DJM 9-OCT-75 14:02 33664

NLS Training Message

Just wanted to make sure that your nls training would not be degradated do to the lack of a message in your nls mail box,Our training at Armcom did not have a message in the NLS mail box and we were therefore unable to see the flag record in our normal message file which would alert us to read the NLS file,Hope this helps, We want to make sure you keep up with us , It's no fun when the MCCUNE FOREVER file goes undetected, 1

Don 2

NLS Training Message

(J33664) 9-OCT-75 14:02;;;; Title: Author(s): Donald J. McCune/DJM; Distribution: /RLJ2([INFO-ONLY]) JAS3([INFO-ONLY]) JDS([INFO-ONLY]) ; Sub-Collections: NIC; Clerk: DJM; Origin: < MCCUNE, WORK-MEMO.NLS;1, >, 9-OCT-75 11:10 DJM ;;;;####;

33664 Distribution
Robert L. James, James A. Saum, J. D. Smith,

TO BE TITLED BY MAJ. HEARN

PART I: OVERVIEW OF THE NATIONAL SOFTWARE WORKS PROJECT 1

Introduction 1a

Software production in the DoD is estimated to cost over $3 Billion per year, (Ref. 1) and dominates the schedule of development of almost all computer systems. Yet programming remains a loosely controlled manual process, with little automated assistance. There are numerous reasons for this unsatisfactory state of affairs, but probably the most important is the fact that tools which can materially aid programmers, analysts and their managers are inherently expensive to develop, and typically require computers much larger than those required to run finished programs. Since most programmers are constrained to use the same computer for both development and operations, only the simplest and widespread tools are developed for each computer, and new tool development is inhibited. 1a1

Computer networks, and an order of magnitude decrease in the cost of on-line storage, provide an opportunity to attack the software production problem in a more complete way than ever before. In the Summer of 1973, the Defense Advanced Research Projects Agency(ARPA) organized discussions among a number of professionals from industry, the Services and universities. The general notion emerged of a software factory implemented on a computer network, with a coherent collection of tools which would expand and become more powerful over time. 1a2

Further discussions with the Services in the Fall and Winter of 1973-74 refined the concept, and led ARPA to form a joint program with the Air Force Data Automation Agency(AFDAA) to implement the first version of a distributed software factory, to be called the National Software Works (NSW). Air Force Systems Command (AFSC) joined the project in the Summer of 1974 through its computer science research organization at Rome Air Development Center. Discussions are continuing with the Army and the Navy, and it seems likely that a coordinated tri-service effort will evolve. The National Software Works can potentially provide for DOD-wide utilization of capabilities which otherwise will be created ad hoc for each new software development program, or worse, not be available at all. 1a3

Background and Technical Need 1b

The Software Problem (Excerpted from Ref. 2) 1b1

Demands for software production are increasing in volume and complexity, but progress in software technology has been slow. The demands have clearly outstripped the state-of-the-art, with very costly results. Cost overruns on software development projects are legendary. Software is seldom delivered on time. There is much waste in programming and computing, resulting from poor matching of software and hardware. Incompatibility between computers results in costly reprogramming or an inability to take advantage of the reduced computing costs of new hardware. The maintenance costs for old software products may be an order of magnitude larger than production cost, due to poor original design and production. 1b1a

The rapidly decreasing costs of computation resulting from new technological advances and the rapid growth in computer networks will, together and separately, cause a large expansion in the population of computer users and a large increase in the variety of applications. The threshold of economic feasibility is dropping for many systems, and awareness of how to employ computations is spreading to many sectors where computing is not a present activity. This will result not only in more computer usage but also in the need for much more software. 1b1b

In addition, major changes are occurring in the character of computing. Batch-mode processing currently dominates computing, but there is a strong trend toward on-line computing of ever-increasing scale. Requirements for complex real-time processing in such areas as tactical systems are also growing. The present software art is poorly matched to the current methods and levels of computation, and as these modes grow in importance, software costs will escalate. The "learning" costs incurred as the art strives to meet new kinds of demands will be high indeed. 1b1c

Finally, as computing becomes more widespread, the problem of tracking users' requirements will become acute. Keeping up with changing requirements may already be the biggest source of DoD software costs, not only in the maintenance phase, but also during the development phase. In the future, these costs will increase as more DoD functions are partially or completely automated. 1b1d

Why So Few Tools? 1b2

The tools used to develop software do not reflect software's relative importance in determining the cost, reliability, and delivery schedule of the total system. In most billion dollar industries, a substantial investment is accumulated in supportive tools. The development of such tools is difficult for labor intensive activities like software production, where each product is somewhat unique; but the real barrier to the development of adequate tools to support software production has been the requirement that the tools be reimplemented for each new kind of hardware. Converting development tools to run on different hardware is usually more difficult than converting an applications system. Since a prime use of software tools is to shield the applications programmers from the details of the computer hardware, the logic of the tool must embody specific knowledge of the hardware characteristics if the results are to be efficient. In the face of conversion costs, some valuable tools have been lost. For example, there were satisfactory solutions to the problems of round-off, overflow, and underflow in numerical computations for the IBM 7094. That was 1966, but the problems are still recurring in newer, and in theory more sophisticated, computer systems. 1b2a

For planning purposes, the Air Force uses six years as the economic life of computer hardware. That means that almost all applications systems development must be completed in the first year or two after a system is installed if the development costs are to be recovered. Tools which are developed after the hardware is delivered will also come after the programming staff has finally become accustomed to the new system and developed standard procedures for using it. Since new tools will be completed too late to help with the bulk of the applications systems, and constant retraining is something operational organizations can ill afford in any case, there is little incentive for people outside of the software R&D community to build tools. 1b2b

A related problem is the fact that machines are usually sized for their production requirements, not their development ones. Hence, they typically do not contain enough mass storage for the files that would be required in an on-line environment, nor enough memory to support both the code being developed and the tools used during that development. Additionally, access to the system is limited by the priorities of the production work load. A little recognized fact is that the tradeoff between manhours and machine resources is vastly different during development than during production. The CCIP-85 study (Reference 3) has shown that development costs increase exponentially as the machine approaches saturation. 1b2c

Despite these problems, the inventory of support software has been gradually expanding. Among the most widely used software tools are compilers, operating systems, time-sharing executives, file systems, program librarians, and interactive editors. Virtually all multi-programming operating systems have attempted to create a suitable programming environment by providing a set of tools. Some merely provide a library from which tools can be selected one at a time by the programmer. Others, like Multics, CP-67, VS-370, and TENEX, have provided an on-line environment for program building and debugging. 1b2d

These systems have not been as productive as they could have been, because there are at present no interfacing standards which assure that tools can be used together effectively. Non-integrated, tool-at-a-time operation places too great a load on the programmer to specify exactly what operations are to occur. This problem is particularly acute since tools often have command language idiosyncracies. On the other hand, if the tools supporting a programming language are tightly integrated, then it is at present impossible to access them from other languages. For example, the APL environment is completely isolated from the rest of its host IBM 360 or 370. Thus, tools may have to be duplicated for each language supported on a hardware system, as well as for all the different kinds of hardware systems. 1b2e

Origins of the National Software Works Program 1b3

Recent technological advances make it possible to overcome the barriers which have prevented the accumulation of a collection of powerful tools to support the software development process. The costs of both processing and on-line storage are dropping rapidly, so it will soon be feasible to have all programmers working on-line. Experiments like the Programmer's Interface have shown that many software tools are language independent or only slightly language dependent. Experiments using the ARPANET have shown that programs running in several machines can cooperate and appear to the user as a single system. Such cooperation is possible even if the host machines were built by different vendors and have significantly different architectures and operating systems. Finally, there are several examples of large time-sharing systems being used to support development environments for other kinds of hardware, in particular mini-computers. 1b3a

Thus there is strong evidence to suggest that tools running on a diverse collection of computers can be used together effectively to develop software for a variety of target machines, using a variety of languages. The key is the definition of appropriate interfacing standards. 1b3b

Recognizing the significance of the Software Problem to the DoD, and believing that these technological advances offered an opportunity to attack that problem in a much more concentrated way than ever before, ARPA/IPT held a series of meetings with software specialists from industry and government during the Summer of 1973. Among the participants were Barry Boehm(TRW), John Brown (TRW), Michael Busch(CSC), F.J. Corbito(MIT), Peter Deutsch(XEROX PARC), Jerry Feldman(Stanford), Cordell Green(Stanford), J.C.R. Licklider(MIT), Tom Lippiatt(Rand), Barbara Liskov(MIT), Richard Watson(SRI), Clark Weissman(SDC), Robert Balzer(ISI), T.E. Cheatham(Harvard), Stephen Warshall(Massachusetts Computer Associates), Stephen Crocker(ARPA/IPT), William Clark(NAVSHIPS), L/C Robert O'Keefe(USAF-ESD), Maj Harold Arthur(USAF-ESD), Norman Glick(NSA), John Mott-Smith(USAF-ESD), and Maj Zara(USAF-ESD). The result of these meetings was a report (reference 4) and a determination that the project should be jointly sponsored by a Service organization which is a major producer of operational software. 1b3c

During the Fall 1973, all three Services were presented with the National Software idea. The strongest interest was expressed by the Air Force Data Automation Agency. The Army Computer Systems Command also assigned an officer to participate in NSW planning sessions. 1b3d

AFDAA tasked two of its components, the Air Force Data Services Center (AFDSC) and the Air Force Data Systems Design Center (AFDSDC), to participate in the project. AFDSDC is located at Gunter AFS, Alabama and is responsible for developing and maintaining standard data systems which run at over 130 AF bases throughout the world. AFDSC is located in the Pentagon, and supports the Headquarters Air Force and the Office of the Secretary of Defense. (The third organization within AFDAA, the Federal ADPE Simulation Center in Springfield, Virginia, is not currently participating.) 1b3e

Rome Air Development Center (RADC) joined the program during the Summer 1974. RADC, located at Griffis AFB, New York, is the component of the Air Force Systems Command which is responsible for advanced computer science research. They are jointly funding the development, and are also serving as the ARPA Agent for NSW contracts. 1b3f

National Software Works Design Concepts 1c

Overview 1c1

The National Software Works will be a software development environment on a very large scale. It will be built on a computer network to reach a wide user community, and will integrate a continually growing collection of specialized services into a coherent system to support the development of software for a variety of diverse hardware. A typical terminal session may involve operations on several different machines. 1c1a

