.

We apologize again for harping on the intercomparison theme -- but all programs in the energy area must eventually rise or fall on that basis. Without analysis of this type, programs are naked and vulnerable to attack, especially from the purveyors of well-established alternatives.

Sad to say, more than one good but small program has been killed or gutted by offhand remarks from influential personages along the lines of, "Biomass? Folderol! Why, they're not even in the ballpark with us."

"TECHNOLOGY AND EAST-WEST TRADE"

A Retrospective Analysis

Note added in Final Draft

These retrospective reviews were developed by R&C with little detailed information regarding the process by which each assessment was done and the constraints of time, budget, and scope which were imposed on the assessment staff. It seemed most appropriate and useful for R&C to develop its retrospective reviews on the basis of the published report.

In later discussions of our draft report with the assessment managers, the above constraints and limitations were specifically pointed out to us. We viewed these constraints as severe, and recognize them as causes of many of the aspects of incompleteness we identify in our report.

Introduction*

It is not our task here to conduct a comprehensive review and critique of OTA's report on East-West Trade. Rather, our task is to "determine the changes in treatment, emphasis and presentation which would have occurred" had the original assessment been done using the R & C methodology for management overview.

The changes we identify are all considered by us to be improvements. Our retrospective study will therefore appear to emphasize negative features of the report; such a result is inevitable. The R & C methodology has been refined throughout the study of several OTA assessments. As a natural result, it is designed to produce reports containing the most useful features and approaches we have discerned in OTA's reports. These very desirable properties of the OTA reports are, of course, not identified in our search for "changes." Moreover, our analysis makes no allowance for OTA's constraints of time and budget.

This retrospective study is done in terms of the R & C management overview methodology, which is described in an earlier section of this report. It should be read in conjunction with that description.

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*The purpose of this introduction is to convey the nature of R & C's task, and the resulting product. We have borrowed it essentially *in toto* from our preceding "Steel" retrospective.

General Discussion:

The topic of this study is in some ways more tractable to assessment than that of the other OTA assessments we have studied. This is so for a variety of reasons: First, the issues involved do not impact strongly on readily identifiable major segments of the population, nor is any major industry affected in a vital way. Second, the topic divides more readily than many into "soft" (i.e. political, etc.) and "hard" (i.e., highly technological, etc.) aspects. Finally, only two of R & C's Fundamental Concerns are involved in a major way: Economy and National Security.

At a first glance, and indeed, on detailed inspection, this report looks much like one which should arise from a study managed in accordance with the R & C management overview methodology. Issues, projected trends (future policies), options, and implications are collected and displayed almost the way we would expect if the iterations through Steps A, B and C of the R & C methodology had been employed. The report defines study topics and treats their implications in terms of fundamental concerns, which in this case are considered to be "Economic," "Military," and "Foreign Policy." This is similar to what would be done in the R & C methodology, except that "Foreign Policy" would not have been explicitly projected out of our "Economy" and "National Security" Fundamental Concerns. However, this would probably make little difference. The organization and development of these sections of the report are much like what would arise from the formulation and eventual convergence of R & C Focus Questions directed to the study.

As far as user orientation is concerned, the report would

benefit from an index and a comprehensive table of contents; but the organization of the report in this case was clear enough that this was not a very crucial need.

In the preceding retrospective analyses, we have concentrated on "changes" we would anticipate if the OTA report had been managed with the R & C approach. These changes were roughly categorized in accordance with the list of desirable report properties given in our preceding methodology description in Section I. In this report, however, we have been hard-pressed to determine many substantive differences in this way, since the report achieves most of these desired characteristics. Therefore, we will instead discuss a few differences in emphasis, treatment, and presentation which would probably have arisen from the R & C approach.

Treatment of Technological Material: We emphasize in the description of our methodology that a "user-oriented" report ought to present all the appropriate technological aspects of the subject to the clients, and OTA has a particular responsibility in this regard. The present report does present to the typical non-technical Congressional reader the material he or she would feel appropriate. But it turns out that very little actual technology is treated in the report, and that small amount is isolated, almost appended. It may be that little specific technological expertise was needed in the preparation of the report. No doubt technical people had to be interviewed to get their insight and overview; this is similar to what might be done by a financial analyst in studying a company. One piece of technological "education" that many Congressional people might have found valuable is a simple treatment of some

specific example of what constitutes selling technology, and what constitutes selling technological "know-how." (VLSI computer circuitry might be a good example.) Another useful educational contribution would be a simple treatment of how civilian technology can be converted to military. (The technological aspects of converting a civilian automobile factory to a military truck or tank factory could be an example.)

East$_1$ and East$_2$:

When we developed our Focus Questions out of the Fundamental Concerns, one Focus Question arising in our first iteration was: "How monolithic is the East?" We realized that while for many issues the East is "polylithic," for the purposes of this study the East is essentially "bilithic." There is the USSR and its sphere, and the PRC and its sphere: East$_1$ and East$_2$. When we considered the further development of our other Focus Questions, we found that in many detailed policy respects the situation for East$_1$ and East$_2$ could be considered to be very different, even contrasting.

Our conclusion was (and we do consider this an outcome of the methodology) that the report of a study developed in this way would have more prominently displayed the option of treating the USSR bloc and the PRC bloc differently, and would have developed the implications of this more generally throughout the study. We note that in the section "Policy Options" in the report's Summary (Chapter 1) this issue is not considered. We do note, however, that a special aspect of it is considered in Chapter IV (Foreign Policy Implications) and that it is addressed again to some extent

in Chapter XI on China.

Other Focus Questions: We outline in the following several Focus Questions which arose in our retrospective analysis, and which were to a large extent not addressed in the report and might well warrant additional treatment. Most of them came up when we specifically addressed the Fundamental Concerns "Environment" and "Social Equity and Other Social Concerns." These issues are certainly not excluded from consideration under the three "concerns" for which this report develops implications (Chapters III, IV and V). However, it is not clear that one is efficiently motivated to consider them under such headings.

1. East-West Trade in Technology and Global Environmental Problems

- Examples of "global environmental problems":
  - Acid rain
  - Ozone Depletion
  - Nuclear accidents (particularly interesting because of lack of containment of USSR reactors)
  - Potential risk associated with genetic engineering
  - Fishing, Whaling, etc.
- How serious might these become compared to the other issues treated in the OTA report?
- How much leverage would technology trade give us in motivating cooperation in these areas?
- Can trade in technology help alleviate these problems by allowing and encouraging joint attack on them?

effect, for example, on the Third World.)

- Briefly review past successes and failure of such policies.

We note that aspects of some of the above Focus Questions are mentioned in the report. Some are simply pointed out as concerns, while others are given a very brief discussion. We felt that these Questions, which arose in our methodology, warrant somewhat more detailed analysis, or at least discussion.

We finally note that this report collects data and issues and presents their implications with various perspectives. It does not do much "analysis" in the rigorous sense of the word. Such a treatment may be the most appropriate for the use for which the report is intended. It is not inconsistent with the statement of intent in the Director's forward.

In contrasting the application of the R & C management overview methodology to this report with the much more technical "Steel" and "Biomass" reports, we were pleased to find that the approach seems well-suited to either type.