THE SOFTWARE TECHNOLOGY SUPPORT CENTER:
HELP FOR ACQUIRING SOFTWARE TOOLS

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ABSTRACT

Many automated tools are available to aid in the software development and maintenance processes. A significant problem for organizations involved in software development and/or maintenance is that there is a plethora of available tools. An organization that is considering acquiring tools to aid in software development/maintenance has difficulty making an appropriate selection from everything that is available. The Software Technology Support Center (STSC) was established at the Ogden Air Logistics Center (OALC), Hill Air Force Base, UT, specifically to meet that need. The STSC is the U.S. Air Force focal point for advocating, sustaining, and disseminating software tools and environments and information about them. The STSC is categorizing these tools by primary function and evaluating them by various criteria. The STSC has developed a Software Tool Evaluation Model (STEM) which serves as a model of an "ideal" tool. The STEM represents an ideal standard against which tools can be measured in terms of functionality and performance. The STSC is identifying tools within various categories and evaluating them systematically. The evaluation results and tool descriptions are maintained in a database which then serves as a basis for providing guidance to organizations interested in obtaining tools for their embedded software development/maintenance needs. In addition to its tool evaluation function, the STSC provides technical consultation, sponsors an annual STSC Conference in April, and provides current awareness to users through its periodic CrossTalk technical reports.

INTRODUCTION

Software development and maintenance continue to be areas in which the demand exceeds supply. Advances in hardware technology occur at a breathtaking pace resulting in orders of magnitude increases in the processing power of compact computers. However, computing systems still rely on the combination of hardware and software to be effective. Software development is a labor-intensive process. An increasing number of people are being trained in computer science and software engineering, in colleges and universities as well as in government and industry. However, while the supply of skilled people in the computer science field is increasing, the demand for software is increasing at a much faster rate. According to the Bureau of Labor Statistics, "Employment for systems analysts will grow much faster than the average for all occupations through the year 2000" [1].

Two techniques which have great promise for alleviating the software crisis are: (1) software modularity and reusability; and (2) more efficient use of software engineers and programmers. Much work is underway in the area of reusability. SofTech has been contracting with the Army for the Reusable Ada Packages for Information Systems Development (RAPID) program [2]. A number of other government and industrial organizations are emphasizing the development of software modules that are reusable in many applications. The concept is very similar to using standard hardware components (amplifiers, Programable Read Only Memories (PROMs), etc.) and assembling them in modular fashion to create a customized electronic unit. In the RAPID program, Reusable Software Components (RSCs) are developed, and the user can select those that perform the function(s) needed and integrate them into the overall design.

The second area—increasing the efficiency of software engineers and programmers—is the area being addressed by the Software Technology Support Center (STSC). One means of increasing efficiency is to supply software engineers and programmers with tools to make their job easier. Just as an automotive
technician needs sophisticated diagnostic equipment and a large number of specialized tools to repair and maintain today's complex automobiles, the software engineer needs an array of tools to help develop and maintain software. The software industry has recognized the importance of the Computer Aided Software Engineering (CASE) approach to software development and maintenance. They understand the need for providing an integrated Software Engineering Environment (SEE). However, a significant problem is that in an effort to provide software tools, vendors have developed so many tools and SEE's to the extent that the user is overwhelmed with possibilities. The STSC was established specifically to address this problem.

**Purpose**

The purpose of the STSC is to serve as a focal point for current information about software tools, development, maintenance environments, and methods. The STSC provides this information to all requesting Air Force organizations, including Software Support Activities (SSAs) and other interested Government, private industry, and academic organizations. This information encompasses the entire range of the software acquisition, development, and maintenance life cycle phases. Providing an authoritative and reliable source and service organization for information about software tools is the driving philosophy of the STSC, and is the motivation for why the STSC was established. The STSC was organized with planned objectives and with a structure and functions to make the STSC a valuable and effective user service organization.

**Objectives**

The objectives of the STSC are:

- To advocate the creation and use of advanced software tools, methods, and environments.
- To coordinate the activities of industry and Government organizations to satisfy DOD needs and to capture experience, expertise, and knowledge about available tools.
- To support the informed selection of tools and the acquisition and use of selected tools.