Consider, for example, the construction of a standard Air Force software system for the Burroughs B3500 using the COBOL language. Programmers may want to use the NLS editor on a PDP-10 to enter their source programs and to prepare their documentation. To reduce the cost of on-line storage, some of the files may be stored elsewhere on one of the new trillion bit storage devices like the Ampex TBM, which offers on-line storage at a cost of about a dollar per megabit per year. A Burroughs B6700 might be used for preliminary syntax checking. Interactive debugging at the source code level might then be done either on the B3500 or on a B4700 (a larger, faster version of the same machine.) Perhaps the best test data generator runs on an IBM 370. Finally, the software should be tested on a Burroughs B3500. The machine on which a tool runs has come to be called a Tool Bearing Host (TBH). The essence of the National Software Works idea is to make the best possible tools available by decoupling the selection of Tool Bearing Host hardware from the selection of production hardware. 1c1b

It is understood that some effort will be required to install tools in the NSW; that is the price of achieving standardization without discarding existing operating systems. There are no plans at present to have the Framework optimize the use of hardware resources. Tool installers and users will decide where files are to be stored, which hosts will support a particular tool, and whether whole files or partial files should be moved to perform a given operation. The Framework will help them make good decisions by simplifying the implementation of the various alternatives, and by providing feedback on costs. 1c1c

In order to provide a more consistent interface, users will access the NSW through Front-End network access machines. The access machines will know which characters require action by the tool being used, so that input characters can be collected and transmitted in blocks. The access machine will also support some local command interpretation and user prompting. Whether additional functions should take place at the user site, for example text editing, is an open issue. 1c1d

A New Capability for Project Control 1c2

A view of the NSW as a mere lash-up of tools which happen to reside on the ARPANET would be extremely short-sighted. The fact that all programmer contact with tools passes through a common communications media with immense computing resources creates an opportunity for the study--and perhaps control--of the whole process of large program creation and maintenance. 1c2a

In the production of a large software system, numerous programmers, analysts, and managers cooperate in a venture whose end product is, in some sense, a single entity. In the course of their work toward this goal, they prepare, edit, and manipulate a very large number of pieces of "text" of various types: routines in a programming language, data descriptions, structured data objects, modules of object code produced by a compiler, assemblages of such modules linked together by a link editor, items of program documentation, and so on. 1c2b

To the degree that all of these types of text are either machine-processable or machine-producible, it is reasonable to say that they are all either prepared (and repaired) by project members or produced by "tools" by which we mean elements of support software invoked by computer specialists to operate on pieces of text. 1c2c

The number of such pieces of text which come into existence in the course of a large project can be astronomical, and even the number in some kind of active status at a particular time is likely to be huge. It ought to be clear that any absence of control over this large and shifting inventory of material is an invitation to confusion and the almost total absence of any support software for "inventory control" might have something to do with the high and uncontrolled cost of program production (and perhaps something to do with our difficulties in figuring out what we are doing wrong). 1c2d

Suppose by contrast that the total inventory of text pieces were explicitly regarded as one logically integrated data base -- the Project File -- and that some piece of support software were charged with the responsibility of managing that data base. This piece of software - for the moment, let us call it the File Manager - would of course, keep books on the contents of the Project File. These books would include not only the character and status of each item in the Project File, but also its relationship to other items in the File (that A is a later version of B, that C is the object code module corresponding to COBOL test D, and so on). 1c2e

It should be obvious that, if we have designed the books correctly and arranged matters so that they are always kept accurately and completely, they provide the data crucial to any serious attempt by management to explore or control what is happening in the project. 1c2f

It is, of course, essential to any interesting use of the project books that they always be complete and correct, and that there be no path of entry to the Project Files unguarded by the File Manager. This suggests strongly that an individual programmer's use of his tools -- at least when that use yields a non-transitory (Filed) result -- must always be reported to (and, perhaps, controlled by) the File Manager. 1c2g

To arrange matters so that this requirement is met is extremely difficult when the support software designer is confined to the resources of a particular local hardware: to keep the File Manager and its books effectively on line at all times may be insupportably expensive. Indeed if a projects development work is performed on several computers with no communication among them, it may be logically impossible to create a reasonable File Manager. Thus, it is not surprising that there has been no serious attempt to provide a facility of the sort we have described: at least the naturalness, if not the feasibility, of the idea depends on a unification and scale of computing resource found only in gigantic machines or in networks. 1c2h

A fairly powerful query system will be provided to answer questions about any filed entity: what it is, where it came from, what other entities depend on it, etc. Later we will introduce a variety of experimental tools for project control which use the File Manager's books as their primary data or use the fact of the File Manager's existence as their means of invocation (after all, the later provides a single control point "awakened" every time anything interesting happens). Here are some proposed tools: 1c2i

Project Status Reporter: This relates the present status of the files to the overall project plan (in machine-readable form), identifying bottlenecks, critical paths, etc. 1c2i1

Project Accountant: This produces reports on the frequency and cost of various patterns of activity interesting to project management. 1c2i2

Policy Enforcer: Everybody in Section A must use the same version of function X; no programmer may link up two routines until each is adjudged debugged by a section manager; no programmer may start debugging until all his code is written; no programmer may write any code for phase 2 of the project until he has written all his code for phase 1; no programmer may start writing a new routine until his last is documented. The above list of (rather inane) policies are meant to suggest a large family of more reasonable policies which might apply to some or all programmers at various phases of a project. If a plausible way of expressing such policies in machine-readable form can be developed, it is no great trick to devise a tool which is invoked by the File Manager to verify that the present action of some programmer is consistent with policy, so that the action may be inhibited or permitted accordingly. 1c2i3

The use of such new tools by the project would of course, be optional. In any event, the research community can make use of such tools to collect the data it needs to discover what makes program development and maintenance so expensive. 1c2j

Internal Design 1c3

Works Manager 1c3a

The Works Manager will create and maintain an extensive catalogue of each project's inventory of filed objects. This catalogue will include both structural and historical information about each object (when was it made at whose request, by what tool, from what other filed objects; what other objects have been made using this one as data; what truths about this object have been asserted, or proved; and so on). Since the Works Manager will also have access to descriptions of the characteristics of all tools within the NSW, it can be seen that validation of a work request can be unusually exhaustive: does the tool exist, do the input files exist, are they of the right type and status for this tool, are the files and the tools both of the right status to be used by this user at this time, and so on. 1c3a1

Foreman 1c3b

The Foreman is that component of the NSW concerned with taking a well-defined and fully validated request for tool use and actually getting the job done. It receives an encoded message from the Works Manager which says, in effect, "At the request of user X on host Y, execute the COBOL Compiler on Host Z, using file HENRY on the Datacomputer as input and filing the result on the Datacomputer under the name GEORGE and, when the job is finished, send me the message W." The Foreman worries about fighting the host protocols and arranging the communication so that the requested task is in fact performed. 1c3b1

While the Works Manager component clearly has as implementation some integrated family of programs resident on the NSW hosts, the structure and location of the programs which do the Foreman's job are by no means so self-evident. A portion of the work will be centralized in the NSW host, but other portions will be handled by pieces of program implemented in each Tool-Bearing Host and in each Front-End user access machine. There are some complex issues here, where best design may be different for "closed" tools, like compilers, on the one hand and "open" tools, like editors, on the other. The goal will be to establish a small number of standards, called "Tool Bearing Host Protocols", which all Tool Bearing Hosts and tools must obey, and leave each tool installer as much flexibility as possible to take advantage of special characteristics of his environment. 1c3b2

Front End 1c3c

The Front-End will normally execute in a mini-computer (initially a PDP-11) which sits between the user's terminal and the ARPANET, but the system will also run on a PDP-10 TENEX time-sharing system to support users whose terminals are connected to TIPS, TENEXs, or large Hosts. All commands to the Works Manager or to any tool must be given through the Front-End. It will provide terminal control, aid the user in command specification, parse commands, and communicate with the appropriate resource(s). While each tool domain within the NSW may have a vocabulary unique to its area, this vocabulary will be used within language and control structures common throughout the NSW. A user will learn to use additional functions by increasing vocabulary, not by having to learn separate "foreign" languages. When in trouble, he will invoke help or tutorial functions in a standard way. 1c3c1

The Front-End will inform the Works Manager whenever it recognizes that the user is attempting to access or create new files, Eventually, the Front-End will save the user's commands for intervals between tool checkpoints (if the tool is capable of checkpointing its environment), allow the user to reissue old commands, allow the user to define and use command macros (abreviations) and interact with tools (upon user request) to "undo" the effect of commands where possible, 1c3c2

The Front-End will support CRT displays and hardcopy typewriter terminals, as well as CRTs used as full two-dimensional device, through a Terminal Controller. The Terminal Controller is a microcomputer supporting primitives for subdividing display screens into rectangular windows and for allowing the user to "point" at information displayed on a screen as arguments in commands to tools, The Front-End will also be able to handle such devices as card readers and punches, line printers, and tape drives, 1c3c3

An operating system interface module, consisting of a set of virtual operating system primitives, will be used to make the Front-End as operating system independent as possible, This will enable the Front-End to be transferred to other equipment later, The Front-End systems will be maintainable, loadable, and (symbolically) debuggable from a remote timesharing (TENEX) system, 1c3c4

Generalized Support tools 1c4

Software libraries, 1c4a

There are many cases when software should not be written at all -- existing code should be used, The NSW must provide access to software libraries to facilitate their use, Ideally it should be possible to access all available libraries using a standard command language, However, in the short run, only a limited number of such libraries can be made available, and there will still be some command language idiosyncracies, 1c4a1

The two major classes of software libraries are libraries containing subroutines or components which can be used as building blocks and incorporated into the applications software, and libraries of self-contained applications systems, These two kinds of libraries will have to be handled differently, especially with regard to accounting and release (copy permission). 1c4a2

The difficult cases are the libraries of subroutines or components which the user can incorporate into the software system he is building. Access control is very difficult with such tools. Three alternatives have been identified thus far: 1c4a3

Subroutines and other components can only be used in the vendor's environment and the system will not allow you to copy a load module out without paying a stiff exit fee. 1c4a3a

The subroutine can be called across the network for debugging, and the user would again be charged a stiff exit fee. 1c4a3b

Only certified linkage tools are allowed to access the subroutine library, and the user is charged each time he builds a new object module. 1c4a3c

An effort should be made to get libraries of government-owned software installed as tools. Regardless of the rules for releasing components, a record must be kept with information about who uses the subroutine, on what machine, under what operating system and with what result. There must be a complete audit trail of all copies so that the users can be notified when the subroutine or component is modified. 1c4a4

Batch scheduler. 1c4b

The purpose of the batch scheduler is to maintain a complete applications system in the NSW file system. The file should include any necessary job control information as well as the source and the object for component modules. 1c4b1

Some systems provide for run-time options. We would like the NSW to control the specialization of the standard system so that records can be kept on which options are exercised. 1c4b2

Applications systems usually require mass storage files and/or tapes. Since many vendor supported systems do not provide for cataloging, sequencing of new versions, etc., it seems desirable for the NSW to offer these services. They will be provided by tool(s) which (if they are developed new for NSW) must be written in COBOL or FORTRAN for a widely available computer system(s). 1c4b3

