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STUDY FOR THE DEVELOPMENT OF HUMAN INTELLECT AUGMENTATION TECHNIQUES

by
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Prepared for

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Copy No. 15

1 General

1a Development of our 940 multiconsole system continues to absorb the major portion of our time.

1a1 All of the hardware development for this system and some of the software development, were to be funded with the ARPA money that was channeled through RADC.

1a2 The software portion of these RADC-ARPA funds served from 1 May through 7 October to carry the portion of our programming staff engaged in designing the new on-line system. They now are back on this NASA-ARPA project.

1a3 The hardware-development activity and the leasing costs of the 940 will continue to be carried under the ARPA-RADC funds.

1b We have been held up for some two months now by delays in equipment deliveries; other such delays threaten to hold us up also in future months.

1b1 The display generators and the 5-inch CRT's which they were to drive were expected in early September and still have not been delivered.

1b1a A number of problems seem to have plagued the manufacturer (Tasker). The early problems involved unavailability of certain high-voltage resistors needed in the CRT power supplies, but since mid-September the delay seems to be a combination of overcommitment, bad planning, and poor engineering.

1b1b One of their commitment-engineering problems involves the fact that they had never before delivered a system as complex as ours. Currently, trouble with signal transients results in poor character shapes.

1b1b1 In order to get going on checking out the rest of our system, we have asked that they deliver the first of our two generators as it is--giving them until February to solve their problems and deliver us the second unit up to specifications. The first unit will then be modified to meet specifications.

1b1b2 Tasker has been postponing delivery from day to day for several weeks, since the above agreement, but we expect that the preoccupation with their getting ready for the Fall

Joint Computer Conference (November 14-16) has been a chief recent cause and that they may indeed be able to deliver by 24 November.

1b2 Delivery of the Potter line printer scheduled for 1 November has also slipped. The current promise is for 1 December.

1b2a Slippage of this delivery is not badly damaging to us.

1b3 Delivery of the Bryant disc, originally scheduled for 15 October, has also slipped. The current promise is for 1 December. However, the Bryant engineers have informally said that this may be slipped an additional month.

1b3a The disc is a vital part of our system and we will be seriously impeded if delivery slips much more.

1c Development of our NLS software continues, but because of the slippage in equipment delivery we are having to go on "building things" without being able to check them out for considerably longer than we had planned (design and programming of this system has been in full progress for slightly more than one year, and we find these delays a bit depressing).

1c1 We decided to go ahead on converting to the new version of time-sharing system (TSS 1.91) that Project Genie (UC-Berkeley) has developed. This will offer advantages both in the dynamic service to our on-line system and in making it easier to share development of disc software with the Berkeley group.

1c1a A number of system conversions are necessary to transfer from the Berkeley machine to a "true 940," since the SDS implementation of the time-sharing hardware was different from Berkeley's.

1c2 We have been running under TSS 1.91 since 24 October, and as far as we can now determine that system is shaken down and performing quite well.

1c3 Since about 1 November we have been plagued quite heavily by system failures which we have become convinced are in the 940 hardware. Up to that time the 940 had performed beautifully for us.

2 The Network Information Center (NIC)

2a Engelbart made a trip to the East Coast, from 19 October to 3 November, in which he discussed the network usage possibilities in general, and NIC needs and possibilities in particular.

2b He held NET-NIC discussions with the following:

2b1 At Bell Telephone Labs, Murray Hill, 25 October--Elliott Pinson, Stan Brown, and Jay Goldstein

2b2 At Dartmouth, 30 October--Tom Kurtz, Bob Hargraves, and Gene Fucci

2b3 At Bolt, Beranek, and Newman, on 1 November--Dan Bobrow (BBN), Bert Sutherland (Lincoln Laboratory), Jerry Saltzer (MAC), and Harold Schwenk (Harvard)

2b4 At Harvard, 2 November--Anthony Oettinger, Adrian Ruyle, Harold Schwenk, and Harry Lewis.

2c From thoughts and discussions held since the NIC was first "chartered" at Ann Arbor last April, a draft set of notes has recently been roughed out discussing most of the considerations and possibilities that have been brought out. This draft is included as Appendix A.

2d Our commitment to getting our 940 system running smoothly before we undertake serious activity on the NIC now indicates that it will probably be February before we begin to put significant amounts of time into planning and developing the NIC.