**Advocacy**

Most tools available to automate software development activities have been aimed at aiding the coding phase. Requirements definition, design, and testing phases have not had comparable levels of tool support. Fewer tools have been specifically targeted to the maintenance phase. However, these neglected areas account for the greatest part of the cost of software. Tool availability in the maintenance phase will result in significant savings.

The STSC advocates and supports the development of advanced software tools. The specific objectives are: (1) to identify and classify all available tools; (2) to identify the users of these tools; and (3) to translate user needs into improvements of the tools. Using quantitative criteria, the STSC is evaluating the most promising tools to aid users in selecting the most suitable tools for their applications. The STSC supplies information about tools to tool users and supplies information about user needs to tool developers.

**Tool Management**

The STSC performs logistics management to sustain tools and environments during their operational life. The specific tasks are: purchasing, storing, distributing, training, maintaining, and configuration tracking of tools. Vendors supply most of this support for their own tools. However, some Government-owned tools that satisfy critical Air Force needs across several projects currently have no support structure. They require STSC support to maintain their value. The STSC plays a significant role in tailoring tools and environments to specific Air Force needs. In performing this logistics management function, the STSC ensures that the Air Force investment in tools and environments returns the greatest benefits. This function is especially important for those tools developed and
owned by the Government, which until now have received almost no distribution or life cycle support. The greater use of tools already paid for and owned by the Government will result in two major benefits. First, the use of these tools will permit the Government to maximize the value of these tools. Second, if these tools are known and used, it will preclude the perceived need to develop similar tools performing the same functions, thus helping overcome the problem of unnecessary tool proliferation.

**Liaison**

The STSC performs a "matchmaker" role between tool developers and Air Force tool users by increasing compatibility and efficiency among software support environments. The STSC encourages developers to make the improvements and extensions to tools needed by Air Force users. The STSC is involving Air Force users in: (1) developing standards that tool developers will follow; (2) fostering the development of effective tool requirements and compatible interfaces among tools; and (3) promoting reusable solutions to software development and maintenance problems for Air Force-wide applications.

**Coordination**

The STSC is coordinating activities to serve the needs of the users. The coordination entails ascertaining the needs and capabilities of the users, knowing the tools that are available for different functions, and being able to apply the expertise and experience of the STSC’s personnel to help the users.

**STSC ORGANIZATION**

The STSC was organized under the Embedded Computer System (ECS) Software Improvement Program (ESIP) [3].

As can be seen, the STSC provides a supporting role, but it is integrated within the ESIP Working Group. In addition to the other five ESIP areas, the STSC works with other Air Force and Department of Defense (DOD) organizations that are also involved in software tools and software environments. These organizations are listed below:

- Ada Joint Program Office (AJPO)
- Air Force Institute of Technology (AFIT)
- Aerospace Guidance and Metrology Center (AGMC)
- Software Center for Excellence
- Software Engineering Institute (SEI)
- Software Technology Application Program Management (TAPM)
- Software Technology for Adaptable Reliable Systems (STARS)
- Software Productivity Consortium

The STSC is an integral part of the Ogden Air Logistics Center (OO-ALC) and is located at Hill Air Force Base, UT. The STSC is staffed by civilian and military Government personnel with support by several contractors.

**STSC Management and Teams**

The primary purpose of the STSC is to serve its customers. With this purpose in mind, the STSC has been structured with an overall management function and three support teams.
Management

The management function provides overall direction and administrative support for the STSC. Management personnel coordinate with other Air Force organizations and provide policy, planning, budgeting, and contract administration for STSC contractors.

STSC Customer Support Team

The Customer Support Team is the most visible group of the STSC. The Customer Support Team is the direct interface with the customers, and customers gain their impressions of the STSC based on the activities and helpfulness of this team. The Customer Support Team is responsible for identifying and assisting Air Force users of software technology. The Customer Support Team is not a "passive" function waiting for users to come to them. The Customer Support Team takes action to find out who potential users are and to make them aware of how the STSC can provide real benefits to the user community. Furthermore, the Customer Support Team assesses the needs and capabilities of the customers so that the STSC can tailor its responses to be of optimum help and benefit. The Customer Support Team also serves as the Public Relations and Communications component of the STSC.