Once the selection of run-time parameters and the control of production files is made internal to the NSW, there are numerous opportunities to provide enhanced capabilities at relatively low cost. An example is a time-sensitve scheduler. Criteria might be established for when the system should run (e. g., the first Tuesday of every month). The NSW scheduler would automatically identify necessary data files, run the appropriate job (on one set of target machines) and distribute the results. Time sensitive scheduling could be implemented by a MULTICS scheduler. NOTE: Many jobs scheduled this way will be run by having the operators move tapes from NSW to independent production machines. An analogy can be made with second generation batch scheduling , except the NSW has automated much, if not all, of the work of the production coordinators and operators. 1c4b4

TO BE TITLED BY MAJ. HEARN

(J33665) 10-OCT-75 08:07;;;; Title: Author(s): Marilynne A. Sims/MAS2; Distribution: /KPH([ACTION]) LAC([INFO-ONLY]) MAS2([INFO-ONLY]) ; Clerk: MAS2; Origin: < HEARN, OVERVIEW-NSW.NLS;3, >, 10-OCT-75 07:55 MAS2 ;;;; Title: Author(s): Maj. K. P. Hearn/KPH; Distribution: /MAW([ACTION]) NSW([INFO-ONLY]) ; Sub-Collections: NIC NSW; Clerk: LAC; Origin: < DSDC-SYD, NEW-NSW-PLAN.NLS;10, >, ;;;;####;####;

33665 Distribution
Kenneth P, Hearn, Lawrence A, Crain, Marilynne A, Sims,

this si a sample message to see how one reserves journal numbers. The number i have reserved is 33667. The journal number for this message is 33668. 1

(J33668) 10-OCT-75 12:15;;;; Title: Author(s): Marilynne A. Sims/MAS2; Distribution: /MAS2([ACTION]) ; Sub-Collections: NIC; Clerk: MAS2;

33668 Distribution
Marilynne A, Sims,

Before long the computer revolution may extend beyond secreatriesand other support personnel to the Professionals they serve, profoundly influeccing the working habits of every office employee. 1

the professinals whose capabilities engelbart seks to augment include all those whome peter drucker refers to as knowledge workers -that is,executies, planners, reseachers, designers,, writers and others wo createand plly knowledge to productive ends. 2

in fact mr. saum intends his system to serve thesecretary. the visible fools include a screen. 3

(J33669) 10-OCT-75 13:07;;;; Title: Author(s): James A, Saum/JAS3; Distribution: /PKA([ACTION]) JAS3([ACTION]) ; Sub-Collections: NIC; Clerk: JAS3; Origin: < SAUM, PRACTICE.NLS;2, >, 10-OCT-75 11:52 JAS3 ;;;;####;

33669 Distribution
   Pamela K, Allen, James A, Saum,

Trip Report for NSW Steering Committee Meeting...7-8 Oct

ATTENDEES: 1

ARPA 1a

Bill Carlson*	IPTO	202-649-5037	1a1

RADC 1b

Col R. Krutz	IS	315-330-2204	1b1
Capt Michael Wingfield*	ISCP	315-330-7746	1b2
Duane Stone*	ISCP	315-330-7746	1b3

AFDSDC 1c

MajKenneth Hearn*	SYOT	205-279-4222	1c1

AFDSC 1d

Maj Gary Hignett*	XM	AUT 22-78723	1d1
Allan Wylie	SF	AUT 22-73577	1d2

COMPASS 1e

Stephen Warshall		617-245-9540	1e1
Robert Millstien		617-245-9540	1e2
Charles Muntz		617-245-9540	1e3

GSG 1f

Norman Rasmuseen		603-893-1000	1f1

PURPOSE: 2

A steering committee (*) review of the project progress and to discuss the upcoming demonstration at Gunter in Nov. 2a

To get inputs from Jim Burrows (AFDAA) on the view of the project from his vantage point. 2b

DISCUSSION: 3

We meet Tues to discuss the progress and problems of the NSW project. COMPASS assured us that all is in order to give the demonstration at Gunter on the 15th of Nov. The essence of the demonstration will be to submit a COBOL job for compilation from NLS files under the control of the WM. COMPASS is still lacking in documentation! There will be another NSW steering group meeting at that time. 3a

DSDC 3b

DSDC does not have a well defined plan of how they will use the NSW after the 1 Nov Demo. Maj. Hearn recognizes this and will be preparing and staffing one as soon as he gets back to Gunter. The appeareance of about 20 NSW managers and workers at Gunter in Nov may shake them up enough down there to take things seriously. 3b1

DSC 3c

DSC has their PDP-11 deliverd, but it will not be installed for about 2 months, the time it will take GSA to get power to the site. 3c1

There is a 3 month maintenance on the 11, then DSC will have to get their own set up. Mike will check to see if this time begins on delivery or at installation. 3c1a

DSC is seriously considering running the UNIX exec on their 11, instead of ELF and the NSW front-end. They feel that this will give them more local editing capability. It will not support the DNLS terminals however, or interact with the WM. We should look further into this, as it has possible negative implications for NSW. 3c1b

DSC current use of the network consists of using NLS to support the publishing of a 1000 page AF manual (66-1) for LG. The manual was input using MTSTs, read onto IBM tape and converted by SRI into NLS files. The OPR for maintenance of this manual may be switched from the pentagon to Gunter. The manual was further revised and updated about a month ago, when 25 people flew into Gunter. The revised manual was sent to the COM machine and proofs forwarded to Admin in the pentagon for final signoff. Admin felt that there was "too much white space" and rejected it. DSC has gone to a smaller typefont, and SRI is creating a hyphenation capability in the output processor to overcome this problem. The deadline for publication of the manual is 1 Nov and LG is without trained NLS proofers and without the GNLS line processor. I will try to expidite the delivery of the GNLS LP to DSC, and look around for sources of manpower for proofing the manual. 3c2

As an interesting sidelight, SAC and Wright-Patterson people were involved in the manual preparation job. They are now using NLS. WP in particular is considering using NLS to prepare tech orders. We should follow up on this, to make sure it doesn't end up in the same state as the LG manual job. 3c2a

BURROWS 3d

Burrows is concerned about presenting a convincing picture to Gen Edge, to assure continued AFDAA participation in the NSW effort. AFDAA money contributed to date can be considered sunk costs, but further conributions will be aimed at improving the operational capability, and must be justified as such. We have to be able to show very explicitly what he will be getting for his money (benefits) and when. One alternative (for example) is just to buy a PDP-10X and stick it in Gunter to support program production and documentation there. 3d1

RADC 3e

It is clear that RADC has to take a stronger role in management of both the technical and longer range planning aspects of the project. This is a natural and desireable trend. 3e1

With the recent reorganization, we have a nucleous of people working together, and should be in a position to take on a more significant role. My only concern is that there still is insufficient manpower to adequately man this project and worry about the other networking jobs that are in being...or could be. 3e1a

ARPA projects are only sucessful when one of the services picks up the ball and runs with it. ARPA WANTS to see us more heavily involved...spending our money and manpower on NSW's advancement. 3e1b

RADC now has most of the main contracts involved, and as the responsible project engineers, we should start taking our responsibility seriously. We should also think about getting a D&F staffed (unless we can use the demonstration programs D&F...Bergstrom) to allow us to spend the kind of money that will be necessary in '77 and '78. 3e1c

The development through protyping is right in the center of the general mission of RADC. It further dove-tails with requirements that are coming out of WWMCCS. 3e1d

This project is 100% in line with the division's goal of improving the software production capabilities of AF in-house and contractor teams. 3e1e

(J33670) 11-OCT-75 06:50;;;; Title: Author(s): Duane L. Stone/DLS;
Distribution: /RDK([INFO-ONLY]) ARB([INFO-ONLY]) FJH([
INFO-ONLY]) MAW([INFO-ONLY]) TFL([INFO-ONLY]) JLM([INFO-ONLY
]) FJT([INFO-ONLY]) ; Sub-Collections: RADC; Clerk: DLS;

33670 Distribution
Robert D. Krutz, Alan R. Barnum, Francis J. Hilbing, Mike A. Wingfield, Thomas F. Lawrence, John L. McNamara, Frank J. Tomaini,

Notes on Appraising Potential Applications

Some notes I took just before walking into FEA last summer...just journalizing for the record.

Notes on Appraising Potential Applications

Some notes to myself on what to look for in a potential application: 1

an initial core group 2

turned-on leader 2a

small group 2b

adequate clerical support 2c

flexible work habits -- not extreme operational time pressure 2d

finite expectations for tools 2e

an initial project 3

simple application of tools 3a

high technical payoff 3b

visibility -- limited to key decision-makers 3c

defined goals 3d

adequate time to do project 3e

secondary application 4

spread visibility -- potential new applications 4a

add capabilities to organization 4b

long-run potential 5

technical pay-off 5a

community relationships 5b

potential funding relationships 6

Notes on Appraising Potential Applications

(J33671) 12-OCT-75 14:26;;;; Title: Author(s): N. Dean Meyer/NDM; Distribution: /DCE([INFO-ONLY]) JCN([INFO-ONLY]) RLL([INFO-ONLY]) ; Sub-Collections: SRI-ARC; Clerk: NDM; Origin: < MEYER, APP.NLS;1, >, 12-OCT-75 14:23 NDM ;;;;####;

33671 Distribution
Douglas C. Engelbart, James C. Norton, Robert N. Lieberman,

The Proposal to OSIS

This is the draft (Version 61) that went to Bart Cox for his approval. The proposal was written in response to the National Science Foundation's Program Solicitation 75-23. In the work, ARC and the Telecommunications Sciences Center would survey emerging computer systems that would give scientists and technologists tools for their everyday benchwork and team work.