3 The On-line Sponsors' Progress-Review Meeting

3a On 12 and 13 October we hosted the following men for a progress-review meeting:

3a1 Robert Taylor and Barry Wessler, ARPA

3a2 A. E. Gribble, NASA-Langley

3a3 Fred Dion and Dean Bergstrom, RADC

3a4 Robert Landau, SOG.

3b For this meeting we built a special square table, seating five on a side, with the center area open. We arranged six of our television monitors in the center area, so that each of the 20 persons was conveniently near at least one of them.

3b1 These TV monitors were placed low enough to give each participant unobstructed visibility of all other participants around the table.

3b2 At one location at the table we set up the mouse, keyboard, and keyset terminal equipment to remotely control the CDC 3100.

3b3 A TV camera captured the image generated on the large display scope in the computer room, and the video was wired to the six monitors in the conference room.

3b3a The video signals were inverted, so that the displays in the conference room showed black characters on a white background.

3b4 Six auxiliary mice were located around the table, wired so that depressing the control button on any one of them would pick up a relay to connect that mouse into a special input channel to the computer.

3b4a This channel controlled the position on the screen of a second, extra large tracking arrow.

3b4b This setup allowed any participant easily to grab a nearby mouse, hold the button down to establish his control of the extra tracking pointer, and move this pointer about on the screen (for all to see) as a means of pointing out items on the display about which he wished to talk.

3c We collected about 150 of the most relevant of the files which have been developed in the program, and put them on one disc pack to be available for access and study during the conference.

3c1 This included all of the working specifications and some of the symbolic source code of our 940 system design, the documentation and user guides for both the 3100 and 940 subsystems, all of our recent reports and proposals, etc.

3c2 There were also included some files specially prepared to show the activity, framework, and candidate conference topics, and a framework from which to generate the working agenda.

3d As a means for presenting a large quantity of complex material, in a manner flexibly adjustable to the course of the discussion, and to the special needs and questions of the participants, this setup proved very valuable.

3d1 We were all quite enthused about the experience, and we are looking forward not only to regularly running our own program meetings and design sessions in this manner, but perhaps to hosting more meetings with sponsors and people outside the program.

4 The New Movie-making Activity

4a Of the three men who were initially planning to work together on our movie, William Bowman returned to his other activities feeling a need to wait until our capability for manipulating graphics on a CRT became established before an appropriate level of mutually valuable activity could be developed and David Casseres has become a full-time member of the program and is absorbed in some larger responsibilities--leaving Jeffrey Nipomnick (quite contentedly) to pursue the movie development by himself.

4b It is still anticipated that by early December we will be ready to distribute a first movie, complete with sound track.

4b1 This is not designed for high-level audiences, but serves doubly as a means to shake down our new personnel and techniques for movie making, and to hit a general audience rather lightly with some of the basic concepts of getting an intellectual aid in real-time CRT-computer interaction.

4c We plan to develop successive movies to present more deeply and specifically the various concepts and techniques being developed in the AHI Program.

5 Visitors

5a Mr. Szabo, General Precision, Inc.

5b Professor Patrick Meredith, University of Leeds, England

5c Ronald A. Finkler, Institute for Defense Analyses

5d Ned M. Cole, Jr. and William Schmitt, Auerbach Corporation

5e Dr. E. Herold, RCA

5f Warren Stark, ARPA

5g Professor J. P. Neal, University of Illinois

5h Thomas N. Pyke, Jr., U. S. Dept. of Commerce

5i G. W. Grimm and E. H. Clay, Owens-Corning Fiberglass

5j J. L. Mastran, R. C. Mastran, D. M. Cook, F. J. Hanson, and C. D. Sullivan, RCA

5k Robert Taylor and Barry Wessler, ARPA

51 A. E. Gribble, NASA-Langley

5m Fred Dion and Dean Bergstrom, RADC

5n D. Chesark and J. Reynolds, IBM

5o R. J. McQuillin, Inforonics.

6 Plans for Next Quarter

6a We expect to have six displays running under our on-line system (NLS), with at least our magnetic tapes available for file storage.

6a1 We hope that the disc delivery will be met so that by then we shall have the file system working off the disc.

6a2 The files containing design specifications, symbolic code, and user guides for our 940 on-line system should be installed within that system, and we plan to convert all of our other past files (as now contained on 3100 discs and tapes) over to the 940 according to need and storage space (eventually all of these will be in the 940 system).

6a3 We expect to be running MOL and META compilations directly from NLS files.

6a4 We also expect (depending upon file-space availability) to undergo a transition of shifting our everyday work over onto NLS.