STSC Technical Support Team

In order for the Customer Support Team to fulfill its responsibilities to the users, it needs to have access to evaluated and validated information to be provided to the users. Nothing would defeat the purposes of the STSC faster than for the Customer Support Team to dispense inaccurate or misleading information and recommendations. Therefore, the Technical Support Team plays a vital role in the STSC operation. The key to the technical support is the test and evaluation of candidate software tools. The STSC has developed the STEM, an "ideal" standard against which software tools are evaluated. The STEM and the test and evaluation function were presented in a NAECON '90 paper by Capt. Berk and Mr. Hanrahan [4].

STSC Tool Support Team

The Tool Support Team serves several roles: (1) to monitor the software tool industry to identify and track tools as they become available; (2) to maintain data and information about tools in a Relational Data Base Management System (RDBMS); (3) to serve as a "proving ground" for tools by acquiring tools for test and evaluation and exercising tools in realistic software support environments; (4) to determine which tools have wide application; and (5) to make quantity purchases of tools and to maintain an inventory of them. In this latter role, the STSC serves in a capacity similar to that of the Defense Electronics Supply Center (DESC) of the Defense Logistics Agency (DLA) in maintaining and supplying standard electronic parts.

The remainder of this paper concentrates on the Central Data Base (CDB) for data and information about software tools and environments.

STSC Central Data Base

The STSC CDB describes available tools, customer experiences with these tools, and evaluations of these tools. At this point, the CDB has been implemented as a prototype. The CDB will be very important for the Customer Support Team since the person responding to a customer's request will often need to use the data base to provide an answer. The CDB will also be maintained on a network node so that users can access the CDB directly. The STSC CDB is hosted on a MicroVAX II (VMS operating system) computer at Hill AFB. The CDB is currently operational as a prototype and will be made available to customers when the design is sufficiently mature. The user interface is not yet refined to make it sufficiently "user friendly."

Development of the Prototype STSC CDB

SofTech is following a MIL-STD-2167A software development cycle in establishing a prototype STSC CDB, i.e., software requirements analysis, design, coding, test including integration testing, and implementation. Appropriate documentation corresponding to each phase is being prepared. This documentation includes a Software Development Plan, Software Requirements Specification, Data Base Specification, Software Test Plan, and User's Guide.

SofTech determined that a Commercial Off-The-Shelf (COTS) RDBMS would be used and that the Transact Structured Query Language (SQL) and possibly Fourth Generation Language(s) (4GLs) may be used for coding. It was also a stipulation that the CDB would be hosted on a MicroVAX II maintained at Hill AFB. Following a trade study, SYBASE was selected as the RDBMS.

The CDB was designed using the Software Engineering Workbench tool which generated the Entity-Relationship (E-R) diagrams. Prototyping tech-
niques are being used to ensure effective user interfaces. The CDB comprises four primary components: Tools Data Base, User Data Base, Test and Evaluation Results Data Base, and Test and Evaluation Procedures Data Base. The diagram shows the data bases conceptually as separate entities, although the data bases are all contained in the overall CDB architecture.

Customer Data Base

The Customer Data Base contains detailed information about users of the CDB and STSC customers. Included in this data base are such data as names, addresses, telephone numbers, areas of interest and experience, and type of work performed. Limitations on types of data that may be accessed are implemented to prevent those without a need to know from obtaining privileged information. This data base is not implemented as part of the current prototype, but it will be included as the design of the CDB progresses.

Tools Data Base

The Tools Data Base provides information regarding software tools available to the Air Force. Included in this data base is a list of tools, vendors, points of contact, and tool descriptions. Commentary on the tools by customers may also be included.

Test and Evaluation Procedures Data Base

The Test and Evaluation Procedures Data Base contains the procedures used in the tool evaluation process. These procedures are made available for two primary reasons: (1) to allow the tool user to determine the validity of STSC’s evaluation methodology in relationship to their own needs; and (2) to allow the tool user to duplicate the STSC evaluation for tools not addressed by the STSC.