AS WE MAY (YET) THINK:

A Survey and Analysis of Computer Assistance in the Use of Scientific and Technical Information

SRI Proposal No. ISU 75-209

NSF Program Solicitation 75-23

prepared by:

R. R. Panko, Communication Analyst
Augmentation Research Center

D. C. Engelbart, Director
Augmentation Research Center

approved by:

Bonnar Cox, Executive Director
Information Sciences and Engineering Division

II CONTENTS

III ABSTRACT

3

Information becomes useful only when it is integrated into the daily work of scientists and technologists. Computers can spur the integration; once scientific and technical information has been computerized, it is possible for many different types of end-use tools to operate on STI output or even on STI data bases -- all through a single user terminal. 3a

Some STI services already provide end-use services, and a number of computer systems that can integrate a variety of STI and end-use services are being built. Because the integrating of STI and end-use services is so fundamental to STI access and effectiveness, it is important to outline a clear and specific set of R&D goals for the future, a set of goals sufficient to make end-use services accessible to and suitable for general users of computer-based STI services. 3b

SRI proposes a two-phase research effort to create a set of R&D objectives for the future. The first phase will be a survey of STI systems that offer end-use services and of computer systems that can integrate arbitrary STI and end-use services. The second phase will compare user-responsive criteria for STI/end-use integration with current systems and trends, and, after consideration of technical, regulatory, and behavioral factors, generate a set of R&D recommendations for potential funding agencies and users. 3c

IV PROJECT DESCRIPTION 4

A. The General Problem 4a

Computer-based science and technical information (STI) services have traditionally stressed the delivery of information to users. Yet once knowledge has reached users, it must be integrated into the complex process of the users' daily work. The information must be annotated and stored away in personal files, used in computations or modeling, forwarded to other members of a task team, and so forth. These end-use activities can be, and in some cases already are, computer-augmented, but the degree to which such augmentation is available and the quality of the available tools is not well known. The intent of Category 7 of the Program Solicitation (R43) is to determine the status of existing computer-based services that augment the end use of STI and to formulate specific R&D objectives for the improvement and expansion of such services. 4a1

There is ample evidence that familiarity and ease of use are crucial to the acceptance of STI services by end users (R4,R24,R28,R31,R50). So it seems highly probable that, if end users were able to work with STI after it had been recovered, preferably using the same computer terminal and software environment used to recover the information, access to STI services would be enhanced. The purpose of the proposed study is not to test this hypothesis, but to lay the groundwork for the widespread provision of end-use services to STI clients. Presumably, an actual test of the hypothesis could be performed once a sufficiently integrated on-line working environment had been located or developed. 4a2

An unknown number of STI services already provide postrecovery (and prerecovery) tools to their users, and one goal of the proposed work is to survey the prevalence of such tools today. Another trend, which was not dealt with extensively in the Program Solicitation (R43), is the emergence of fully integrated working environments for knowledge workers, to which future STI services can be linked. The earliest attempt to create such an environment was NLS (Online System), developed at SRI's Augmentation Research Center. Since 1962, roughly 150 person-years have gone into the development of NLS. In 1974, NLS became operational and is now in use by a growing community that currently numbers about 300 users in 13 client organizations. 4a3

In the middle 1970s, the integration of working environments -- such as NLS -- with arbitrary external tools became the subject of extensive research. The most ambitious research effort to date has been the National Software Works (NSW) project of the Advanced Research Projects Agency and the Air Force. Begun in 1974, the NSW project is aimed at developing a general "front-end" working environment through which a user can interconnect to arbitrary tools on different back-end host computers, through a simple and user-adaptable interface. ARPA is now advancing similar goals in its Intelligent Terminal and Communication Command and Control programs. Outside of the NSW project, a number of other integrated front-end environments are being developed. One of the largest of the developments is the Information Automation project at USC's Information Sciences Institute, sponsored partially by ARPA but with major support coming from the Navy. 4a4

The purpose of the preceding discussion has not been to downplay the importance of current STI services that provide end-use tools, but rather to bring to the attention of proposal reviewers another, perhaps equally or even more important, stream of development, one that should benefit from several millions of dollars in funding during the next two to five years and that could produce results useful to the STI community in a brief time. 4a5

If integrated working environments are to be provided to users in the future, the two phases suggested in the Program Solicitation (R43) seem appropriate. In the first phase, a survey should be performed to determine the current (and near-term future) availability of end-use tools provided in conjunction with STI services and also to examine the current and near-term development of general integrated working environments. 4a6

In the second phase, an analysis should be performed to pave the way for future actions on the part of the Office of Science Information Service (OSIS), STI vendors, vendors of computer services that provide access to STI tools, organizations that use STI services, and agencies that are developing or may develop integrated working environments with which STI services can be integrated. Three tasks will be needed: an explication of user needs and behaviors (in the light of past research) that should be considered in designs; an analysis of the probable development of end-use services, in view of current and anticipated trends; and, finally, the creation of an agenda for needed action, based on the needs and trends analysis. 4a7

It seems unwise to attempt to provide a taxonomy of possible end-use services in this proposal. During the proposed work, however, the project team will be guided by Paisley's taxonomy (R46) of the scientist's or technologists's working environment, a taxonomy that was extended by Allen (R6) to encompass not only information sources but also the work flows that go on in various organizational contexts. 4a8

Paisley and Allen conceived the scientist or technologist as living amid a number of roughly concentric systems or organizational environments, beginning with the individual scientist or technologist, extending to the work team, the formal organization, a number of intermediate levels, and finally to the society as a whole. In light of the Program Solicitation, it would seem appropriate to concentrate on tools that would assist the individual scientist or technologist. As extended by Allen, this would consist not only of thought processes but also of calculation work, personal filing systems, and so forth. 4a9

Certainly, there is considerable evidence that individual work strongly interacts with information needs; for example, it has been demonstrated that the phase of a project determines how and what information will be selected (R1,R3,R9,R25,R51,R57). Also, it is known that scientists in the same discipline but working in different task environments will have markedly different information-seeking behavior (R39,R51). More generally, the task and the scientist's past store of knowledge determine what new information will be needed from the outside and what must be done with external STI once it has been received. In a broad sense, a scientist or technologist usually has the choice of relying on his or her own stored (or filed) knowledge, of generating information anew, or of seeking outside knowledge from people or external STI. 4a10

For the purposes of the proposal, however, we will extend our focus to include the tools needed in what Paisley and Allen termed the work team. This is because it is very difficult, and probably impossible, to separate the work team from the individual's needs and resources in any working environment. Most information contacts come from the work team, if the individual does not have the information already (R2,R10,R45,R48,R51). Another consideration is that much knowledge transfer is a two- (or more) step process, in which a gatekeeper initially collects the information and passes it on (e.g., R2,R26). This two-step process even extends to the use of formal STI systems; most searches of infrequently used STI systems depend on a person other than the original information seeker (R16,R33). 4a11

Overall, it seems best to integrate formal STI systems into benchwork tools both for individual users and for at least members of the work team. Pragmatically, most integrated on-line working environments are likely to provide such tools as a matter of course in the future, and even individual STI services may do this to some extent. 4a12

In the proposed research, SRI will focus on tools applicable to the individual's working environment and to the task team. As appropriate, however, SRI will also consider tools that link individuals with colleagues outside the work teams, because of the known importance of such links (R2,R5,R12,R35,R48,R52,R56) 4a13

B. Specific Objectives 4b

The program solicitation asks that the work proceed in two phases: a survey phase to determine what capabilities are available and an analysis phase to set objectives for what must be done to make end-use tools for individuals and work teams available to increasing numbers of scientists and technologists. Both phases will have the overall objective of determining how end-use tools can be made available to users of STI services, so that STI services can be integrated more completely into the total enterprise of scientific and technological work. 4b1

1. Objective of Phase I: The Survey Phase 4b2

The principal objective of the survey phase is to determine what end-use aids to STI users are available or under development, and to assess the status, limitations, characteristics, and sources of these services. 4b2a

a. Systematic Catalog of Special-Purpose Systems 4b2b

SRI will survey STI vendors and some major suppliers of computer processing services on which STI services are available, to determine which have tools to augment the use of recovered or retrieved STI. For each tool complex (set of related end-use and STI services), SRI will develop a systematic catalog of capabilities, oriented around user actions that are augmented (e.g., filing of information, collaboration in writing joint reports). 4b2b1

An analysis of capabilities will be performed on each complex; the analysis will determine what specific end-use services are provided and will also determine general availability, price, extent of usage, and practical limitations. The strengths and weaknesses of individual tools will be considered. The catalog will also specify the computer hardware and executive system software that are required and the terminal equipment that is supported. The catalog will emphasize fully implemented systems, except where a highly interesting system is under development. 4b2b2

The features analysis will phrase capabilities in human terms, describing the work processes that are augmented. Examples might be writing documents, forwarding a piece of recovered STI to a coworker, exchanging drafts of papers with colleagues, converting recovered data into a form that can be assimilated by numerical processing programs, annotating recovered information, and filing STI in personalized ways. In some cases the general features provided to users may not lend themselves easily to work process phraseology; such features will be described in their own terms; then their implications for general work processes will be described. 4b2b3

The survey will concentrate on tool complexes that are generally available to the public or may soon become so. Exclusively in-house systems, such as those that may exist within university computer centers and that access a set of tools not generally sold as a package, will be surveyed in less detail, but SRI will examine original (and potentially exportable) approaches. 4b2b4

b. Survey of General-Purpose Systems 4b2c

SRI will survey at least four systems that aim to provide an integrated front-end working environment through which users can reach a large variety of services on a large number of machines with comparatively little effort. These systems are important because they can fulfill the need for manipulating information after it has been gathered and even for tying end-use services and STI services to a number of formal and informal communication services, through which the scientist or technologist can converse with task team members, others in his or her formal organization, and external colleagues. 4b2c1

Specifically, the NLS-8 system currently in use will be surveyed for price, general availability, extent of usage, and the level of sophistication at which various tools are implemented. Software and hardware requirements will be considered. SRI will also survey the three systems still in development that could be available within a year after the survey's end: NLS-9, the National Software Works project, and the Information Automation project. 4b2c2

Other projects, such as the RITA project at RAND, may bear inclusion in the survey of general-purpose systems. SRI will interview representatives of funding agencies and personnel of known projects, to determine whether specific projects will be included and to identify other potentially interesting projects. For each project that is included in the survey, specific capabilities and the extent to which general tools can be used will be surveyed. Special emphasis will be given to core tools that will form the user's intimate working environment and to the techniques being used to implement generality of access to tools. 4b2c3

c. Generation of an Overview 4b2d

SRI will prepare an overview of current developments, synthesizing from the particular data on individual systems an overview of the use and development of current systems and of the emerging trends in the development of end-use services for scientists and technologists. 4b2d1

2. Objective of Phase II: The Analysis Phase 4b3

The overall objective of the analysis phase will be to determine how well current and nearly developed end-use services fit users' general information needs and then to determine what research and development should be encouraged to spur the development of these tools. 4b3a

a. Analysis of User Needs 4b3b

There is an extensive body of literature on how scientists seek, and finally use, information. SRI will review relevant portions of this literature, to collect evidence that can be translated into a set of general criteria and requirements for the provision of end-use services. SRI will develop a taxonomy of desired end uses, as well as a framework for specifying how services must be integrated. 4b3b1

b. Assessment of the Existing Technology 4b3c

In light of the need assessment and the characteristics of available and nearly developed end-use services to augment STI use, the match between needs and available tools will be assessed. It is not clear at present whether a feature-by-feature comparison or a broader and more theoretical comparison will be more suitable. The method of comparison will depend on the results of the prior work. The assessment will, however, focus on trends that should be encouraged or discouraged and on identifying especially promising tool complexes. 4b3c1

c. Specific Objectives for Advancing the Technology 4b3d

Finally, guided by the previously-determined criteria and requirements and the assessment of current developments, SRI will propose a set of specific actions that can be taken to develop and disseminate the tools that scientists need in order to use STI services effectively in their daily work. The actions to be proposed will depend on, among other things, the availability of end-use tools on existing STI systems, the time frame in which full front-end working environments are likely to be ready, and the prevalence of nontechnological problems (such as the setting of standards) and of human problems (changes in working behavior) that might be encountered. Further research may be proposed to settle on specific courses of action, particularly if two or three promising approaches emerge from the assessment, and the selection of one or more for implementation could be decided only by a detailed comparison. 4b3d1