6b We should have some initial distribution, and associated reactions, on our first "new" movie, and should be under way on the second.

6c We will continue to collect and shape up considerations, needs, and possibilities relative to the NIC.

6d We will produce a final report for this project, and perhaps one or more technical reports dealing with specific developments that have reached a good state of maturity.

Submitted by:

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APPENDIX A: Early Notes on NIC

1 General

1a The following rough notes summarize the miscellaneous collection gathered since April--many of them generated during visits this past month at BTL, Dartmouth, BBN, and Harvard, including discussions with representatives from MAC and Lincoln Laboratory.

1a1 Numerous considerations and possibilities are yet to be integrated and cleaning up and reorganization are still needed.

1b There is a universal uncertainty among potential network participants regarding the nature and degree of their participation in network usage. A good portion of each discussion about needs and possibilities for the NIC thus involved general questions of network usage, and the following notes reflect this in occasionally containing considerations probably beyond the scope of NIC responsibility.

1c I have categorized the notes into five topics (corresponding to Sections 2 through 6 below) as follows:

1c1 Network practices--those considerations, relevant to the service required of the NIC, which will be affected by practices and decisions outside of NIC "jurisdiction."

1c2 Generation of reference documentation

1c3 Integration into reference data base

1c4 Hard-copy dissemination

1c5 Query service.

1d Many people seem to be expressing (either explicitly or implicitly) a hope that the techniques and usage associated with the NIC would have a beneficial effect upon the in-house documentation situation within their own research center.

1d1 For instance, a common representation of an important part of the NIC service is that it should provide the equivalent of word-of-mouth "folklore."

1d2 It seems to be generally felt that dependence upon word-of-mouth communication of such folklore, to permit reasonable usage of software systems, generally "has to go"--within most centers the scale of activity and roster of users is becoming too large to tolerate such a dependence.

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1e It is significant here to wonder how much added documentation burden, over and above that required to meet reasonable local standards, will be inflicted upon each center as a result of its participation in the network, in order to meet the reasonable needs of the network.

1e1 Other questions are

1e1a What the total bulk of such documentation is likely to be, and how much of this must be in computer-sensible form

1e1b What the resulting implications are for the total needs for disc (or equivalent) and magnetic-tape transports throughout the network

1e1c How much of this increased storage need will have to be, or be wanted, at the NIC and how much at the various centers.

1f Whether all queries and complaints should be routed through the NIC, or whether frustrated users should approach the author directly.

1f1 It could be quite possible for conditions of popularity of a given service, the badness of its documentation, the number of bugs in its program, etc. (or some combination thereof) to be such that the provider of the service and/or the author of its documentation could be unbearably hounded by phone calls or Teletype messages from all over the country.

1f2 Another consideration is that it would be important information, relative to NIC operation, to know the extent and nature of such frustration, criticisms, questions, and troubles--so that at the very least warnings and comments can be introduced into the central reference files, and hopefully so that the same questions need not be repeatedly asked of the author and that the "management" problems involved with knowing the problems and coordinating efforts and pressures toward remedying things may be helped.

1f3 It would probably be of value for the NIC to receive all such communications, to record them, and to make the necessary communication to the author. In all, this could serve

1f3a As a clearing house for criticisms, needs, bugs, etc.

1f3b As an organized and controlled means to see that the responsible people are aware of inadequacies in their programs and documentation.

1f3c To keep appropriate comments and notes updated (either integrated within periodically referenced material, or in suitable supplementary material) to provide an organized picture of the current state of weaknesses, bugs, needs, etc.

1f3c1 This would perhaps be an effective means of applying necessary "social pressure" to prompt the responsible party to correct the problems.

1g It is apparent that the basic usage of the network will involve services which in some way are unique and not available at a user's own center.

1g1 At the outset, this category of services presents a special motivational and instructional problem in that there is little or no local folklore about either the discipline (i.e., problem area) served, types of services available, the organization of the services and their resultant output, or the detailed protocol and command language involved in using the service.

1g2 Thus, the "depth" of documentation generally needed will tend to be greater than for the average service provided at the centers.

1g3 The pattern of growth of usage of the supplied services is likely to be initially that an isolated person or project in one center becomes interested enough to surmount the threshold of learning these details--and it is likely to involve some initial desire for direct telephone (or face-to-face) chit-chat with the originator or some experienced user of the service.

2 Network Practices

2a It is quite apparent that each center will have to establish and enforce rules as to whom from the network may have what kind of service and when.