Test and Evaluation Results Data Base

The Test and Evaluation Results Data Base contains the results of the tool evaluation process. The STEM used for the evaluation is contained in this portion of the CDB. The data base will contain a set of criteria used for the evaluation of the tool. Associated with each criterion is a score and a default weight. The total score based upon the default weight will be available. For certain user requirements, the user may wish to assign weighting values to criteria other than the default weights for those criteria of particular importance. A capability to assign user-requested weights to specific criteria is not part of the initial prototype, but it will be included as the design of the CDB progresses.

The STSC Toolbox/PC

A product that preceded the STSC CDB is the STSC Toolbox/PC. It operates on an IBM-compatible PC. The STSC Toolbox was first distributed at the STSC Conference in April 1990. The STSC Toolbox is an organized collection of information about software tools based on STEM categories. An updated STSC Toolbox will be distributed at the STSC Conference in April 1991. The Toolbox allows the user to retrieve tool data and information by various categories and parameters and also provides a convenient way for the tool users to report their experiences back to the STSC. The tool categories are as follows:

- Software Management
- Software Requirements
- Design
- Coding
- Testing
- Utilities
CONTINUING STSC ACTIVITIES

Annual STSC Conference

The Annual STSC Conference represents one of STSC's continuing activities. The conference provides an opportunity for Air Force users, the STSC, private industry, and academia to exchange ideas, share information, and catch a glimpse of the future direction of Air Force software tools, methods, and environments. Proceedings are published and distributed.

The CDB will be demonstrated at the STSC Conference in Salt Lake City, UT in April 1991. During the STSC Conference, STSC personnel will be soliciting comments and suggestions on the STSC CDB to ascertain whether it meets user requirements and to solicit suggestions for how it can be improved.

Technical Consultation

The STSC provides direct person-to-person technical consultation to users through its Customer Support Team as was mentioned earlier. The STSC welcomes the opportunity to help customers with their software tool requirements and problems and also to find out about how the STSC can better serve its customers' needs.

Technical Report (CrossTalk)

The STSC publishes a free periodic technical report, CrossTalk, which is distributed to over 2,500 recipients. CrossTalk provides articles and information about new software tools and environments, STSC activities, and items from other sources that are of interest to STSC customers. To obtain a copy of this report, call or write:

George A. Klipper Phone: AV 458-7703
STSC (801) 777-7703
OO-ALC/TISAC
Hill AFB, UT 84056

Electronic Bulletin Board System (EBBS)

The STSC EBBS network permits the STSC to issue memoranda and notices, to receive messages from customers, and is one of the means by which customers can access the CDB. The STSC EBBS contains the latest copy of CrossTalk as well as information on numerous tools.

Phone: (801) 777-7553
(2400 Baud, 8 bits, 1 stop bit, no parity)

Publications

The STSC publishes and distributes documents to requestors. An early document outlined the STSC Strategy [5]. Another document the STSC has published is the Software Management Guide, principally authored by Ray Rubey of SofTech [6]. This guide assists personnel such as Air Force Program Managers who have the responsibility of acquiring software and managing the system (including software) acquisition effort.

The STSC has released three interim reports to make available to its customers information that has been collected to date and to receive customer input. These reports are on Software Test Tools [7], Software Documentation Tools [8], and Software Requirements Analysis and Design Tools [9].

History and Future

The STSC was established in 1988 at the Ogden Air Logistics Center (OO-ALC) at Hill Air Force Base, UT. The beginnings of the STSC were described in a NAECON paper presented by Reuel Alder at NAECON '89 [10].

At NAECON '90, Robert Hanrahan presented a paper discussing the test and evaluation process used by the STSC with particular emphasis on the STEM [4]. This paper, being presented at NAECON '91, reports on progress made by the STSC with particular emphasis on the STSC CDB. A prototype STSC CDB will be demonstrated, and an updated STSC Toolbox will be available at the April 1991 STSC Conference. The STSC Toolbox was first distributed at the April 1990 STSC Conference held in Salt Lake City, UT.

The STSC is proceeding on schedule with its activities and is continuing to develop its capabilities. We anticipate presenting a paper at NAECON '92 that will update progress and provide more technical details.
REFERENCES


5. STSC, Ogden Air Logistics Center, 00-ALC/MMETI, STSC Strategy, April 1990.

6. STSC Ogden Air Logistics Center, 00-ALC, Software Management Guide, October 1990.