C. Anticipated Impact 4c

The potential impact of this project is exceptionally large. In the past, STI services have had considerable difficulty penetrating the working patterns of scientists and technologists and have not been heavily used. Yet information is known to influence productivity (R2,R5,R12,R47,R48,R56). Informal communication seems to be most influential, both because it brings information not in the literature and also because it brings formal STI to end users who do not directly use information channels. Because it is notoriously difficult to correlate productivity with inputs and outputs in most forms of work, these findings of information-productivity correlations are very important. 4c1

Emphasizing the value of productivity enhancement is the growing importance of scientists, and other knowledge workers to the nation. Our national problems are becomming increasingly technical, and an increasing percentage of our total work force is composed of knowledge workers (R17). It is important to enhance the productivity of scientists, technologists, and other knowledge workers, and access to information seems to be one of the few tangible ways to do this. 4c2

Access to formal STI services has traditionally been a problem. Each new service imposes new protocols on the user, thus raising the psychic costs of using it, and the integration of STI with a scientist or technologist's ongoing work process has traditionally been left to the STI user. Bringing STI services to scientists and technologists in ways directly applicable to their daily work would probably reduce psychic costs greatly, making the use of STI more universal in appeal and liberating it from the current small subset of potential users who serve as the primary entry points of STI into organizations. It should be emphasized, however, that research is needed to probe this matter. 4c3

The integration of STI with daily work is not just a pipe dream or an effort that must be started from scratch. As noted above, a number of STI services already offer end-use services and, of great potential importance, major efforts are already underway to develop integrated on-line working environments for average knowledge workers. If research is done now, to probe the real needs of scientists and technologists for such services, it should be possible both to guide the emergence of end-use services among STI services in a coherent manner and to help direct the development of integrated on-line working environments in ways that will benefit the community of scientists and technologists. 4c4

In the long run, the increasing automation of end-use tools and the more complete integration of information services into these tools have the potential of drastically altering the nature of scientific work, and, in fact, the nature of all knowledge work. Many organizations, not only government funding agencies, are seeking ways to automate human work functions, which are subject to increasing costs with questionably increasing productivity. The proposed research can create a framework for understanding what must be done in this area and can set R&D agendas that are likely to be adopted by many research sponsors. 4c5

D. Technical Approach 4d

1. The Survey Phase 4d1

a. Survey of Special-Purpose Systems 4d1a

SRI will develop a list of 50 to 200 STI systems and general computation vendors that might offer end-use services in conjunction with STI. Simultaneously, SRI will develop a one-page project description and mail this description to prospective interviewees. With the project description will be enclosed a one-page questionnaire to probe the existence of end-use services for STI. This mailing will be followed by one or two waves of follow-up inquiries to nonrespondents; some telephone calls to persistent nonrespondents will be made, as well. 4d1a1

Next, a telephone interviewing procedure will be developed. The intent of this interview schedule will be to determine whether end-use services identified through the mail questionnaire really meet the objectives of our study andto probe their nature. All potentially interesting vendors identified through the mail questionnaire will then be interviewed by telephone. Subsequently, live interviews will be conducted with representatives of roughly two dozen promising systems. 4d1a2

To control the interviewing, an on-line list of vendors will be maintained, and reports from mailings, telephone interviews, and live interviews will be stored there. This status file will be available to the technical contract monitor. 4d1a3

In both the identification phase (the mail survey and telephone interviews) and the detailed examination phase (the personal interviews), the questionnaire instruments will stress features that assist human working processes, e.g., the writing of documents or the conversion of numerical data into forms that can be handled by numerical processing programs. 4d1a4

b. Survey of General-Purpose Systems 4d1b

SRI is already reasonably familiar with major developments among systems attempting to provide fully integrated on-line working environments. However, SRI will attempt to locate unknown systems by contacting likely research funding sources and other workers in this field. 4d1b1

SRI will obtain all available documentation and will conduct interviews with system designers. Where possible, use data will be collected, as well as data on prices and on the specific services actually available to users. Hardware, executive system software, and terminal constraints will be studied. 4d1b2

The analysis will be most detailed for NLS-8, the only currently operational system. As noted in the objectives section, this analysis will include cost, usage, and the extent to which individual tools are implemented, as well as system characteristics. However, the NSW project and the Information Automation project at USC's Information Sciences Institute are well into their development phase, and a detailed survey of their characteristics will be provided. The final system that will certainly be examined, NLS-9 with a Distributed Programming System (DPS), does not have firm development plans, but DPS and most of the tools for NLS-9 are fully developed, and the integration of NLS-9 with DPS is under consideration. 4d1b3

After collecting data, SRI will develop a systematic overview of the fully integrated systems. This overview will present methods being used to achieve integration and other methods that could be used. Problems encountered to date will also be discussed. Overall, a systematic conceptual overview will be provided. A systematic overview, rather than a bare catalog of services, is desirable because the systems are few in number and have not developed in isolation from one another. 4d1b4

c. Summary 4d1c

The project team will compare the current systems and emerging trends in the two areas surveyed: STI systems offering end-use services and integrated on-line working environments. A joint summary will be prepared, with emphasis given to the current usefulness and limitations of various end-use services, probable developments in the near future, and important trends. 4d1c1

d. Reports 4d1d

The Phase I report will have four sections: an Introduction to describe the study and review SRI's approach, followed by surveys of special-purpose and integrated end-use services available to STI users, and a 10- to 25-page summary. Detailed information about special-purpose systems offering assistance in the use of STI information will be presented in an appendix, which will probably appear as a second volume. 4d1d1

The report will be prepared on-line and made available for examination to the technical contract monitor. The summary will be extracted (an introduction will be added) and published separately. Fifty copies of the final report and 100 copies of the summary will be delivered to the Office of Science Information Services. Both the final report and the summary will be submitted in multifont, computer-typeset form. 4d1d2

2. Assessment Phase 4d2

a. Needs Assessment 4d2a

The needs assessment will be based on a review of the literature on (1) communication among scientists and technologists and (2) the ways computer technology has been used to augment general knowledge workers. The review of the STI literature will be roughly coextensive with what Paisley (R46) and Allen (R6) have characterized as "the scientist within his own head," and the "task team." 4d2a1

The literature review will go somewhat beyond the literature on information-seeking behavior, to deal with how scientists spend their working (other than communicating) time and with the information and work interactions that take place in a task team. It is important to do this, because the integration of STI services with end-use services obviously depends on what scientists and task teams actually do in their daily work. 4d2a2

After performing the literature review, SRI will extract a summary of the specific and general features that could be offered by a system to augment the end uses of STI and of the general features that such a system would need to fully integrate the end uses and be accepted by users. 4d2a3

b. Existing Capabilities and User Needs 4d2b

Having surveyed both the existing end-use capabilities of STI service and the probable needs of scientists and technologists, SRI will compare the two and will develop specific and general comparisons between capabilities and needs. It is not yet clear how the comparisons can best be done, because the approach will be influenced by the earlier results. However, it seems certain that a general comparison will be needed, embracing an overview of how closely the broad group of existing and emerging tools comes to augmenting end-use services. A taxonomy of individual features may also be desirable. It is hoped that a conceptually rich (rather than feature-by-feature) formulation of end-use services for STI can be developed, because this would serve to focus future research and planning. 4d2b1

c. Agenda of Opportunities for Action 4d2c

On the basis of the comparison of needs and existing capabilities, SRI will isolate two to five general strategies by which current capabilities could be expanded to meet the needs. One likely strategy is encouragement of sharing among individual STI services offering end-use tools, possibly including the creation of a few general tool packages to fill lacunae. Another is encouragement of current trends to develop fully integrated systems, perhaps including the creation of special environments to simplify the user interface to a number of STI tools. 4d2c1

The discussion of these strategies would include a broad spectrum of actions that would be required to ensure national availability and adequate quality. Examples might be: 4d2c2

(1) R&D to develop tools or probe user needs experimentally. 4d2c2a

(2) The setting of standards for data sharing among integrated or special-purpose systems. 4d2c2b

(3) The development of excellent user interfaces and training tools. 4d2c2c

(4) Strategies to integrate on-line users with colleagues lacking access to on-line services. 4d2c2d

(5) Strategies to affect the general adoption process through which bench work tools would become available to a broad spectrum of users. 4d2c2e

(6) Strategies for dealing with potential regulatory impediments to free growth (e.g., copyright, FCC restrictions on the use of computers for communication). 4d2c2f

(7) Research to probe changes in individual and team work processes that would arise from more extensive integration of STI and end-use tools. 4d2c2g

Although all possible actions cannot be discussed in extensive detail, all major action areas will be identified; the relative need for action in each area will be defined; and action agendas will be laid out in sufficient detail to give a clear focus for future R&D efforts. 4d2c3

After selecting the alternative strategies, SRI will evaluate each in terms of the probable cost to various agencies and the probable usefulness and generality of the products. Probable user acceptance and cost to users will also be evaluated. On the basis of the evaluation, SRI will propose one or two promising courses of action. If two are proposed, SRI will suggest a program for fuller evaluation of alternatives than the scope of the proposed study will permit. 4d2c4

d. Reports 4d2d

A final report for the entire project will be prepared on-line by the project team. During preparation, the report will be available to the technical contract monitor for comment. A 20- to 30- page executive summary of the project will also be written on-line and made available to the technical contract monitor for comment. The executive summary will be submitted to a scientific journal. 4d2d1

Both the final report and the executive summary will be published through multifont computer-typeset printing. Fifty copies of the final report and 250 copies of the executive summary will be presented to the Office of Science Information Services at the conclusion of the project. 4d2d2

E. Qualifications in This Area 4e

In 1961 and 1962, Dr. Douglas C. Engelbart completed two studies: "Special Considerations of the Individual as a User, Generator, and Retriever of Information" (R18) and "Augmenting Human Intellect: A Conceptual Framework" (R19) These studies reviewed the literature on human working forms, the emerging computer technology, and conceptual designs for human work systems, including Vannevar Bush's Memex. Engelbart concluded that (1) on-line tools could augment both the individual and working communities and (2) an integrated, on-line working environment could serve all types of groups and individual knowledge workers. 4e1

Between 1962 and the present, Dr. Engelbart's group has been developing an integrated working environment called NLS (for Online System). In 1974, NLS was made available to organizations outside the Augmentation Research Center, (ARC), where it was designed and implemented (R23). 4e2