2b There appears to be a need for expanded accounts, record-keeping, charging, and billing to handle the more widely distributed clientele for each of the network centers.

2c A question was raised as to the burden in various time-sharing processors of handling the throughput messages between a local Teletype and a distant processor.

2c1 Jerry Saltzer made an off-the-cuff estimate that such a service might represent to the local time-sharing processor about 10 percent of the burden involved in completely serving a local user.

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2c2 There was a question of whether it would be easy to equip a NIC to handle directly such local Teletypes, in case this kind of usage would otherwise be an unnecessarily large burden on the local processor.

2c3 There might be value, in trying to maximize the total service provided between network and its interconnected processors, to reduce as much as possible the need for character-by-character interaction (at least in some modes of use of particular services) so that both the transmission, system (which would include the time-sharing processor of the user) and the service-providing processor could reduce their service overhead and their high-priority congestion by providing "batch" buffering, transmission, and processing.

2d Probably it would be valuable, in operation of the NIC, to have available some fairly detailed records of who in the network used what services, from where, and when.

2e A number of the services available around the network are designed to operate with special terminals (e.g., JOSS, Culler-Fried TX-2 graphics). It seems probable that other people, with adequate but different terminals, would like to avail themselves of some of these special services.

2e1 To meet this problem in an organized way (other than duplicating special terminals), there will be a need for specifying intermediate data forms and protocol for such special services, so that another center may translate back and forth between this "language" and a control language suitable for its terminal.

2e2 Standards could be set for the syntactic constructs used in such intermediate languages, so that implementation of a standard compiler-compiler at each center could provide easy development and modification of translation programs to match any of these intermediate languages.

2e3 The intermediate language could then be defined in standard syntactic form which would improve considerably their documentation, their understandability, and their usability throughout the network.

2f Some services at some of the centers will involve the production of hard copy, photographs, video tapes, etc., which cannot be sent back to the user via the network's digital transmission links. Some special systematic procedure will be needed in order to ship these products back to the user.

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3 Generation of Reference Documentation

3a Standards of format and organization will probably have to be set in order to permit efficient query and study.

3b Business-like procedures must be established and practiced for revealing documentation inadequacies, notifying responsible parties that new documentation or modification of old documentation is required, and producing suitable "social pressure" to encourage follow-through.

3c Some kind of regular "quality control" activity will have to be maintained, with respect to adequacy, unambiguity, and accuracy of documentation.

3d A number of people have expressed a desire to make use of SRI computer aids for composing, studying, and modifying documentation.

3d1 Supplying a certain amount of this service could be considered within the limits of processor and disc capacity of our 940 (and considering our local needs).

3d2 Specific Comments

3d2a Bert Sutherland felt that he would just as soon dial his Teletype across the country into our system to make use of our services in preference to developing similar services on the TX-2.

3d2b Both Sutherland and Dan Bobrow felt that we should offer this service generally--and that if the load on our system became too great, the value of this service to the network could justify adding another 940, or otherwise beefing up the capacity to provide this service.

3d3 The following considerations are of some significance in regard to a centralized service for documentation aids:

3d3a The concepts and conventions which must necessarily be mastered to achieve reasonable skill in

3d3a1 Using the search-printout services will be identical to those involved in the compose/study/modify services of the SRI system.

3d3b There will be a considerable overlap in command language and operating procedures.

3d3c Also, a person developing his documentation using these joint central services can turn around at any point in this development and apply the search-printout techniques to review the appearance of his product to subsequent NIC users.

3d4 One possible way to derive added capacity for this type of service would be to make use of commercially available 940 capacity.

3d4a For example, SRI could see to it that updated versions of these service routines could be kept in the libraries of such systems as Tymshare, Comshare, Data Net, etc.

3d5 Centralized documentation-aid service could be of several varieties:

3d5a Via Teletype, with small-batch processing (i.e., not instantaneous reaction), by accumulating input in a buffer and then processing it and providing the response upon special request.

3d5a1 Our experience with a paper-tape off-line text-manipulation system convinces me that very useful service can thus be derived even with a turn-around time of minutes.

3d5a2 This type of service would be much easier on the network, and upon our processor, and conceivably a relatively large number of people could be serviced in the background of our local, fast-response service processing.

3d5b Immediate-response Teletype, such as most on-line Teletype editors provde.

3d5b1 The actual increase in value to the user, for the type of use involved in composing, reviewing, and modifying documentation, is not objectively known.

3d5b2 However, it would certainly increase network and processor overhead.

