AVAILABILITY OF Ada AND C++
COMPILERS, TOOLS, EDUCATION, AND TRAINING

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July 1991

Prepared for
Director of Defense Information
Office of the Assistant Secretary of Defense (OASD)
Command, Control, Communications, and Intelligence (C3I)

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The DoD is in the process of gathering information on the status of market offerings for software engineering environments. This paper identifies and analyzes (1) compiler and computer-aided software engineering (CASE) tools that support the software engineering process for applications written in the Ada and C++ programming languages, and (2) associated training and education available for each language. The primary focus was on business systems; application domains such as artificial intelligence, computer-aided design/computer-aided manufacturing, and embedded systems were excluded. Only commercial-off-the-shelf (COTS) products from U.S. vendors were considered. The data provided will be used by the DoD in the development of a business case to determine whether any waivers to the Ada requirement for business systems may be warranted.
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PREFACE

This paper presents the results of a five-week study to determine the comparative availability of compilers, tools, education, and training for the Ada and C++ programming languages.

The delivery of this paper responds to Task Order T-J5-954, which requested the Institute for Defense Analyses (IDA) “to identify, analyze, and report on (1) compiler and automated engineering tools that can support and supplement current software development, integration, test, and support functions of Ada and C++ programming languages and (2) associated training and education available for each language.” This report will be one of several information sources used by the Department of Defense in the development of a business case to determine whether any waivers to the Ada requirement may be warranted for business systems.

This document was reviewed by the following members of the Institute for Defense Analyses: Dr. Richard Morton, Dr. Richard Wexelblat, and Dr. Richard Ivanetich.
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1. INTRODUCTION

The use of compilers and tools that support modern software engineering practices has the potential to greatly increase programmer productivity. Many U. S. and European companies are offering off-the-shelf products that support some aspect of the software engineering process with choices of design and development paradigms, and implementation language. The Department of Defense (DoD) is interested in the status of market offerings for software engineering environments to support the software life cycle.

The Institute for Defense Analyses (IDA) was tasked by the Director of Defense Information, Office of Assistant Secretary of Defense (C3I) to identify, analyze, and report on (1) compiler and automated engineering tools that can support and supplement current software development, integration, test, and support functions of Ada and C++ programming languages, and (2) associated training and education available for each language. This report will be one of several information sources used by the DoD in the development of a business case to determine whether any waivers to the Ada requirement for business systems may be warranted.

1.1 BACKGROUND

The Ada programming language, standardized in 1983, is Congressionally mandated for software development within the DoD. The 1983 standard, informally known as Ada83, is currently under revision in the normal American National Standards Institute (ANSI) process. Two important changes planned are an extension of Ada's data abstraction capabilities, adding object-oriented programming features, and improved control over concurrency for real-time applications. The DoD has also established a rigorous compiler testing and validation process used in the U. S. and Europe as a mechanism for determining conformity to the standard.

C++ is an incremental addition to the C language that includes type checking and provides object-oriented programming features. The C language was standardized in 1989 but there is no standard for C++ and no formal compiler testing and validation process for C or C++. Thus, there could be considerable variation among the C++ products reported in this study; time constraints preclude conducting an in-depth analysis of this variability.
1.2 SCOPE

This report documents a five-week effort to collect and analyze information on the market availability of Ada and C++ compilers, tools, education, and training. We have eliminated from discussion such application domains as artificial intelligence, computer-aided design, and embedded systems because the primary focus of this study is on business systems. We also excluded Fourth Generation Languages (4GLs) as a category of Computer-aided Software Engineering (CASE) tools because 4GLs are for the most part proprietary, non-procedural languages that have limited utility during the maintenance phase of a large, complex business application. Where they were reported, we made note of extended compiler libraries that provide interfaces or bindings to other Federal Information Processing Standard (FIPS) languages and protocols and to International Organization for Standards (ISO) libraries. For the purpose of this report, we considered operating system services and utilities generally provided with computer systems as basic extensions to the capabilities of a software engineering environment. Finally, only commercial off-the-shelf (COTS) products available from U. S. vendors were considered in this study.

1.3 DEFINITION OF TERMS

There are many tool vendors who offer products for specific jobs during software development. Some tools are designed for use with a particular programming language, with a particular program development method, or during a specific part of the software life cycle. In this report, we have investigated the availability of tools that are coupled with compilers and those that extend software engineering support of certain phases of the software life cycle. For the purpose of this report, the following definitions of terms apply:

- **Tool:** A tool is a software product or package which serves a quite specific and narrow purpose for programming such as, for example, a source code editor or a static debugger.

- **CASE:** CASE tools are collections of tools that support specific task activities performed during the software life cycle, such as requirements analysis, preliminary design, program testing, or verification.

- **Environment:** An environment is used here to mean computer and communications hardware and software, including operating systems and a tool set for supporting tasks during the software life cycle. Some degree of interoperability among tools may exist but the general translation of data structures and their semantics among tools and environments without loss of information requires further research and development.
1.4 APPROACH

Commercial suppliers of Ada and C++ compilers, CASE tools, and training in the use of Ada and C++ were contacted by telephone to solicit the information used in this study. The source of information concerning commercial suppliers was lists published by the Association for Computing Machinery (ACM) Special Interest Group on Ada (SIGAda), Ada Joint Program Office (AJPO), journals and data collected by IDA in connection with several other tasks such as Ada Technology Insertion and the Strategic Defense Initiative Office (SDIO) Software Technology Plan. Data collected during the survey was analyzed to determine current status and indications of trends of significance to information business systems. Since the information on specific products and training collected during this study may be of interest to others concerned with the application of Ada and C++, it is documented in Appendices A-H.
2. FINDINGS AND DISCUSSION

2.1 Ada COMPILERS AND TOOLS

There are 28 companies located in the U. S. that have Ada compilers with current validated status. The official list of validated Ada compilers published by the AJPO and National Institute of Science and Technology (NIST) pairs Ada compiler names with the computer systems that make up a validated Ada implementation.

For this survey, the following information was solicited from compiler vendors:
- products (how the compiler is marketed and any other tools)
- prices
- maturity (earliest validation date)
- education/training (includes courses and consulting)
- other languages (specifically C++)
- customer base

Table 1 provides the names of companies contacted during this survey along with data on platform type, prices, and primary business of the company.

Appendix A documents the information provided by the compiler vendors.
<table>
<thead>
<tr>
<th></th>
<th>Ada Compiler Vendors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Price Range</td>
</tr>
<tr>
<td></td>
<td>low</td>
</tr>
<tr>
<td>1.</td>
<td>AEtech Compilers</td>
</tr>
<tr>
<td>2.</td>
<td>Altech Systems Ltd.</td>
</tr>
<tr>
<td>3.</td>
<td>Alliant Computer Systems</td>
</tr>
<tr>
<td>4.</td>
<td>Alsys Compilers</td>
</tr>
<tr>
<td>5.</td>
<td>Apollo Computer Systems</td>
</tr>
<tr>
<td>6.</td>
<td>Concurrent Computer Corp. Systems</td>
</tr>
<tr>
<td>7.</td>
<td>CONVEX Computer Corp. Systems</td>
</tr>
<tr>
<td>8.</td>
<td>DDC International Compilers</td>
</tr>
<tr>
<td>9.</td>
<td>Digital Equipment Corp. Systems</td>
</tr>
<tr>
<td>10.</td>
<td>E-Systems, Inc. Systems</td>
</tr>
<tr>
<td>11.</td>
<td>Encore Computer Systems</td>
</tr>
<tr>
<td>12.</td>
<td>Harris Systems</td>
</tr>
<tr>
<td>13.</td>
<td>Hewlett-Packard Systems</td>
</tr>
<tr>
<td>14.</td>
<td>IBM, IBM Canada Ltd. System</td>
</tr>
</tbody>
</table>