Although heavily involved in the creation of NLS, ARC has been more broadly concerned with the problems of integrating people into the new working environments made possible by computer systems and with the general problem of building more flexible and more fully integrated working environments. ARC was concerned, for example, with the need to broaden NLS's core services by tying users to resources on other computer systems, especially to tools like large-scale information retrieval systems and special systems for large or fast numerical processes. As a result of its conceptual work, ARC was selected to design a distributed programming system and a front-end working environment for the NSW project, which is aiming at building a general user interface to resources on the ARPA Net. 4e3

ARC is also studying the adaption of a new version of NLS (NLS-9), which was developed under the NSW project, and of the distributed processing system (DPS) of the NSW project, to non-ARPA Net working environments. The future of this effort is not yet clear. 4e4

ARC is closely tied to other research organizations that are developing computer tool environments. For example, a teleconference is under way among system designers to probe the needs of future communication systems. The participants other than ARC consist of USC's Information Automation project, which is constructing a front-end working environment for correspondence creation and control in military organizations; MIT's project MAC, which is developing a general on-line working environment for computer programmers; Bolt Beranek and Newman, which is developing communication facilities for the ARPA Net , and several users. 4e5

As noted in the subsequent section on Institutional Information, SRI also has broad general competence in the surveying of state-of-the-art communication and telecommunication services. From its analysis of teleconferencing systems, the facsimile market, and many other technological services, SRI has developed techniques to survey an area comprehensively and efficiently and to analyze overall trends in an emerging field. 4e6

V PROJECT PLAN 5

A. Schedule of Activities 5a

1. The Survey Phase 5a1

The survey of special-purpose systems will begin January 2, 1976. During January and most of February, a list of prospective interviewees will be generated, and the mail questionnaire will be executed. Beginning in late February, telephone interviews will be conducted, and a few site visits will be made. During March and April, the site visits will be completed. 5a1a

The survey of general-purpose systems will also begin on January 2. SRI will collect documentation from known projects, will inerview project leaders in these efforts, and will attempt to locate additional projects. Between January and May, ARC will develop a conceptual overview of trends and techniques in the integration of work environments, pointing out areas where important trends are developing well and areas where developments have yet to emerge. The analysis will also consider the reasons for creating integrated work environments in terms of human work processes. The price of NLS service will be analyzed, and future cost trends for various types of integrated systems will be assessed. A survey of the features each system is likely to have will also be performed. 5a1b

In May and June, SRI will prepare the Phase I report and summary. As noted above, the report and summary will be prepared on-line, and the technical contract monitor will be invited to comment on them. Both the final report and the summary will be delivered (in printed form) to the Office of Science Information Services by July 1, 1976. During the project, monthly progress reports will be presented to the technical contract monitor; SRI would prefer to deliver these reports on-line. 5a1c

These dates assume receipt of a contract by January 2, 1976. If the contract negotiation is delayed, a corresponding slippage will occur in all dates. 5a1d

2. The Analysis Phase 5a2

It is assumed that the analysis phase will begin on August 1, 1976, provided this is acceptable to the OSIS. The analysis of needs will be completed by October 31, 1976. The comparison of needs with characteristics will begin on October 1 and will continue until November 15, 1976. From October 1, 1976 through January 15, 1977, alternatives for action will be examined, and the agenda for proposed actions will be formulated. By February 15, 1977, the final report and summary will have been written, and comments will have been solicited from the technical contract monitor. On March 15, 1977, the final report will be submitted to the OSIS. If the second phase begins later than August 1, 1976, a corresponding slippage will occur in other dates. 5a2a

3. Dissemination 5a3

As soon as possible after the completion of substantial portions of Phase I, SRI will present its results at a national professional society meeting. The same will be true of Phase II results. These presentations will be subject to approval by the technical contract monitor. Logical meetings for these presentations will be the national meetings of the American Society for Information Science and the International Conference on Computers. The ASIS meeting is a logical choice because many STI vendors and end users will be in attendance. The ICC is attractive because computer vendors, the developers of integrated on-line working environments and the funders of integrated working environments will attend it. The actual choice of conferences will be made on the basis of discussions with the technical contract monitor. The summaries for Phases I and II will be submitted for publication in technical journals. 5a3a

B. Project Management 5b

The project leader will be Dr. Raymond R. Panko. Dr. Panko will be responsible for the overall management of the project. The project supervisor will be Dr. Douglas C. Engelbart. 5b1

The survey of STI services offering significant end-use services will be led by Dr. Panko. The bulk of the interviewing will be done by Mr. Roger W. Hough and Dr. Richard C. Harkness. 5b2

The survey of integrated on-line working environments will be led by Mr. James E. White. Dr. Robert L. Lieberman, Mr. James H. Bair, and Mr. White will do the bulk of the interviewing and literature review. Dr. Engelbart will develop a framework for viewing the emergence of integrated working environments, with the assistance of Mr. White. 5b3

The analysis of past and ongoing research on communication among scientists and technologists will be performed by Dr. Panko. The comparison of existing capabilities with user needs will be led by Dr. Panko, with the actual comparison being performed by Mr. Bair, Dr. Engelbart, Dr. Harkness, Mr. Hough, Dr. Lieberman, Dr. Panko, and Mr. White. 5b4

The analysis of future research and action needs will be led by Dr. Panko. The analysis of the research needed to develop integrated on-line working environments will be led by Dr. Engelbart and performed by Dr. Engelbart, and Mr. White. The analysis of the research needed to develop special-purpose STI systems with end-use tools will be led by Mr. Hough. Technical problems of interconnection will be analyzed by Mr. White. Economic and standards problems will be analyzed by Mr. Hough and Dr. Panko. 5b5

VI BUDGET

6

VII INSTITUTIONAL INFORMATION 7

Stanford Research Institute is an independent, nonprofit, nonendowed research organization. The professional staff consists of about 2,900 people, over 400 of whom have Ph.D.s or equivalent degrees. Since its beginning in 1946, SRI has conducted more than 8,000 research projects throughout the world, examining technological, social, and economic problems. 7a

SRI has conducted numerous studies of computer applications and technological surveys. SRI's Augmentation Research Center (ARC), with a staff of 43, has pioneered the integration of computer services into knowledge work processes since 1962. ARC continues to be a leader in the development of techniques to integrate dispersed computer services for easy access by individual knowledge workers. SRI's Telecommunications Sciences Center (TSC), with a staff of 42, has conducted national and international surveys of state-of-the-art computer and telecommunications services. 7b

In addition to its broad professional staff, SRI has the extensive communication and computational facilities needed to conduct and analyze a national survey of computer services. SRI also has extensive computer-based composition and communication facilities, represented primarily by NLS, which will be used to coordinate the project and to prepare the final report and executive summary for computer typesetting. 7c

The following sections list some representative research projects of ARC and TSC and give biographies of project team members. 7d

Evaluation of Experimental and Operational Teleconferencing Systems 7e

The objectives of this research, being conducted for the National Science Foundation, are (1) to bring together in one document all the currently available information on audio, video, and computer teleconferencing systems that have been set up around the world, for either experimental or operational purposes, and (2) to present this information in a primer or handbook form, so that it can be used by government agencies and others as an aid to decision making. The results of the research are expected to be particularly applicable to the operation of federal government agencies. The principal benefits are expected to accrue from an increase in efficiency of operations. The coverage of the study is worldwide. The kinds of information being gathered include: system costs (start-up and operations); purpose; transmission capabilities (voice, video, facsimile, text, and so forth); number of locations; user characteristics; effectiveness; and usage and evaluative data. 7e1

Evaluation of FORUM Teleconference on Travel/Communication Trade-Offs 7f

This study assessed a recent international computer teleconference on the subject of travel/communication trade-offs. This conference, held over a two-week period in February 1974, included some 30 participants from the United States, Canada, and the England. The conference was one of several taking place via the NSF-funded FORUM teleconferencing system. 7f1

Assessment of the conference was a coordinated effort of SRI, Bell Canada, and Institute for the Future. Among SRI's contributions to the document was a description and analysis of communication patterns among the participants. 7f2

Study of Regulatory and Policy Problems Presented by Interdependence of Computer and Communication Facilities 7g

This study for the Federal Communications Commission investigated the growing interdependence of the computer and communications industries. As part of the study, it was necessary to estimate the extent of that interdependence by studying the trends in demand for telecommunications services through the use of data communications devices. This is one of the major uses to be expected in the next ten years of domestic telecommunications services. 7g1

National Academy of Sciences Interconnection Panel 7h

SRI has been engaged in studies of the technical problems affecting interconnection of user-furnished terminal equipment with the common carrier system. During 1969 and 1970, an SRI telecommunications expert served as a member of the National Academy of Sciences panel that was commissioned by the Common Carrier Bureau of the FCC to study the technical aspects of interconnection of customer-owned and -maintained equipment with the common carrier telephone facilities. In particular, he served as Chairman of the panel's Subcommittee on Network Control Signaling, an activity concerned with all aspects of control exerted by the customer's equipment on the switched network, and vice versa. The panel's report is considered a definitive work on the subject. 7h1

A Study of the Demand for Information Transfer 7i

SRI performed a trend analysis of the future needs and demands for communication and information transfer services in the United States from 1970 to 1990 for the National Aeronautics and Space Administration, Ames Research Center. Potential, as well as current, services were identified and classified into major categories, and quantitative estimates of the message traffic occurring within a given time period were established. 7i1

International Telecommunications Study 7j

This major study of U. S. international telecommunications for the Executive Office of the President drew together SRI telecommunications engineers and economists to analyze the operation of the U. S. international telecommunications common carriers and the Comunications Satellite Corporation. Industry structure, competition, and plant conditions were studied. Demand, circuit requirements, costs, and revenues were projected through 1975. The study presented the economic trade-offs among several alternative plans for telecommunications industry organization. 7j1

NLS (Online System) Development 7k

Since 1962 ARC has been developing NLS (Online System), an on-line working environment for typical knowledge workers rather than computer programmers. Approxinately 150 person-years have been invested in the development of NLS, with funding coming primarily from the Advanced Research Projects Agency of the Department of Defense and the Rome Air Development Center, and also from the Air Force Office of Science Research, the Office of Naval Research, the National Aeronautics and Space Administration, and the National Sciense Foundation. In 1974 a version of NLS was offered to clients outside ARC (see the Augmented Knowledge Workshop). 7k1

National Software Works Development 7l

Since mid-1974 ARC has been a principal contractor for the National Software Works (NSW) project of the Advanced Research Projects Agency, the Rome Air Development Command, and the Air Force Data Automation Agency. The NSW project will closely integrate various tools on different hosts on the ARPA Net in ways that are highly transparent to users. The project includes the development of a front-end minicomputer with core services (such as editing) for individual users, as well as the development of a distributed programming system and works management systems to control access. ARC has developed the Distributed Programming System and is currently debugging the front-end. ARC is also integrating the NLS Base subsystem into the front-end. 7l1