3d5c Remote CRT service, as patterned after our local CRT service, but again buffering and background processing to yield relatively low responsiveness.

3d5d Remote CRT service with essentially the same interactive responsiveness as we provide our local users.

3d6 Extensive use throughout the network of documentation-aid

service from a central location could provide beneficial experience in network usage.

3d6a It might be the most widely used, or at least the most rapidly taken-up service which the network could provide.

3d6b Even if other centers relatively soon developed their own service, an early transient surge of network usage for documentation aid would have stimulated awareness of network possibilities among users, shaken down the traffic-handling and reliability aspects of the network, etc., to provide some solid benefit.

3e For the NIC, there will be a special category of documents consisting of those for which it will be valuable to produce periodic updating.

3e1 It will probably develop that we have a number of categories of documentation, depending upon not only this updating but upon the special structural form, special query needs and procedures, automatic question-answering service, etc. of different kinds of information.

3e2 Depending upon the degree of expected change in the corresponding programs and services, this "changeable documentation" category may include only the details of accessing protocol, or it may reach up into the details of the command language, or further into the repertoire of service features described in the basic user's guide or into even more significant regions involving the principles and concepts of applications--each of these representing a certain "level" of documentation affected.

3e3 An ideal way to provide updating as associated with the different types of changes would be to produce a new document with the changes appropriately integrated (perhaps specially flagged so that a quick scan can detect where changes have been made). A less ideal updating would consist of supplemental pages describing the changes.

3e4 Depending upon the heaviness of usage, upon the nature of the user community, and upon the nature of its dependence upon the documentation, ideal documentation updating will be more valuable for some services than for others.

3e5 For those services which have a high enough value within our network, it would be important to have some or all levels of their documentation in computer-sensible form so that fast and flexible updating may be provided.

3e6 There would be basic experimental value, independent of the above considerations, in producing as much as possible of the documentation generated by the network community in computer-sensible form.

3e6a It is quite apparent that the generation and production of such documentation will more and more be done to advantage by means of computer aids--not to speak of their subsequent study and "digestion" by other researchers (and indeed by authors in their subsequent work).

3e6b The practice of using computer aids for documentation, and the subsequent use of the computer-held documentary material, would both seem to be germane and important to ARPA-IPT goals.

3e6c In addition, the investment by ARPA-IPT in the basic network "experiment" will benefit in terms of the faster, more responsive evolution of system documentation that will result from extensive use of computer aids--and thus the faster, more responsive evolution of the Network.

3e7 For the probably necessary amount of NIC documentation that should be in computer-sensible form, there is likely to be a relatively large initial transcription job to convert existing documentation into computer-sensible form.

3e7a This would raise the problem of who will bear the burden of doing this initial transcription.

3e7b It would be easier to accommodate the initial (and relatively foreign) conventions of organization and structure, and inevitable early changes, if this conversion were done centrally at the NIC--where the computer aids for transcribing, structuring, testing, and modifying are available and familiar.

3e7c It is acknowledged that the individual centers will eventually need to learn the conventions, both to enable their production of new documentation and to enable them to search the reference files. However, it might be better if they waited until

3e7c1 The conventions stabilized after the NIC had achieved initial experience.

3e7c2 The users at the various centers had the opportunity, through use of the resulting documentation and query services, both to become familiar to some extent with the

general nature of these conventions and to become aware of the dependency of the search printout techniques upon these conventions.

4 Integration into Reference Data Base

4a Specifications of Structuring Conventions

4b Specifications of Updating Procedures

5 Hard-copy Dissemination

5a It seems impractical (for some years to come) to plan for all of the querying and studying associated with learning about a given service to be done via remote interaction with the NIC. Providing hard-copy material at each of the centers, to permit browsing and studying in the "old-fashioned" way, would seem to be important.

5a1 Some of the larger centers may need several independently maintained collections to serve different separated groups of users.

5b A local hard-copy reference collection should include, at least, copies of relevant reports, papers, user guides, etc., that have been published; but it could usefully include other, more changeable types of information such as internal memoranda, thesis proposals, who's who in the ARPA network, current network protocol, who is building or buying what kinds of special equipment, etc.

5c The NIC could help toward these ends by making available a periodically updated bibliography listing all of the available documentation of this kind, and from whom it is available.

5c1 This would leave it up to the individual centers to establish procedures and responsibilities for checking the "updatedness" of their current collection, and of ordering and inserting or replacing into the files new or modified documents as they became available.