* PC = Portable Computer; WS = Work Station; MF = Main Frame
** n/a = not available
<table>
<thead>
<tr>
<th></th>
<th>Price Range</th>
<th>Platform</th>
<th>Training</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>low</td>
<td>high</td>
<td>PC/WS/MF*</td>
</tr>
<tr>
<td>15. Intermetrics Compiler</td>
<td>$50,000</td>
<td>$30,000</td>
<td>WS</td>
</tr>
<tr>
<td>16. Irvine Compiler Compiler</td>
<td>$5,000</td>
<td>$18,000</td>
<td>(self-host)</td>
</tr>
<tr>
<td>17. Meridian Software Systems Compilers</td>
<td>$249</td>
<td>$6,500</td>
<td>PC</td>
</tr>
<tr>
<td>18. MIPS Computer Systems Systems</td>
<td>n/a</td>
<td>n/a</td>
<td>Note: No information provided</td>
</tr>
<tr>
<td>19. R.R. Software Compilers</td>
<td>n/a</td>
<td>PC</td>
<td>DOS</td>
</tr>
<tr>
<td>20. Rational Systems</td>
<td>$25,000</td>
<td>$48,000</td>
<td>WS/MF</td>
</tr>
<tr>
<td>21. Rockwell International Systems</td>
<td>n/a</td>
<td>n/a</td>
<td>Note: No information provided</td>
</tr>
<tr>
<td>22. SD_SCICON Systems</td>
<td>n/a</td>
<td>WS</td>
<td>VMS</td>
</tr>
<tr>
<td>23. Silicon Graphics Systems</td>
<td>n/a</td>
<td>MF</td>
<td>Note: No information provided</td>
</tr>
<tr>
<td>24. Tartan Laboratories, Inc. Compilers</td>
<td>$20,000</td>
<td>$48,000</td>
<td>WS</td>
</tr>
<tr>
<td></td>
<td>$30,000</td>
<td>$140,000</td>
<td>MF</td>
</tr>
<tr>
<td>25. TeleSoft Compilers</td>
<td>$4,500</td>
<td>$7,500</td>
<td>WS</td>
</tr>
<tr>
<td></td>
<td>$20,000</td>
<td>$90,000</td>
<td>MF</td>
</tr>
<tr>
<td>26. Texas Instruments Systems</td>
<td>n/a</td>
<td>WS</td>
<td>VMS</td>
</tr>
<tr>
<td>27. Verdiix Compilers</td>
<td>n/a</td>
<td>WS</td>
<td>SUN OS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MF</td>
</tr>
<tr>
<td>28. Wang Laboratories Systems</td>
<td>n/a</td>
<td>n/a</td>
<td>Note: No information provided</td>
</tr>
</tbody>
</table>

* PC = Portable Computer; WS = Work Station; MF = Main Frame
** n/a = not available
2.1.1 Ada programming tools are available with the compiler or as extra options.

All of the vendors provide a minimal set of tools for Ada code development which includes the compiler, editor, debugger, library manager, and runtime environment. Beyond this minimal set, vendors also offer an optimizer, profiler, language-sensitive editor, cross referencer, math library, and simulator (if a cross-compilation system). The major variability of these offerings is whether the tools are bundled in the compiler price or are sold separately. Special tools, such as the language-sensitive editor or profiler, are often part of a package of software engineering tools that can be purchased separately. Bindings to software products such as IBM's database (IMS), graphical data display, and interactive program development facility are provided by several vendors who supply the IBM mainframe Ada environment for business applications. Compiler vendors are beginning to provide bindings to standards such as X-Windows, Structured Query Language (SQL), Programmer's Hierarchical Interactive Graphics (PHIGS), and MOTIF to facilitate development of user interfaces to applications and data.

2.1.2 Ada compilers and tools are hosted on a variety of computer manufacturer equipment and widely available operating systems.

Compilers and environments are offered for personal computers (PCs), workstations, and mainframes that are available on General Services Administration (GSA) schedules, DoD requirements contracts, or are part of the government's installed inventory of general purpose computers. Industry promotion of Motorola and Intel processors has resulted in the availability of compilers that are compatible with PCs and workstations sold under many brand names. The enduring popularity of MS/DOS and UNIX for PCs and workstations is also reflected in the availability of Ada compilers from more than one vendor. For example, four Ada compiler vendors provide compilers for PCs operating under MS/DOS 3.0 or higher while eight vendors provide compilers for UNIX-based operating systems for PCs, workstations (including Reduced Instruction Set Computer (RISC) machines), and mainframe computers. The installed customer base of Digital Equipment Corporation (DEC) in the U. S. is reflected in the number of Ada compiler vendors (six) who provide compilers and tools for DEC's VMS operating system. Three vendors provide compilers and tools for IBM's mainframe operating systems. Two vendors also provide Ada compilers and tools for the Macintosh.

Ada compiler vendors are sensitive to commercial demand for a particular computer and/or operating system. Watching what a compiler vendor drops from his validation schedule is a perceived weakness in commercial demand for a computer system. The cost of obsolescence is unknown; however, it is true that the government must pay higher than typical maintenance fees for
equipment, operating systems, and Ada environments that have been made obsolescent by technology advances. One compiler vendor stated that the maintenance fee is $50,000 per year for a compiler version that is not a current product. It has been estimated by several compiler vendors that they spend approximately $100,000 for each compiler version that successfully completes the Ada validation process every two years. Naturally, vendors intend to maximize their return on investment by targeting growing industry markets. However, government users may not be able to find an Ada compiler for vintage Automated Data Processing Equipment (ADPE) and operating systems without paying a compiler vendor to customize a compiler for them.

2.1.3 There are two major vendor categories: compiler developers and system vendors.

The Ada compiler developers (12 of 28) are those that build Ada compilers as their primary business activity. They build compilers (and tools) for a variety of hosts and target computers with cross-compilation support suitable for real-time and embedded applications. The second category of system vendors (16 of 28) are those that build systems and provide an Ada compiler for their hardware systems. In some cases, the system vendors have obtained a compiler from an Ada compiler developer.

During the survey, one vendor indicated that he believed that almost all the system vendors had their compilers originally developed by one of the “Ada compiler developers.” It appears that these developers and at least one of the system vendors (DEC) were the commercial source of the Ada compiler technology. For example, Telesoft does about $1 million in business a year with Cray to maintain the Ada compiler on that machine, though the compiler is marketed through Cray only. Thus, many of the system vendors are actually customers of the compiler developers, and the same compiler can in some cases be obtained from either the system vendor or the developer.

2.1.4 Compiler purchase prices range from $249 for a PC to $400,000 for a multi-user mainframe.

The average price for an environment is $7500 for a network file server. For a PC, there are compilers ranging from $249 to $3000, depending on the number of tools provided and the power of the PC. Discounts of 20-30% are negotiable and at least two vendors provide discounts to academic users. The price of software for mainframes is the highest and also provides a richer environment than is possible for a PC or workstation. Some vendors provide monthly lease options and separate maintenance contracts. A maintenance contract with the compiler vendor includes software problems/errors fixes and product improvements in successively validated versions of the compiler.
2.1.5 Three Ada vendors support IBM business system environments.

Historically, business systems maintain corporate data bases and financial systems on IBM equipment or Instruction Set Architecture (ISA) compatible computers. The following is a profile of the tools and interface packages available for mainframes and IBM operating systems (i.e., VM/SP, VM/XA, VM/ESA, MVS/SP):

- on-line publication system
- source-code formatter
- library manager
- source-level debugger
- profiler (run-time performance measurements)
- dependency lister
- cross-reference utility
- interface to graphical data display (IBM environment)
- interface to interactive program development facility (IBM environment)
- interface to Information Management System (IMS) (IBM environment)
- standard math functions, including ISO Numerics Working Group (NUMWG)

Information provided by IBM indicates that Ada is a major product strategy and that implementing bindings and protocols to access products implementing other standards is being pushed (e.g., SQL, PHIGS, Portable Operating System Interface for Computing Environments (POSIX)). In addition to IBM, Ada compilers for IBM system environments are provided by Intermetrics and Alsys.

2.1.6 Stability and maturity characterize Ada vendors.

Most of the vendors (20 of 28) have provided validated compilers for more than 5 years. That is a relatively mature group of vendors, given that the Ada language standard dates from 1983. In the past three years, vendors have enlarged the basic compiler tool set to include design, documentation and testing tools and are now offering some bindings to FIPS and industry standards (e.g., X-Windows, MOTIF).
Information concerning the customer base was either not available or companies were unwilling to disclose these numbers. From the information obtained, there appears to be a wide variance in the size of the customer base. If the vendor (such as Alliant) makes supercomputers, then its customer base may only be a handful. Conversely, a vendor of DOS-based systems (such as Meridian) may claim a customer base of several thousand.