Development of an Augmented Knowledge Workshop User Community 7m

Since January 1974, ARC has been offering NLS to outside clients. There are currently 13 client organizations containing over 200 individual users. Clients form a community involved in the exploratory application of the Augmented Knowledge Workshop, dedicated to exploring on-line working environments, and exchanging user-developed subsystems. The most sophisticated subsystems built to date have been a financial management system for the Rome Air Development Center and a marketing information system for SRI's Office of Research

Operations. ARC supplies extensive technology transfer assistance, including on site training in NLS and the facilitation of dialogue among members of the Workshop. 7m1

Operation of the Network Information Center (NIC) for the ARPA Net 7n

Since 1970 ARC has operated the Network Information Center (NIC) for the ARPA Net. The NIC was funded by ARPA until mid-1975, thereafter by the Defense Communications Agency. NIC serves as coordinator for the collection and dissemination of information about the network. A primary service is the ARPA Net Resource Handbook, which lists useful programs, the hardware configurations of host computers, key people and their interests, bibliographic information, and scenarios for using programs and the network in general. NIC also acts as a clearinghouse for Requests for Comments, which are usually proposed changes in network standards, and maintains a listing of ARPA Net protocols (i.e., network standards). 7n1

Facsimile Markets 7o

Completed in 1971, this multiclient study assessed facsimile relative to competitive telecommunications media in a wide variety of current and potential applications. Detailed attention was given to the possible impact of technological innovation on facsimile performance. Projections to 1980 of markets for facsimile equipment, supplies, and services were based on applications in which facsimiles appear to offer a significant economic advantage over available alternatives. 7o1

Economic Viability Analysis of the Proposed U.S. Communications Satellite Systems 7p

To assist the Office of Telecommunications Policy in framing meaningful policy recommendations on domestic communications satellites, SRI recently studied the following issues: 7p1

-The nature and magnitude of the unique or committed demand for each applicant, and the total capacity and the excess or uncommitted capacity proposed by that applicant. 7p1a

-Each applicant's quantitative definition of the markets it would seek to serve with its uncommitted capacity. 7p1b

-The nature and magnitude of satellite transmission capacity that the uncommitted market sectors would support. 7p1c

The prospects for economic viability of each applicant in serving its unique or guaranteed market, and an appraisal of each applicant's dependence on the nonguaranteed market sector in light of several applicants' possible competition for the same markets. 7p1d

Analysis of Consumer Demand for Pay Television 7q

This study projected an upper bound on consumer demand for pay television to the year 1985. The projections were based on an extensive survey and analysis of operational pay television systems, plus an analysis of consumer behavior towards analogous situations: television viewing, spending at spectator situations, and early pay television experiments. A consumer survey was also used to collect evidence. The research was funded by the Office of Telecommunications Policy. 7q1

Technology Assessment of Communication/Travel Trade-Offs 7r

This study, which is currently being conducted for the National Science Foundation, is a comprehensive analysis of impacts that could be expected if telecommunications interact with travel demand in the future. The study will develop a set of policy options for achieving the most beneficial development of travel/communication interactions. 7r1

B. Biographical Sketches 7s

Biographies for SRI personnel who will participate in the project are listed in alphabetical order, beginning on the following page. SRI certifies that all personnel named here will be available to the project as it is proposed.,PES. 7s1

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The stage of research affects information-seeking behavior.

R2. Allen, T.J., "Managing the Flow of Scientific and Technological Information," Ph.D. dissertation, M.I.T., 1966.

Gatekeepers are important in determining what information reaches scientists and technologists.

High quality R&D organizations in competitive bidding situations use more internal communication and less communication outside the firm than bidders with lower quality proposals.

Scientists may use literature more than technologists because of their training, the nature of their tasks, or the adequacy of available STI information.

The work team is the most significant source of STI.

R3. Allen, T.J., M. Adrien, and A. Gerstenfeld, "Time Allocation among Three Technical Information Channels by R and D Engineers," Alfred P. Sloan School of Management Working Paper 184-66, M.I.T., 1966.

Information needs vary with the phase of the project.

R4. Allen, T.J., and P.G. Gerstberger, "Criteria for the

Selection of an Information Source," Alfred P. Sloan School of Management Working Paper No. 284-67, M.I.T., 1967.

Accessibility, familiarity, and ease of use are more important than quality in determining which sources of STI are used first, although not in determining the sources of information from which selection will be made.

R5. Allen, T.J., A. Gerstenfield, and P.G. Gerstberger, "The Problem of Internal Consulting in an R and D Laboratory," Alfred P. Sloan School of Management Working Paper No. 319-68, M.I.T., 1968.

When task teams doing similar tasks are compared, those using the larger amounts of communication with colleagues in the organization outside the work team are usually the more successful. Communication within the team is high regardless of performance.

Literature is often turned to first, probably in preparation for oral discussions.

R6. Allen, T.J., "Information Needs and Uses," in Annual Review of Information Science and Technology, Vol. 4, C.A. Cuadra and A.W. Luke, eds. (Encyclopedia Britannica, 1969) pp. 3-29.

Allen extended Paisley's conceptual framework to embrace not only the conceptual systems in which information seeking was taking place but also the organizations in the systems and the nature of the work being performed by the organizations.

R7. Allen, T.J., and Gerstberger, P.G., "Report of a Field Experiment To Improve Communications in a Product Engineering Department: The Nonterritorial Office," Alfred P. Sloan School of Management Working Paper No. 579-71, M.I.T., 1971.

A nonterritorial office, in which there are no fixed desks, improves communication.

R8, American Psychological Association, "Reports of the American Psychological Association's Project on Scientific Information Exchange," Report No, 10, 1965,

American and foreign scientists at an international meeting rated sources of information differently,

R9, American Psychological Association, "Reports of the American Psychological Association's Project on Scientific Information Exchange in Psychology," Report No, 11, 1965,

Stages of research affect information-seeking behavior,

R10, Auerbach Corporation, Department of Defense User Needs Study, Phase I, Final Technical Report, 1965,

A colleague in the work team is the modal choice for seeking information,

R11, Augmentation Research Center, "Online Team Environment: Network Information Center and Computer Augmented Team Interaction," Stanford Research Institute, Menlo Park, California, March 1968,

R12, Baker, N,R,, J, Siegmann, and A,H, Rubenstein, "The Effects of Perceived Needs and Means on the Generation of Ideas for Industrial Research and Development Projects," I,E,E,E, Transactions on Engineering Management, Vol, EM-14, No, 4, 1967, pp, 156-163,

Needs information (i,e,, demand information) most often comes from colleagues outside the immediate group, Even when special idea-generating group sessions are initiated, as many needs ideas come from outside the immediate group as from within the group,

R13, Brittain, J,M,, "User Studies in Education and the Feasibility of an International Survey of Information Needs in Education," Council of Europe, EUDISED Steering Group, Strasbourg, France, 1971,

Needs may be very different from demands.

R14. Crane, D., "Social Structure in a Group of Scientists: A Test of the 'Invisible College' Hypothesis," American Sociological Review, Vol. 34, No. 3, June 1969, pp. 335-352.

A scientist's field of research guides his or her problem selection.

R15. Crane, D., "The Nature of Scientific Communication and Influence," International Social Science Journal, Vol. 22, No. 1, 1970, pp. 28-41.

A scientist's field of research guides his or her problem selection.

R16. Del Frate, A.A., and J.T. Riddle, "Computer User Interaction: Does it Exist?" Proceedings of the American Society for Information Science Annual Meeting No. 36, Los Angeles, 1973.

Few people used the RECON system directly. Most worked through intermediaries.

R17. Drucker, P.F., The Age of Discontinuity (Harper & Row, 1968).

A growing portion of the society is involved in knowledge work, to the point where knowledge work, not manufacturing, will soon be the dominant working mode in America in the very near future, if it is not already. We badly need to understand how to make knowledge work more productive.

R18. Engelbart, D.C., "Special Considerations of the Individual as a User, Generator, and Retriever of Information," American Documentation, Vol. 12, No. 2, April 1961, p. 121.

This paper focused on the role of the individual knowledge worker, rather than on formal information systems, in the knowledge production and dissemination function.

R19. Engelbart, D.C., "Augmenting Human Intellect: A Conceptual Framework," Stanford Research Institute, Menlo Park, California, October 1962.

This was the original concept study that led to the development of NLS. The concept of an integrated on-line working environment was described. The document refers extensively to Memex and other STI tools and needs.

R20. Engelbart, D.C., and B. Huddart, "Research on Computer-Augmented Information Management," Stanford Research Institute, Menlo Park, California, March 1965.

R21. Engelbart, D.C., "Human Intellect Augmentation Techniques," Stanford Research Institute, Menlo Park, California, March 1968.

R22. Engelbart, D.C., "Coordinated Information Services for a Discipline- or Mission-Oriented Community," paper presented at the Second Annual Computer Communications Conference, January 24, 1973.

Describes how on-line and offline information services for a community of workers can be designed and coordinated.

R23. Engelbart, D.C., R.W. Watson, and J.C. Norton, "The Augmented Knowledge Workshop," Proceedings of the National Computer Conference, June 1973.

Describes the community of client organizations making use of on-line and offline working environments coordinated through the use of NLS and technology transfer techniques developed by the Augmentation Research Center and the client organizations.

R24. Friedlander, J., "Clinician Search for Information," Journal of the American Society for Information Science, Vol. 24, No. 1, (January-February 1973), pp. 65-69.

Ease of accessibility promotes use.

R25. Frischmuth, D.S., and T.J. Allen, "A Model for the Description and Evalutation of Technical Problem Solving," I.E.E.E. Transactions on Engineering Management, Vol. EM-6, No. 2, 1969, pp. 58-64.

Different sources of information are needed for idea generation and for problem generation.

R26. Frost, P., and R. Whitley, "Communication Patterns in a Research Laboratory," R&D Management, Vol. 1, No. 2, February 1971, pp. 71-79.

In this British study, not gatekeeper roles but rank and formal group membership determined how concepts entered the organization.

R27. Garvey, W.D., N. Lin, and K. Tomita, "Communication in the Physical and Social Sciences," Science, Vol. 170, No. 3963, December 11, 1970, pp. 1166-1173.

Social scientists differ from hard scientists in their information-seeking behavior.

R28. Gerstberger, P.G., and T.J. Allen, "Criteria Used by R and D Engineers in the Selection of an Information Source," Journal of Applied Psychology, Vol. 52, 1968.

Ease of use and familiarity affect what source is used first, although not necessarily which information source provides the information a scientist or technologist ultimately uses in his or her work.

R29. Goldberg, A.L., "Information Needs of Social Scientists and

Ways of Meeting Them," International Social Science Journal, Vol. 23, No. 2, 1971, pp. 273-284.

Social scientists use the library more than other scientists.