5d Alternatively, as seems more efficient and generally workable, make it a NIC function to provide each center with the new and modified documents, with appropriate instructions for inserting and replacing, and with appropriate new indexing documents for the updated collections.

5e Assuming that bibliographies, summaries, and indices to such collections would at any rate be an integral part of the computer-based file within the NIC, the "publication" techniques that we have at SRI would make it straightforward to publish periodic

summary and index documents to be distributed for use with these hard-copy collections.

5f The use of microfilm, and the distribution of hard-copy reference collections in microfiche form seems (for initial consideration) to be practical and appealing.

5f1 The documents as published by the different centers can be converted to microfiche form through standard commercial services.

5f1a The Computer Science Department at the University of Illinois is setting up to publish all of their technical reports in this mode--and are setting up the equipment to produce microfiche cards internally. For pilot experimentation, Bruce McCormick suggested that we might avail ourselves of their services for converting a reasonable number of documents into microfiche form.

5f2 It also seems relatively straightforward to adapt the SRI publication processes to go directly to microfilm and microfiche.

5f2a There are Stromberg-Carlson magnetic-tape-driven CRT-to-film printers that seem adequate, and for which magnetic-tape-to-film service appears to be commercially available.

5f3 Attractive features of the microfiche approach are

5f3a Inexpensive duplication of entire sets of reference documents, so that there could easily be numerous sets scattered around the bigger centers (or distributed to non-NET organizations).

5f3a1 The small physical size of such a collection, together with the portability and low cost (e.g., around $300) of the reader would also facilitate this duplication--as well as making it feasible to move the complete kit to an individual's office for a period of intensive use.

5f3a2 Relative to the changeable documentation (e.g., protocol, user features, complaints, what's new, ever-improving indices to the rest of the collection, etc.), it would seem feasible for the NIC to replace periodically (weekly if necessary) a large number of microfiche pages (in whole-fiche modules, of course) of newly updated material.

5f3a2a The updating could contain new indices, new versions of user guides with small or large changes (and

including inserted complaints, criticisms, etc., as offered by dissatisfied users) and essentially any other product of the information, experience, and new organizing or indexing techniques as developed since the prior edition.

5g It was suggested that some type of selective dissemination service could be valuable.

5g1 For example, the known set of active users of a given service might automatically be sent page-print hard copy of updated user guides or other user-oriented notes.

5g2 Perhaps the biggest problem associated with this kind of service would be in keeping updated the list of appropriate recipients for each category of information. This problem would be alleviated if automatic records were kept as to who used what service throughout the network.

6 Query Service

6a Before the network becomes operative, it may be valuable to provide up-to-date information, as available, through either Teletype or telephone queries regarding (for example) the state of Network policies, designs, conventions, implementation progress, and startup schedule.

6b Automatic query-response service will probably be developed ultimately, at least for certain types of stylized query, and over certain portions of the data bank.

6b1 Ultimately this may include question-answering service, or "concept-retrieval" service, etc., as provided by heuristic programs.

6b1a Initially, however, no such services are contemplated.

6b2 The basic text-studying processes included in the SRI text-manipulation system could, in a rather straightforward fashion, provide selective printout of condensed or expanded information, based upon complex textual content, upon explicit descriptor tagging (with full combinatorial specification) and upon explicitly installed cross references or associative trails.

6b2a For information appropriately structured by the authors and the NIC staff, these facilities would provide powerful search and print-generation services.

6b2b New facilities for search and print generation will be

easy to add to our system, and are quite likely to evolve with experience.

6b2c Availing oneself of this type of service would require learning basic concepts and procedures associated with our data structure and our command language--but this is a seemingly inevitable condition for any kind of user-driven query system of the limited degree of sophistication which we can practically consider.

6c As part of the initial query service, we would plan to have a NIC operator on duty at SRI over a reasonable span of working hours.

6c1 Automatically under some conditions, or by user choice with a simple protocol, a user would be switched to this operator (or a telephone call could be used).

6c2 The NIC operator, sitting at one of our high-response CRT work stations, and being very familiar with the structure and content of the NIC data base, could search out and compile (in the sense of "collecting together") a variety of segments of the reference file, and ship it off to the user quickly and efficiently.

6c3 This could be a highly interactive process where the operator could send tentative responses and/or clarifying questions back to the querying user.

6c4 This operator could also serve as a basic consultant and teacher for those doing their own reference searching.

6d It may well be feasible, in response to special needs of a given user, to compile an extensive special printout for him that may be either page-printed and mailed, or produced for a microfiche file.