2.1.7 Ada compilers provide interfaces to other languages.

The pre-defined pragma interface is a feature of the Ada language that has caused concern about the uniformity of "openness" among Ada compilers. A review of recent validation documents for the 150 compilers formally tested under Ada Compiler Validation Capability (ACVC) 1.11 shows that almost all compilers support pragma interface to assembler languages of various sorts, C, and Fortran languages. Several provide an interface to Pascal and one to Cobol. The ability to import and export names and objects permits programmers to reuse non-Ada programs and operating systems or run-time services. (See Appendix B for interface names.)

2.1.8 New developments

For a handful of vendors (DEC, IBM, Verdix), there is a movement towards providing an "integrated development environment" that encompasses most phases of the software development life cycle. For the implementation phase, there are tool sets offered with the compiler. For the phases of requirements definition and design, this environment supports various off-the-shelf CASE tools. The objective is to eliminate some of the redundant work in going from requirements to design and from design to implementation. Both DEC and Verdix have either a database or "object repository" that maintains those objects.

2.2 C++ COMPILERS AND TOOLS

Eighteen out of the 22 vendors surveyed market C++ products on the commercial market as well. One of the 22 vendors sells only to other software vendors and 3 companies claimed to not have the C++ products. Table 2 is a summary of the data collected and documented in Appendix C.
Table 2. C++ Product Vendors

<table>
<thead>
<tr>
<th>Product Features</th>
<th>Profiler</th>
<th>Debugger</th>
<th>Assembler</th>
<th>ANSI-C compatible</th>
<th>Cross compiler</th>
<th>Compiler</th>
<th>Translator</th>
<th>Version control</th>
<th>Multiple inheritance</th>
<th>IDE</th>
<th>Class library</th>
<th>cfront (AT&amp;T)</th>
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<td></td>
</tr>
<tr>
<td>Price ($)</td>
<td>495</td>
<td>150</td>
<td>250-5,500</td>
<td>200</td>
<td>409-9,000</td>
<td>1,185</td>
<td>1,500-19,800</td>
<td>2,500</td>
<td>1,000-20,000</td>
<td>1,000</td>
<td>1,000</td>
<td>1,185</td>
</tr>
<tr>
<td>Platform — Hardware</td>
<td>Workstations</td>
<td>Mac</td>
<td>386/486</td>
<td>PC/Compatibles</td>
<td>Other</td>
<td>VMS</td>
<td>Unix</td>
<td>Microsoft Windows</td>
<td>DOS</td>
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2.2.1 C++ vendors provide programming environments composed of products that are differentiated by features and implementation strategy.

The two kinds of development products that accept C++ programs are compilers and translators. For the purpose of this survey, a compiler is a process which accepts a C++ source file as input and produces a file containing an executable or linkable program for some computer. Whereas, a translator is a process which accepts a C++ source file and produces a C language source file that can be input to a C compiler. Vendors provide compilers or translators with or without class libraries and various development tools.

Differences among C++ development products include operating systems and hardware platforms on which they function and the availability of other compatible product features. These features include operating environments and tools as well as language elements. Descriptions of some C++ product features follows.

AT&T provides a product called “cfront” which is a front end or preprocessor for C++ source code. This product has been adopted by some as a standard for the C++ language semantics. While there continues to be no formal C++ standard, several vendors offer products which began as licensed versions of “cfront” or are fully compatible with its semantics. In the survey of C++ vendors, nearly half claim such compatibility.

A feature of the C++ language is its facility for inheritance by an object from a parent object or object class. To augment this facility, vendors may supply libraries of object classes with their products: more than half the vendors surveyed do so. An ANSI committee, seeking to define C++ standards, plans to describe the minimum list of required classes for a class library.

An implementation of a C++ development product generally provides either command line execution or an integrated development environment (IDE) or both. An IDE is a facility to interactively connect a source editor, a compiler or translator, and a runtime environment. Usually the IDE is centered around a user interface such as a windowing capability. From the IDE a developer can maintain the connection among the edit, compile or translate, and execute processes. In other words, a user who is editing the source of a program can tell the environment to compile and execute the program. The IDE will then provide the necessary connections among the source file, the compiler, the runtime environment and any other tools or libraries needed. Most of the C++ vendors claim to have an IDE.

Inheritance of attributes by an object from another object is a feature of object-oriented programming (OOP) and the C++ language. For an object to inherit from a single parent is called single inheritance: to be able to inherit some features from one parent and some from another is called multiple inheritance. Multiple inheritance is more powerful but is considered more difficult for programmers. Users of C++ do not agree on whether multiple inheritance should be included in the language; however, most of the vendors surveyed claim to provide multiple inheritance.
Vendors provide several features which, for purposes of this survey, are called version control. Version control includes the ability to keep track of previous versions of various levels of program elements such as source code, relocatable objects, and executable modules. In the software development area version control includes archiving previous versions, providing release descriptions, controlling which modules need to be compiled before linking (called the “make” feature), etc. Nearly half the vendors surveyed claim to provide some kind of version control.

Cross compilation is a process which executes on one platform producing an executable program that runs on a different target platform. As an example, a Fortran or Pascal compiler running on a DEC VAX computer may produce output which will execute on an IBM PC. Some of the vendors surveyed claimed to provide cross compilers.

C++ compilers accept source program input which adheres to some description of C++ syntax and semantics. A subset of C++ is some version of the C language, but not necessarily ANSI C. A feature of a C++ compiler is its ability to accept and correctly compile any source file which complies with the ANSI C standard. Most vendors surveyed claim to be ANSI C compatible.

A C++ development product may provide the capability to use other languages in several ways. The product may allow instructions in another language, usually assembler, to be included within the source file along with the C++ statements. In C++ this capability is called in-line code. Another way other languages can be used is by providing a way to link the output of another compiler or assembler with the output of the C++ compiler. In the DOS product world it is not uncommon for a vendor to provide such compatibility for some of its own products and some limited number of other products. In addition, many vendors include assemblers with their C++ products to provide programmers the ability to develop their own additional functions. This last case seemed to be most common among the vendors surveyed since about half claim to provide an assembler with their products.

Many vendors provide debugging tools. A profiler is a more advanced debugger which provides a link between an executing program running under debug mode and the source statements from which each instruction came. Most vendors provide some form of debugger; a few claim to have profilers.

2.2.2 The majority of C++ products are for PCs and workstations.

The largest number of product offerings are for IBM PC-compatible systems running DOS and workstations running UNIX. For several other platforms there are individual offerings by platform vendors and by third party suppliers, such as products that run on VAX/VMS from Digital Equipment Corporation and Bull/GCOS from Honeywell.
The large mainframe manufacturers are not yet offering C++ for their systems. Thus, C++ compilers and translators are only available on small multi-user systems (e.g., AT&T B2).

2.2.3 Most vendors are software distributors who have recently entered the market.

C++ development products, like Ada products, are available from both computer vendors and third party software vendors. The clear majority of currently available products are from software vendors. However, several computer companies have development efforts underway. Some may develop their own products. Others are prone to license existing products from compiler development companies. Most vendors claim to have delivered their C++ development product within the past two years. About half of those have been on the market for a year or less.

2.2.4 Purchase prices range from $150 to $20,000 for PC's and small multi-user systems.

With most software products like compilers, prices vary with the category of platform. In general, products divide along the lines of PC compatibles, workstations, and shared systems such as minicomputers and mainframes. This appears to hold for C++ development products. Products which run under DOS on PC compatibles are typically priced under $500. Workstation products tend to be under $2000. Some products for small, multi-user systems are priced up to $20,000. These prices tend to be in line with prices of other language compilers for the same platforms.

2.2.5 Efforts are being organized to develop a C++ standard for the language and the class library.

The companies are currently working on establishing ANSI and ISO standards for C++ are listed in Appendix D. These standards will be in two areas, the language and the class library. Although the participants represent many companies and the committees are currently active, adoption of a standard is not expected in the immediate future. At present the committee appears to have the beginnings of a working document for the language but may not have begun to construct one for the library.

2.2.6 Vendors of low cost C++ development products have a relatively large customer base.

Claims of installed base vary from very few to a high of around 350,000. These figures were not available from most vendors. The ones that were seem to be estimates and may not be accurate. There is, however, a trend which tends to indicate substantial sales of at least two products for DOS
systems, Zortec C++ with 200,000 copies and Borland C++ with 350,000 copies, as well as some considerable activity in the workstation market. The estimated installed base figures show both interest by the development community and enough sales to indicate acceptance of the products. The apparent flurry of computer companies to provide C++ products for their systems indicates some acceptance of C++ as a programming language.