R30. Hagerstrand, T., Innovation Diffusion as a Spatial Process (Univ. of Chicago Press, 1967).

Propinquity affects communication.

R31. Hall, A., P. Clague, and T.M. Atchison, "The Effect of the Use of a SDI Service on Information-Gathering Habits of Scientists and Technologists," Institution of Electrical Engineers, INSPEC, London, 1972.

Scientists who use SDI services tend to value them despite a general decline in valuation among other scientists. A familiarity effect is suspected.

R32. Hall, E.T., The Hidden Dimension (Doubleday, 1966).

Propinquity affects communication.

R33. Hillman, D.J., "Customized User Services via Interactions with LEADERMART," Information Storage and Retrieval, Vol. 9, No. 11, November 1973, pp. 587-596.

There is much two-step flow in the use of STI; a person other than the seeker performs the actual search.

R34. Krulee, G.K., and E.B. Nadler, "Studies of Education for Scientists and Engineers: Student Values and Curriculum Choice," I.E.E.E. Transactions on Engineering Management, December 1960.

Differences among scientists and technologists are discussed.

R35. Langrish, J., et al., Wealth from Knowledge (MacMillan, London, 1972).

About two thirds of the important ideas leading to innovation in an industrial firm came from outside the firm.

R36. Lin, N., The Study of Human Communications (Bobbs-Merrill, 1973).

Propinquity affects communication.

R37. Line, M.B., "The Information Uses and Needs of Social Scientists: An Overview of INFROSS, "Aslib Proceedings, Vol. 23, No. 8, August 1971, pp. 412-434.

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Teachers differ from researchers in their uses of library services.

R38. Line, M.B., M.J. Britain, and F.A. Cranmer, "Information Requirements of Education Lecturers and School Teachers," Research Report No. 3, Bath University of Technology, Bath, England, 1971.

Teachers differ from researchers in their uses of library services.

R39. Line, M.B., M.J. Britain, and F.A. Cranmer, "Information Requirements of Social Scientists in Government Departments," Investigation into Information Requirements, Research Report No. 3, Bath University of Technology, Bath, England, 1971.

Social scientists in government positions need fewer information services than social scientists working in educational institutions.

R40. Line, M.B., "Summing Up: The Information Service in Practice," Aslib Proceedings, Vol. 26, No. 1, January 1974, pp. 47-53.

There seems to be a core of information that scientists absolutely need, to do their daily work, plus a mass of information that can be helpful in difficult-to-define ways.

R41. Menzel, H., "Scientific Communication: Five Themes from Social Science Research," American Psychologist, Vol. 21, November 1966, pp. 99-1004.

Needs are not identical to habits. A scientist's or technologist's way of proceeding and attitudes toward information souces may be unrelated to his or her need for information.

R42. Menzel, H.T., "Can Science Information Needs Be Empirically Determined?" in Communication: Concepts and Perspectives, L. Thayer, ed. (Spartan, 1967).

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R43. National Science Foundation, "Improved Dissemination and More Productive Use of Scientific and Technical Information," Program Solicitation NSF 75-23, Office of Science Information Service, 1975 (x32600).

R44. Nelson, J., "Faculty Awareness and Attitudes Toward Academic Library Reference Services: A Measure of Communication," College and Research Libraries, Vol. 34, No. 5., September 1973, pp. 415-423.

A faculty is generally ignorant of information aids.

R45. North American Aviation, "Department of Defense User Needs Study, Phase II," Final Technical Report, 1966.

A colleague in the work team is the modal choice for seeking information.

R46. Paisley, W.J., "Information Needs and Uses," in Annual Review of Information Science and Technology, Volume 3, C. A. Cuadra, ed. (Encyclopedia Britannica, 1968).

In his review section, Paisley advanced a conceptual framework for viewing a scientist as existing amid a number of roughly concentric systems or environments, beginning with the scientist's own head and extending through the work team, the formal organization, and so on, up to the level of the society as a whole.

R47. Parker, E.B., D.A. Lingwood, and W.J. Paisley, "Communication and Research Productivity in an Interdisciplinary Behavioral Science Research Area," Stanford University, Institute for Communication Research, 1968.

Research productivity is correlated with informal information seeking but not with formal information seeking.

R48. Pelz, D.C., and F.M. Andrews, Scientists in Organizations: Productive Climates for Research and Development (Wiley, 1966).

High individual performance relates to high levels of communication. Diversity of communication sources also correlates with high performance.

The work team is the most significant source of STI.

R49. Price, D.J. de S., Science Since Babylon (Yale, 1961).

R50. Rosenberg, V., "Factors Affecting the Preferences of Industrial Personnel for Information Gathering Methods," Information Storage and Retrieval, Vol. 3, June 1967.

Accessibility and ease of use determine which source of information will be used first.

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The type of information sought and the channels used depend on work setting, task, experience, seniority, education, and professional activiity, in ways that are difficult to discuss simply.

Task differences among scientists and among technologists dilute the traditional dissimilarities in information seeking styles between scientists and technologists.

The work team is the most significant source of STI, even for technologists.

R52. Rosenbloom R.S., and F.W. Wolek, "Technology, Information and Organization: Information Transfer in Industrial R and D.," Harvard Graduate School of Business, 1967.

Chance acquisition accounts for 30 percent of successful information-receiving episodes.

R53. Scott, C., "The Use of Technical Literature by Industrial Technologists," Proceedings of the International Conference on Scientific Information, NAS-NRC, Washington, D.C., 1959.

Dissimilarity of styles in a group is important to high performance.

R54. Slater, M.O., et al., "Data and the Chemist," Aslib Occasional Publication No. 10., Aslib, London, 1973.

Chemists make two data searches, on the average, each day.

R55. Smith, C.G., "Scientific Performance and the Composition of Research Teams," Administrative Science Quarterly, Vol. 16, No. 4, December 1971, pp. 486-495.

If leaders use different problem solving techniques from followers, there will be a higher volume of results.

R56. Sussex, University of, Science Policy Research Unit, "Success and Failure in Industrial Innovation," Center for the Study of Industrial Innovation, London, 1972.

Differences in information-seeking behavior were found between social and physical scientists.

Organizations that are superior in meeting market demand are better tied with communications to the outside world.

R57. Utterback, J.M. "The Process of Technical Innovation in Industrial Firms," Ph.D. dissertation, M.I.T, 1969.

Needs information (i.e., demand information) comes primarily from discussions with others, while most means information (i.e., solution information) comes from the individual. After the problem has been identified, information-seeking patterns change.

R58. Wolek, F.W., "The Complexity of Messages in Science and Engineering: An Influence on Patterns of Communication," in Communication among Scientists and Engineers, C.E. Nelson and D.K. Pollock, eds. (Heath Lexington, 1970), pp. 233-265.

It was speculated that complex messages require interpersonal communication.

Bdugetary Planning - not in proposal

Phase I

35K Survey of special-purpose STI systems

30K Survey of integrated on-line working environments

10K Summary of the surveys

10K Computer services

10K Report Production and Distribution

95K Total for Phase I

Phase II

25K Survey of information and working needs

10K Comparison of needs and current trends

45K Development of R&D Agenda

10K Computer services

10K Report production and distribution

100K Total for Phase II

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33672 Distribution

Douglas C. Engelbart, Martin E. Hardy, J. D. Hopper, Charles H. Irby, Harvey G. Lehtman, James C. Norton, Jeffrey C. Peters, Dirk H. Van Nouhuys, Kenneth E. (Ken) Victor, Richard W. Watson, Don I. Andrews, Israel A. Torres, Jan H. Kremers, Susan K. Ocken, Raphael Rom, David C. Smith, Buddie J. Pine, Andy Poggio, David L. Retz, Laura J. Metzger, Karolyn J. Martin, Jan A. Cornish, Larry L. Garlick, Priscilla A. Wold, Pamela K. Allen, Delorse M. Brooks, Beverly Boli, Rita Hysmith, Log Augmentation, Raymond R. Panko, Susan Gail Roetter, Robert Louis Belleville, Ann Weinberg, Adrian C. McGinnis, Robert S. Ratner, David S. Maynard, Robert N. Lieberman, Sandy L. Johnson, James H. Bair, Jeanne M. Leavitt, Rodney A. Bondurant, Jeanne M. Beck, Marcia L. Keeney, Elizabeth K. Michael, Jonathan B. Postel, Elizabeth J. Feinler, Kirk E. Kelley, N. Dean Meyer, James E. (Jim) White bev notes

I decided to be on vacation again this week as I got way behind last week when I went to menlo park. However, if you have any pressing questions, please call me on (408) 354-4096 or (408) 426-2218. 1

I will do most of my work on saturday and sunday this quarter. However, I hope to have time to check my mail during the week. There was no time for that this week so this note is a bit late. 2

1) Branch <xhelp,helpd,5h> contains the procedures for back links. 3

2) You can go ahead and modify core any time, just remember to update. 4

Dont lexicon items that only have general definitions common to more than one tool as these should appear in core. If you need a term which fits this description for a special purpose in the tool (i.e. a specific definition specific only to that tool) AND you DONT want the user to get that term (while in that file) when typing it out of the blue; then and only then (i think) should you lexicon the item and yes it should point to the more general definition in core. 5

3) I don't know what the best procedures are yet. I should know better after I've had a chance to do some work on core. Again, feel free to modify core. 6

The computer is about to go down so I'll have to make this short. I'm giving the WUC seminar this friday if all goes well. They have a video projector studio we'll use. After that, I hope to know better what kinds of things along those lines I'll be able to get credit doing. 7

I'm working with the "Galt Alternative School" to make a terminal available to those kids. Not WUC, but general educational stuff. Still very much in the planning stages. There might be the possibility of getting funding for some of this stuff but nothing is in sight. 8

I converted one of my lower division courses into an individual study class in "neural-pharmacological models of motivation" for which I must write a paper and get upperdivision credit. However, it means an even greater strain on my time. There is one class I can drop if things get too bad, but I'm going to see if I can hold on to them all. 9

I'm tentavely thinking about coming down this coming weekend (if i can get my car fixed in time (it won't start)). 10

I really appreciate the kirknotes, keep them coming. Also, call. 11

bev notes

(J33673) 12-OCT-75 23:29;;;; Title: Author(s): Kirk E, Kelley/KIRK; Distribution: /BEV([INFO-ONLY]) ; Sub-Collections: SRI-ARC; Clerk: KIRK;

33673 Distribution
Beverly Boli,

List of NLS users

I'm sure Rob Lieberman can set you up with a list of key people at each organization. You should realize, however, that some of the organizations have only one or two NLS users. 1

List of NLS users

(J33674) 13-OCT-75 10:00;;;; Title: Author(s): Raymond R. Panko/RA3Y; Distribution: /GCE([ACTION]) ; Sub-Collections: SRI-ARC; Clerk: RA3Y;

33674 Distribution
Gwen C. Edwards,