2.2.7 C++ products provide interfaces to other software implemented in C or assembler.

External interfaces to other software products are available from some vendors. In particular, vendors tend to provide access to an assembler and in some cases other language interfaces. Other accesses are available to data base management systems and user interfaces like X-windows. It appears that almost any product available to a vendor’s C language product is also available to its C++ product.

2.2.8 New developments target mainframe hardware systems.

Although C++ development products are now on the market for PCs, workstations and shared systems, many more are on the way. As with most previous languages, computer vendors are anxious to provide C++ products which will take advantage of their own platform configurations. C++ projects are now underway at IBM, Honeywell, Hewlett-Packard, and many other companies. Expectations are that the language will be available for most major platforms in the United States.

2.3 AVAILABILITY OF Ada AND C++ TRAINING AND EDUCATION

In preparing this analysis, the following sources were used:

- Ada Software Engineering Education and Training (ASEET) Data Base
- The Journal for Object-Oriented Programming
- Contacts within the academic and DoD areas

Appendix E includes the updated ASEET database and sources for C++ training. The database includes the types of courses taught, and when available the cost and a point of contact.
2.3.1 There are more sources of training and/or education for Ada usage than for C++.

Since 1983, when Ada was adopted as an ANSI standard, the AJPO has emphasized the need for Ada education and training within the DoD, industry, and academia. One of the first initiatives was to encourage the creation of numerous Ada courses by both government and commercial organizations. Today, Ada training is available throughout the country, at least one university in every state teaching Ada. All three military academies offer Ada in their computer courses. We were not able to find any DoD facilities that taught C++; however, we have been told that the Naval Postgraduate School does use C++. In fact, most said they used Ada when teaching object-oriented design. The results of the survey on C++ in the universities is incomplete since most of the time was spent gathering information from C++ training vendors. Ada compiler vendors provide training for system designers and programmers in a classroom setting or as self-study books and software.

Recent programmer interest in C++ parallels some of the developments of object-oriented system design methods and object-oriented data base products. Object-oriented programming (OOP) is an engineering technique used to solve problems that can be expressed in terms of objects, classes of objects, inherited properties, and state data. The superiority of OOP for all types of systems is yet to be demonstrated but it is a convenient solution when the environment is based upon UNIX and C. On the other hand, Ada is being used by computer scientists and programmers to implement systems that require solutions to a range of problems (i.e., temporal, function, and structure). See Appendix F for discussion of design paradigm needs.
Table 3. Sites Teaching Ada and C++ Listed by State

<table>
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<th>State</th>
<th>Ada Univ</th>
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<th>Ada Commercial</th>
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- indicates unknown; note results on C++ in Universities is incomplete due to time constraints.
Table 3. Sites Teaching Ada and C++ Listed by State (continued)

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- indicates unknown; note results on C++ in Universities is incomplete due to time constraints.

2.3.2 There is some disparity between Ada and C++ training providers.

In addition to university and compiler vendor courses, there are several Ada education and training vendors who specialize in teaching software engineering with Ada. The courses vary from two-to-four hour introduction courses for managers to a one-or-two week long intensive Ada programming course. Some vendors charge a flat fee ($10,000) and limit the course to 12-20 people, while others charge per student ($1100/each). These courses may be taught either at the customer’s site or at a public seminar or a the vendor’s site. Most of the hands-on workshops do limit the number of participants, while a course such as the executive overview is left open.

Most of the listings for C++ were independent training vendors. Many are small consulting firms that offer training only on the customer’s site. The average course is five days long and includes some type of hands-on lab. Most claim to provide hands-on for any type of platform for which C++ products are sold, although one firm stated that they only teach C++ on the Macintosh (Arbor Intelligent Systems, Inc.). The cost of these courses varies and does not include the travel and living expenses of the instructor. The student cost ranges from $695/each for a two-day course to $1,200/each for a five-day course to a set price of $9,900 for a four-day course with a maximum number of 20 students. Vendors always indicated that they could develop or customize a C++ for
their customer if needed. Most of the companies are small (i.e., two to five people) and some of the vendors listed in the November-December 1990 issue of Journal of Object-Oriented Programming appear to have already gone out of business.

2.4 STATUS OF CASE TOOLS.

From a list of 200 commercial vendors of products, informally known as CASE tools, data was collected on 155 with 44 being classified by our definition as CASE tools. Tools that support particular design or analysis methodologies are not usually influenced by the choice of implementation language, but the majority of these CASE tools is not completely language independent because most generate code. Appendix G provides ten tables that consolidate descriptive information about CASE tools. Appendix H documents, in more detail, the information collected on the 44 CASE tools. The following findings indicate the status of CASE tools.

2.4.1 Structured Analysis (SA) and Structured Design (SD) are the most widely supported software development methods, although increasing support for object-oriented approaches is evident.

Methods for software design and then analysis fall into two groups: process-oriented methods to support the development of information systems, and behavior- or state-oriented methods for process-control systems. This distinction has blurred as the most popular, process-oriented methods, SA and SD, have been augmented with techniques for expressing behavior. In the last few years, an object orientation to software development has evolved.

Over 65% of CASE tools provide support for SA and SD and three quarters of these include the augmentations for expressing behavior. Over one quarter support OOD, and a quarter of these also support OOA. Nearly a fifth support both SA/SD and object-oriented approaches. More details on the method support offered by particular CASE tools are presented in Appendix G, Table 2. Information on operating environments, breadth of use, report generation, adaptability, etc., can be found in Appendix G, Table 3.

2.4.2 CASE tools for the development of information systems differ from those that support the development of other types of software.

Roughly half as many CASE tools are intended for the development of information systems as for other types of software systems (for example, real-time and process control systems). The distinction between these two groups of CASE tools is evidenced in several ways. For example,
only those CASE tools intended for the development of information systems typically support data base design and, in the few cases where prototyping is provided, it supports user interface (forms and screen) design. Again, only information system-oriented CASE tools typically support business analysis and planning activities. On the other hand, CASE tools in the second group are more likely to support simulation and requirements tracing activities and to provide the users with a selection of development methods.

2.4.3 Support for CASE tool customization is limited.

Over 65% of CASE tools provide free-form or customizable graphics. Tailoring of the underlying development methods is much less frequent and generally requires the user to develop new code. Three vendors market tools that support rule-based customization of their CASE tool, two offer tools specifically intended to the user screens or menus, and one markets a meta-CASE tool that can be used to develop CASE software. See Table 4, Appendix G.

2.4.4 The majority of CASE tools support source code generation.

Virtually all CASE tools generate some type of code, though those that support the development of information systems may only generate data handling or user interface code. The language(s) generated varies, depending on the type of CASE tool considered:

- CASE tools supporting the development of information systems either include tool components that generate code or link with independent application generators for this function. In the first case, code generators typically produce Cobol and C, and the introduction of Ada and C++ has had little impact. In the second case, application generators (see Table 5, Appendix G) are traditionally devoted to the production of Cobol; although no application generators that support Ada have been identified, some support for C++ is evident.

- Code generation for other types of software systems (e.g., process control, embedded, real time) favors (in descending order) C, Ada, Pascal, Fortran, C++, PL/I, and Jovial. The entire source code is not necessarily generated and some tools provide user-customizable templates that govern this partial generation. Support for C++ is one of the most frequently cited planned tool enhancements and C++ is expected to follow Ada in popularity within the next 18 months.
2.4.5 C is being used by CASE tool developers.

In terms of tool implementation language, the majority of CASE tools are implemented in C. However, over 20% of the vendors already have, or plan to, reimplement their products in C++. Fewer tools have been developed or reimplemented in Ada. Reasons for using C or C++ for tools may be based on economics. For example, C compilers are relatively inexpensive (no validation costs, smaller language, etc.) and existing C interfaces to windows and UNIX facilities reduces effort.

2.4.6 Workstations are the favored hardware platform.

The majority of CASE tools operate on workstations and are capable of supporting multiple concurrent users over a network. Roughly two thirds are also supported on PCs, and roughly one third are also supported on mainframes. PCs and mainframes are rarely the only operating platform. The dependence of these tools on the underlying programming support environment is restricted to a language compiler and related language-sensitive tools.

2.4.7 CASE vendors say they support open systems and interoperability.

Roughly half of the CASE tool vendors state that their tools exist in an open environment. Many vendors further support interoperability by conforming with the de facto industry standard X-Windows. Support for the CASE Data Interchange Format (CDIF) (Electronics Industry Association) standard is less prevalent but increasingly apparent.

2.4.8 CASE vendors offer relatively mature products.

While six tools are major extensions or reworks of products developed in the late 1970s and early 1980s, roughly half of the currently marketed CASE tools were introduced between 1984 and 1987. Tools continue to be introduced. The initial focus on support for development of information systems has gradually changed and the majority of recent offerings support the development of real-time software systems.

Some vendors report the number of licenses they have sold, whereas others measure usage in terms of the number of installations. Until recently, information system-oriented CASE tools have been the most widely used, with installations and licenses numbering in the thousands. Over the last few years, increased awareness of software engineering and, perhaps, better marketing of
CASE products have led to wide usage of CASE tools supporting the development of other types of software systems. Table 1 (Appendix G) lists product introduction date and estimated customer base.

2.4.9 Future Trends

Bridges between CASE tools are increasingly used to extend the scope of software development activities supported by particular tools. Roughly one third of the CASE tools have vendor-supported bridges that exploit the capabilities of other CASE tools. While the majority of current bridges only support a one-way transition between tools, some bi-directional bridges are beginning to appear. In addition to allowing the use of specialized tools as required, these bridges can facilitate the reuse of software products developed using different tools. Table 6 (Appendix G) identifies the available bridges.

2.4.10 CASE tools continually increase their coverage of software development activities.

Early CASE tools focused on software analysis and design activities. Initial extensions focused on earlier development activities and led to the provision of requirements traceability capabilities. Roughly half the CASE tools provide this capability, the majority of which do so as an integral part of the tool. Another area of early extension was the provision of system specification and simulation capabilities. Roughly one third of the tools support system simulation, usually via a separately purchasable option.

In the last few years, vendors have been introducing support for reverse engineering to facilitate software maintenance and, to some extent, reuse. Roughly half the CASE tools have this capability, and several more expect it within the next 18 months. Although usually provided as an integral part of the CASE tool, reverse engineering tools are also available as separately purchasable options and as stand-alone tools. Roughly equivalent numbers of tools are available for reverse engineering of Ada and C++. See Table 7 (Appendix G).

A few CASE vendors are starting to support software testing. This capability is generally provided through separately purchasable options, primarily for Ada and C code. The stand-alone testing tools identified. See Table 8 (Appendix G), predominantly support Ada, although one vendor does offer support for C++.
2.4.11 CASE vendors talk about migration to repositories.

Early CASE tools used a data dictionary to store definitions of the various data flows, processes, data stores, etc., specified as part of software analysis and design activities. A repository, in simple terms, is a central database that contains all information pertaining to a development effort. It provides better support for information sharing among team members, tool integration, and new development paradigms such as Boehm's risk-driven approach. An object-oriented repository, in particular, provides the flexibility to facilitate CASE customization and extension. All CASE tools introduced in the last couple of years employ repositories. A significant number of early tools have recently switched to a repository.

2.4.12 Integration frameworks are increasingly preferred as a mechanism for integrating project management and similar tools with CASE tools.

Repositories have led to the development of integration frameworks that provide a consolidation of the underlying information architecture to offer a disciplined approach to tool integration. They allow CASE tools to be integrated into a base set of capabilities supporting, for example, resource management, change management, and access to multiple databases. Identified repositories are listed in Table 9 (Appendix G).

IBM's announced integration framework, AD/Cycle, is expected to have a significant impact on CASE tool evolution, and the majority of vendors plan to ensure compatibility with AD/Cycle as it becomes available.

2.5 CONCLUSIONS

Conclusions based on the limited scope of the survey and analysis of findings are:

- Ada compilers are available for PCs, workstations, and mainframes, including the mainframe computers most often used for large business applications. C++ products are available for PCs and some multi-user engineering workstations but not in general for mainframes.

- There is stability and maturity among Ada compiler vendors with the majority of Ada companies providing validated compilers for five or more years. The majority of C++ vendors have entered the market during the last two years although many have provided C compilers for many years.
There is considerable variability among C++ products in the language features they support, the libraries provided, and strategy for language support. The standardization effort for C++ and libraries is just beginning. The Ada 9X standard with its object-oriented programming support is expected to be adopted by ANSI and ISO by the time the C++ standardization effort results in an adopted standard.

The wide availability of Ada training and education reflects DoD efforts to promote Ada as a way to teach software engineering methods. Currently, Ada is being taught and used in university computer science departments. Most Ada compiler vendors are a source of training materials and instruction while C++ training and education is in limited supply.

CASE tools exist to support both Ada and C++. Structured analysis and structured design are the most widely supported development methods but object-oriented design and analysis are just entering the picture. CASE tools marketed for business applications do not contain features such as requirements tracing and simulation and choices among design paradigms. Future plans among CASE and compiler vendors call for an integration framework so that tools can be distributed as commercial-off-the-shelf products for a variety of platforms.
### 3. ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>4GL</td>
<td>Fourth Generation Language</td>
</tr>
<tr>
<td>ACM</td>
<td>Association for Computer Machinery</td>
</tr>
<tr>
<td>ACVC</td>
<td>Ada Compiler Validation Capability</td>
</tr>
<tr>
<td>ADPE</td>
<td>Automated Data Processing Equipment</td>
</tr>
<tr>
<td>AI</td>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td>AJPO</td>
<td>Ada Joint Program Office</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>ASEET</td>
<td>Ada Software Engineering Education and Training</td>
</tr>
<tr>
<td>C3I</td>
<td>Command, Control, Communications, and Intelligence</td>
</tr>
<tr>
<td>CAD</td>
<td>Computer-aided Design</td>
</tr>
<tr>
<td>CASE</td>
<td>Computer-aided Software Engineering</td>
</tr>
<tr>
<td>CDIF</td>
<td>Computer-aided Software Engineering (CASE) Data Interchange Format</td>
</tr>
<tr>
<td>COTS</td>
<td>Commercial Off-the-Shelf</td>
</tr>
<tr>
<td>DEC</td>
<td>Digital Equipment Corporation</td>
</tr>
<tr>
<td>DoD</td>
<td>Department of Defense</td>
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<tr>
<td>FIPS</td>
<td>Federal Information Processing Standard</td>
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<tr>
<td>GSA</td>
<td>General Services Administration</td>
</tr>
<tr>
<td>IDA</td>
<td>Institute for Defense Analyses</td>
</tr>
<tr>
<td>IDE</td>
<td>Integrated Development Environment</td>
</tr>
<tr>
<td>IMS</td>
<td>Information Management System</td>
</tr>
<tr>
<td>ISA</td>
<td>Instruction Set Architecture</td>
</tr>
<tr>
<td>ISO</td>
<td>International Organization for Standardization</td>
</tr>
<tr>
<td>MF</td>
<td>Main Frame</td>
</tr>
<tr>
<td>n/a</td>
<td>not available</td>
</tr>
<tr>
<td>NIST</td>
<td>National Institute of Standards and Technology</td>
</tr>
<tr>
<td>NUMWIG</td>
<td>Numerics Working Group, International Organization for Standardization</td>
</tr>
<tr>
<td>OOA</td>
<td>Object-oriented Analysis</td>
</tr>
<tr>
<td>OOD</td>
<td>Object-oriented Design</td>
</tr>
<tr>
<td>OOP</td>
<td>Object-oriented Programming</td>
</tr>
<tr>
<td>Acronym</td>
<td>Full Form</td>
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<tr>
<td>---------</td>
<td>-----------</td>
</tr>
<tr>
<td>PC</td>
<td>Personal Computer</td>
</tr>
<tr>
<td>PHIGS</td>
<td>Programmer's Hierarchical Interactive Graphics</td>
</tr>
<tr>
<td>POSIX</td>
<td>Portable Operating System Interface for Computing Environments</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>RISC</td>
<td>Reduced Instruction Set Computer</td>
</tr>
<tr>
<td>SA</td>
<td>Structured Analysis</td>
</tr>
<tr>
<td>SD</td>
<td>Structured Design</td>
</tr>
<tr>
<td>SDIO</td>
<td>Strategic Defense Initiative Office</td>
</tr>
<tr>
<td>SIGAda</td>
<td>Special Interest Group, Ada</td>
</tr>
<tr>
<td>SQL</td>
<td>Structured Query Language</td>
</tr>
<tr>
<td>WS</td>
<td>Work Station</td>
</tr>
</tbody>
</table>
Appendix A -
Data Sheets for Ada Compiler Vendors
1. AETECH - James Dorman - (619) 755-1277

Compilers:
   a. IntegrAda 386 5.1.0
   b. IntegrAda 5.1.0 POSIX
   c. IntegrAda Posix 5.1.0

Products:
   a. IntegrAda
      (1) MS-DOS $795
      (2) Interactive Unix Version 2.1 $1,995
      (3) SCO/Unix Version 3.2 $1,995
      (4) SCO/Xenix $1,995
   b. Ada Software Development Toolset
      (1) MS-DOS $495
      (2) Interactive Unix Version 2.1 $895
      (3) SCO/Unix Version 3.2 $1,995
      (4) SCO/Xenix $1,995
   c. Assembler
      (1) MS-DOS $395
      (2) Interactive Unix Version 2.1 $895
      (3) SCO/Unix Version 3.2 $795
      (4) SCO/Xenix $795
   d. AdaScope Debugger (MS-DOS only) $595
   e. AdaGraphics (MS-DOS only) $695
   f. Training & Reference Module
      (1) MS-DOS $295
      (2) Interactive Unix Version 2.1 $695
      (3) SCO/Unix Version 3.2 $695
      (4) SCO/Xenix $695
   g. HyperARM (MS-DOS only) $75
   h. Ada Training Environment (MS-DOS only) $895
   i. Academic IntegrAda (MS-DOS only) $249
   j. AdaEval (MS-DOS only) $1,295
   k. Ada Instructor Courseware (MS-DOS only) $399
   l. Ada Workstation Environment (Telesoft compiler)
      (1) Interactive Unix Version 2.1 $995
      (2) SCO/Unix Version 32. $995
(3) SCO/Xenix $ 995

m. Programmer's Deluxe Package (MS-DOS) $2,495
   - IntegrAda compiler
   - Ada Software Development Toolset
   - Assembler
   - AdaGraphics
   - "On-Line" Training & Reference Module
   - HyperARM

n. Programmer's Special Package $1,195
   - IntegrAda
   - Ada Software Development Toolset

(1) MS-DOS $1,195
(2) Interactive Unix Version 2.1 $2,495
(3) SCO/Unix Version 3.2 $2,495
(4) SCO/XJ $2,495

o. Student Package (MS-DOS only) $ 399
   - Academic IntegrAda
   - Training & Reference Module

Maturity: Since 1988
Education/Training: "Ada Training Environment" product. On-site training also.
Other languages: No; Only bindings to XWindows, PHIGS.
Customer Base: AF Desktop III contract

2. Aitech Systems Ltd. - Eric Gries
   Compilers:
   a. AI-ADA/88K Version 2.4

   Products:
   Maturity: Since 1988
   Education/Training:
   Other languages: Assembler for targets; no C++
   Customer Base:

3. Alliant Computer Systems - Paul Rubin - (508) 486-4950
   Compilers:
   a. Alliant FX/Ada-2800 Compiler, Version 1.0

A-4
b. Alliant FX/Ada Compiler, Version 2.3

Products:

(1) FX/Ada Development System
   - compiler
   - symbolic debugger
   - library maintenance utilities
   - runtime system
   - "make" utility
   - link preprocessor
   - math libraries
   - disassembler utility
   - source code formatter utility
   - vi editor

Prices:

a. FX40 - $15,000
b. FX80 - $25,000
c. FX800 - $25,000
d. FX2800 - $50,000 - $75,000

Maturity: Since 1987 (FX8)

Education/Training: No

Other languages: ANSI standard C and Fortran

Customer Base: 3 customers; FX40 - 25 users

4. Alsys

Compilers:

a. AlsyCOMP_016
b. AlsyCOMP_026 Version 5.3
c. AlsyCOMP_030
d. AlsyCOMP_031
e. AlsyCOMP_042, Version 5.3
f. AlsyCOMP_026, Version 1.82
g. AlsyCOMP_025, Version 1.83
h. AlsyCOMP_046, Version 5.3
i. AlsyCOMP_004, Version 5.3
j. AlsyCOMP_050, Version 5.3
k. AlsyCOMP_002, Version 5.3
l. AlsyCOMP_005, Version 5.3
m. AlsyCOMP_035, Version 5.3  

n. AlsyCOMP_016, Version 5.1  
o. AlsyCOMP_003, Version 5.1  
p. AlsyCOMP_037, Version 5.2  
q. AlsyCOMP_037, Version 5.3  
r. AlsyCOMP_012, Version 5.3  
s. AlsyCOMP_036, Version 5.3  
t. AlsyCOMP_015, Version 5.3  
u. AlsyCOMP_017, Version 5.2  
v. AlsyCOMP_017, Version 5.3  
w. AlsyCOMP_018, Version 5.2  

x. AlsyCOMP_006, Version 5.3  
y. AlsyCOMP_023, Version 5.3  
z. AlsyCOMP_011, Version 5.3  

aa. AlsyCOMP_034, Version 5.2  
ab. AlsyCOMP_043, Version 5.3  
ac. AlsyCOMP_034, Version 5.1

Products:

a. FirstAda - Ada Software Development Environment for DOS. Price: $1,815  
b. AIX 370 Ada Compilation System and Toolset. Price: $37,800 - 126,000 (depending upon cpu power)  
c. Ada Development Environment 680x0 System. Price: $25,000  
d. 386 DOS Ada Software Development Environment. Price: $2,995  
e. 486 DOS Ada Software Development Environment. Price: $2,995  
g. Ada Software Development Environment for 68k UNIX Workstations. Price: $4,495  
h. Ada Software Development Environment for 386 LynxOS. Price: $7,500  
i. Ada Software Development Environment - Sun4 workstation. Price: $7,500  
j. RS/6000 Ada Software Development Environment. Price: $6,000  
k. Ada Compilation System and Toolset for DECstation and MIPSworkstations. Price: $7,500  
l. Ada Software Development Environment Targeted to the Inmos Transputer. Price: $30,000 - 65,000  
m. VAX/VMS to MIPS Ada Cross-Compilation System and Toolset. Price: $30,000 - 65,000  
n. Alsys AdaProbe/ICE. Price: $5,000 (separate)
5. Apollo

Compilers: Compiler provided by ALSYS
   a. Apollo DN10000, Domain/OS
   b. Apollo DN3500, Domain/OS

Products:
Maturity: Since 1987
Education/Training:
Other languages:
Customer Base:


Compilers:
   a. C3 Ada, Version 0.5
   b. C3 Ada, Version 1.1v
   c. C3 Ada Version R03-00
   d. C3 Ada Version 1.0v
   e. C3 Ada Version 1.1v

Products: In-house compiler for applications, hardware and software systems.
Maturity: Since 1986
Education/Training:
Other languages:
Customer Base:

7. CONVEX Computer corp.

Compilers:
   a. CONVEX Ada, Version 2.0

A-7
Products: Compiler used in-house, sold as part of a total system.
Maturity: Since 1988
Education/Training:
Other languages:
Customer Base:

8. DDC International

Compilers:
   a. DACS VAX/VMS to 80386 PM Bare Ada Cross Compiler System, Version 4.6
   b. DACS80386 UNIX V Ada Compiler System, Version 4.6
   c. DACS Sun3/SunOS Native Ada Compiler System, Version 4.6
   d. DACS VAX/VMS to 80186 Bare Ada Cross Compiler System with Rate Monotonic Scheduling, Version 4.6
   e. DACS VAX/VMS to 80386 Bare Ada Cross Compiler System with Rate Monotonic Scheduling, Version 4.6
   f. DACS VAX/VMS to 80186 Bare Ada Cross Compiler System, Version 4.6
   g. DACS 80386 DMS/OS Ada Compiler System, Version 4.6
   h. DACS VAX/VMS Native Ada Compiler System, Version 4.6
   i. DACS VAX/VMS to 68020 Bare Cross Compiler, Version 4.6

Products:
   a. DDC-1 Ada Compiler System (DACS)
      — Native mode compiler
      — DACS Ada Symbolic Debugger
      — Ada Program Library Utility
      — DACS Downloader
   b. DACS-80860 Ada Cross Compiler System (VAX Host)
      — DACS-80860 Cross Compiler
      — DACS-80860 Ada Symbolic Debugger
      — DARTS (DDC-I Ada Run-Time System)
      — DACS PLU (Program Library Utility)
      — DACS Linker
      — DACS Mathematics package
      — DACS Recompiler
      — DACS Disassembler
   c. DACS-386/UNIX Tool Set
      — Ada Compiler
      — Program Library Manager
      — Disassembler
9. Digital Equipment Corp. - Pat Bernard

Compilers:
   a. VAX Ada Version 2.2

Products: (Prices are for VAXstation 3000/4000 single-cpu)
   a. VAX Ada
      - Ada compiler
      - Ada program library manager
      - VMS Ada run-time library
      - Ada library of predefined units
      - VMS Debugger support
      Price: $5,160 (VAXstation 3000/4000 single cpu)
      (max $331,200 for VAX 9000 with cluster license)
   b. VAXELN Ada
      - VAXELN Ada run-time library
      - VAXELN Remote Debugger support
      Price: $1,540
   c. VAX DEC/Code Management System (CMS)
      Price: $1,960
   d. VAX Language-Sensitive Editor (LSE) - source code analyzer
      Price: $1,280
   e. VAX DEC Model Management System (MMS)
      Price: $480
   f. VAX DEC/Test Manager
      Price: $1,810
   g. VAX Performance and Coverage Analyzer (PCA)
      Price: $1,590
h. VAXset (VAX Software Engineering Tools)
   - VAX DEC/Code Management System (CMS)
   - VAX Language-Sensitive Editor (LSE)
   - VAX DEC/Test Manager
   - VAX Performance and Coverage Analyzer (PCA)
   - VAX DEC Module Management System (MMS)
   - Program Design Facility (PDF)
   Price: $5,340

i. DEC FUSE (for ULTRIX) - workstation-based programming environment (supports C, Fortran, and Pascal)
   - Editor
   - Debugger
   - Program Builder
   - Call Graph Browser
   - Profiler
   - Cross-Referencer
   - Code Management Tool
   Price: $1,500

j. CDD/Repository (Cohesion - integrated environment)
   Price: To be announced in June 91

Maturity: Since 1984
Education/Training: Yes...
Other languages: not for C++; support for BASIC, C, Pascal, FORTRAN, COBOL, PL/I, BLISS-32
Customer Base: Proprietary

    Compilers:
    a. Tolerant Ada Development System, Version 6.0
       - has debugger, but no other tools
    Prices: Not developed yet.
    Maturity: Since July 90; Tolerant originally validated in 1986.
    Education/Training:
    Other languages: No
    Customer Base: Only in-house to-date

11. Encore Computer

A-10
Compilers:
  a. APLEX Ada Compiler revision 2.3

Products: Verdix compiler
Maturity: Since 1987 (Verdix)
Education/Training:
Other languages:
Customer Base:

12. Harris

Compiler:
  a. Harris Ada 5.1

Products:
  a. Ada Compiler (w/o APSE tools)
     Price: $18,500 (usually discounted 20-30%)
  b. Harris Ada Programming Support Environment (HAPSE)
     - compiler
     - editor
     - library manager
     - link loader
     - code profiler
     - symbolic debugger
     - optimizer
     - configuration management
     Price: $30,000 (usually discounted 20-30%)
  c. HAPSE for Software Engineering (HAPSE/SE) (no longer offered)
     - Harris Ada PDL
     - Management Report Generator
     - Documentation Generator
     - Testing Assistant
     Price: ($30,000 - no longer offered)

Maturity: Since 1986
Education/Training: Courses: Ada Programming, Project Management
Other languages: C, Fortran
Customer Base: Military

13. Hewlett-Packard
Compilers:
   a. HP 9000 Series 300 Ada Compiler, Version 5.35

Products:
   a. Ada Development System (uses Alsys tools)
      - compiler
      - editor
      - AdaProbe symbolic debugger
      - AdaMake program builder
      - AdaTune program analyzer
      - AdaFormat source code formatter
      - AdaXref cross referencer
      - library management utilities
      - Run-time Executive
      - math library
   b. HP Ada/SoftBench (integrated development environment) adds:
      - Ada Reference Manual Browser
      - Program Builder
      - Static Analyzer
      - Development Manager
   c. Bindings to GKS, Starbase, HP-UX, SQL, Xlib, Xtoolkit, and OSF/Motif (separate)

Maturity: Since 1987

Education/Training:

Other languages: C++

Customer Base:

14. IBM, IBM Canada Ltd

Compilers:
   a. AIX/Ada 6000 Release 2, Preliminary Version

Products:
   a. IBM Ada/370
      - compiler
      - natural language support
      - screen editor
      - product information library and messages
      - subsystem support
      - Graphical Data Display Manager
      - NUMWG standard math functions
      - Interactive System Productivity Facility
— ISPF/Program Development Facility
— MVS Event Control Blocks
— Information Management System
— development support facilities
— library management tools
— cross-reference utility
— source-level debugger
— online publication library
— source code formatter
— Ada source dependency lister
— Ada profiler

b. IBM Ada/370 Runtime Library (separate)

c. AIX Ada/6000
— APSE tools
— source level debugger
— online hypertext publications
— integration module for Atherton Backplane
— Bindings
— X Windows
— Math library including NUMWG
— AIX NLS library
— AIX Window Graphics Support library
— GL Graphics Library

d. AIX Ada Run Time Environment/6000
Maturity: Since 1986 (S/370); 1988 (AIX/RT)
Education/Training: 3 1-week courses, 6 seminars
Other languages:
Customer Base: FAA/AAS project

15. Intermetrics, Inc. - Bill Zimmerman

Compilers:
  a. (Scheduled for testing - IBM 3083, UTS)
  b. (Scheduled for testing - IBM, MVS)
  c. (Scheduled for testing - VAXstation 3100, VMS)

Products:
  a. Ada development environment
     — Compiler
     — code generator
     — Byron PDL
— SLCSE (Software Lifecycle Environment which maps code from an Ada ERA
type database to commercial relational DB
— SQL interface
— Adaview Debugger

b. InterTools
c. Whitesmiths

Maturity: 1986
Education/Training: Provide courses for use of tools
Other languages: C, Pascal, Lisp, Modula, Fortran, CMS-2
Customer Base: proprietary

16. Irvine Compiler

Compilers:
   a. (Scheduled for testing - HP 300/400 series, UNIX)
   b. (Scheduled for testing - HP 800/700 series, UNIX)
   c. (Scheduled for testing - ISI Optimum V, Unix)
   d. (Scheduled for testing - Sun, SunOS)
   e. (Scheduled for testing - VAX, VMS)

Products:
   a. ICC Ada Software Development and Test Environment (HP 9000/ Series 300/400/700,
      SPARC, SUN3 self-hosting)
      — compiler
      — optimizer
      — archiver
      — compilation system librarian
      — debugger
      — language sensitive editor

Prices: (for self-hosting compiler systems)
   (1) HP9000/700 (single user HP Risc) $ 5,000
   (2) HP9000 series 300/HP-UX v6.2 $ 5,000
   (3) HP9000/800 (below 840)/HP-UX $14,000
   (4) HP9000/800 (above 840)/HP-UX $18,000
   (5) HP9000/700 (multi user HP Risc) $18,000
   (6) Sun 3 / Sun OS 4.0 $ 5,000
   (7) SPARCstation (Sun Risc) $ 5,000
   (8) MicroVAX/VMS 4.x $ 5,000
   (9) VAX 11/7XX VMS 4.x $10,000
(10) VAX8XXX/VMS 4.x $15,000
(11) UNIX 68000, 10, 20, 30 systems --
(12) Integrated Solutions/BSI UNIX 4.3 $ 5,000
(13) AT&T 3B2 / System V --

b. ICC Ada Software Development and Test Environment (68000, 68010, 68020, 68030, i80960MC targets)
   - compiler
   - optimizer
   - archiver
   - compilation system librarian
   - debugger
   - language sensitive editor
   - assembler
   - linker
   - simulator
   - profiler
   - symbol table utility
   - disassembler

Prices:

(1) VAX cpu (VS2000, VAXsrv 3100, VSII, VS8000, VS3xxx, VAXsrv 3xxx, MV2000, MV3100) host to Intel i80960MC $25,000
(2) VAX cpu (MVII, 730, MV3300, MV3400, 750, 78x, MV3500, MV3600, MV3800, MV3900) host to Intel i80960MC $50,000
(3) VAX cpu (82xx, 83xx, 8500, 8530, 86xx, 8550, 8700, 8810) host to Intel i80960MC $70,000
(4) VAX cpu (8800, 8820, 8840, 8974, 8978, VAXsrv 6000, 6000 -xxx) host to Intel i80960MC $90,000
(5) VAX cpu (VS2000, VAXsrv 3100, VSII, VS8000, VS3xxx, VAXsrv 3xxx, MV2000, MV3100) host to 68000, 680x0 $30,000
(6) VAX cpu (MVII, 730, MV3300, MV3400, 750, 78x, MV3500, MV3600, MV3800, MV3900) host to 68000, 680X0 $50,000
(7) VAX cpu (82xx, 83xx, 8500, 8530, 86xx, 8550, 8700, 8810) host to 68000, 680X0 $70,000
(8) VAX cpu (8800, 8820, 8840, 8974, 8978, VAXsrv 6000, 6000 -xxx) host to 68000, 680X0 $90,000
(9) HP cpu (HP9000/300) host to 68000, 680X0 $30,000
(10) HP cpu (HP9000/400) host to 68000, 680X0 $50,000
(11) HP cpu (HP9000/800 HP-PA I) host to 68000, 680X0 $70,000
(12) HP cpu (HP9000/700 HP-PA II) host to 68000, 680X0 $90,000

Maturity: Since 1982
Education/Training: Training/Consulting at $1000/day
Other languages: No
Customer Base: Boeing, GE, General Dynamics, Hughes, IBM, Litton, Lockheed, Loral, McDonnel Douglas, Northrop, Rockwell, Singer, TRW

17. Meridian Software Systems

Compilers:
   a. Meridian Ada, Version 4.1

Products:
   a. OpenAda
      - compiler
      - editor
      - linker
      - make tool
      - optimizer
      - debugger
      - utility libraries
   b. Meridian Ada
      - compiler
      - editor
      - linker
      - source level debugger
      - code optimizer
      - customizable developer interface
      - utility libraries
      - Amake (automatic recompilation and link system)
      - Software Composition Manager
      - embedded systems RTCL library
      - host system environment libraries
   c. Professional Developer Kit (non-DOS systems)
   d. Software Composition Manager

Prices:
   a. OpenAda DOS $ 299
   b. Meridian Ada DOS 286 $ 995
   c. Meridian Ada DOS 386 $1,695
   d. Software Composition Manager $ 795
   e. OpenAda Unix $1,995
   f. OpenAda Mac $ 249
g. Professional Developer Kit
   (1) Mac                          $1,995
   (2) DECstation 2100 (Ultrix)     $2,500
   (3) DECstation 3100 (Ultrix)     $3,500
   (4) DECstation 5000 (Ultrix)     $4,500
   (5) Sun 3 (SunOS)                $3,500
   (6) Sun 4 SPARC (SunOS)          $4,500
   (7) VAX (Ultrix)                 not available

h. Software Composition Manager
   (1) DOS systems                  $795
   (2) DECstation 3100              $995
   (3) DECstation 5000              $1,995
   (4) Sun 3                        $995
   (5) Sun 4 SPARC                  $995

Maturity: Since 1987
Education/Training: NSITE-Ada CBT: computer-based Ada training environment with online
LRM, assignments, tests.
   Level 1 license - 10 users/year $3,200
   Level 2 license - 25 users/year $6,000
   Level 3 license - 50 users/year $8,000
   Level 4 license - unlimited/year $12,000

Other languages: Pascal
Customer Base: Claim to have sold 10,000 copies of Ada compilers in the last 5 months; AT&T
FAA/OATS; NASA SSE; USAF RADC;

18. MIPS Computer Systems

   Compilers:
   a. MIPS ASAPP 3.0
   b. MIPS Ada 3.0

   Products:
   a. Development environment on UNIX
      — debugger
      — editor
      — libraries

Maturity: 4 years
Education/Training:
Other languages: Fortran, C, Pascal, C++
Customer Base:

19. R.R. Software

Compilers:
   a. Janus/Ada 2.2.0 Phar Lap/DOS
   b. Janus/Ada 2.2.0 Unix

Products:
   a. Development Environment with
      — debugger
      — editor
      — assembler
      — windows
   b. Pascal to Ada Translator (95%)

Maturity: 8 years
Education/Training: Videotapes, tutorial
Other languages:
Customer Base: Few thousand

20. Rational

Compilers:
   a. M68020/OS-200 Cross-Development System Facility, Version 7
   b. M68020/Bare Cross-Development Facility, Version 7
   c. Rational Environment, D_12_24_0

Products:
   a. Rational Environment (software)
      — editor
      — debugger
      — cross referencer
      — Configuration Management tool (CMVC)
      — X Interface
   b. R1000 Development System Series 400 (hardware) (can support 10 - 12 users)
      — 32M RAM
      — Networking

Price: $25,000/user
Price: $36,000 with additional hard disks (+ $12,500)

c. Rational Network Mail
   Price: $500/user

d. Rational Design Facility
   Price: $5,000/user

e. Rational Design Facility CASE Tool Interfaces
   Price: $2,000/user

f. Rational Publishing Interface
   Price: $1,000/user

g. Rational Cross-Development Facilities
   Price: $5,000/user

h. Performance Analysis Interfaces
   Price: $10,000/user

i. Rational Remote Compilation Facilities
   Price: $2,500/user

j. Rational Target Build Utility
   Price: $500/user

Maturity: Validation and first system delivered in 1985

Education/Training: $900/person/course

Other languages: No

Customer Base: IBM, Bofors Electronics (Sweden), U.S. Army

21. Rockwell International

   Compilers:
   a. (Scheduled for testing - VAX 8650)
   b. (Scheduled for testing - VAXstation 3100)

   Products:
   Maturity: DDC-based compiler validated in 1987

   Education/Training:
   Other languages:
   Customer Base:

22. SD_SCICON - Carol Perkins

   Compilers:
23. Silicon Graphics

Compilers:
   a. IRIS 4D ADA 3.0

Maturity: Since 1987

Education/Training:

Other languages:

Customer Base:

24. Tartan Laboratories, Inc.

Compilers:
   a. Tartan Ada Sun Ada960MC Compiler V2.0
   b. Tartan Ada Sun/C30, Version 2.2
   d. Tartan Ada VMS/C30, Version 2.2

A-20
e. VMS Ada960MC Compiler R1.0

Products:

a. Ada VMS 1750A Compilation System
   - compiler
   - "Multiple Librarian"
   - runtime system
   - ARTClient - Tartan Ada Runtime Client Package
   - TXREF - cross reference tool
   - AdaScope - source-level debugger
   - Object File Utilities
   - linker
   - object file librarian
   - format conversion utilities
   - object file dumper
   - Ada library with Ada packages for I/O and other facilities
   - online help

b. Optional Products for the 1750A Compilation System:
   (1) Runtime Enhancement Package
   (2) Package of elementary math functions
   (3) Expanded memory support
   (4) Tartan 1750A simulator
   (5) Support for HP64000 and Tektronix 8540 emulators

c. Ada VMS C30 & Sun-3 C30 Compilation System
   - compiler
   - librarian
   - runtime system
   - ARTClient - Tartan Ada Runtime Client Package
   - TXREF - cross reference tool
   - AdaScope - source-level debugger
   - Object File Utilities
   - linker
   - object file librarian
   - format conversion utilities
   - object file dumper
   - Ada library with Ada packages for I/O and other facilities
   - package of elementary math functions
   - online help

d. Optional Products for C30 Compilation System:
   (1) Ada Runtime Enhancement Package

e. Ada VMS 960MC & Sun-3 960MC Compilation System
compiler
“Multiple Librarian”
runtime system
ARThClient - Tartan Ada Runtime Client Package
AdaScope - source-level debugger
Object File Utilities
linker
object file librarian
format conversion utilities
object file dumper
Ada library with Ada packages for I/O and other facilities
online help

f. Optional Products for 960MC Compilation System:
   (1) Runtime Enhancement Package

g. Ada VMS 680X0 Compilation System
   compiler
   librarian
   runtime system
   ARThClient - Tartan Ada Runtime Client package
   TXREF - cross reference tool
   AdaScope - source-level debugger
   Object File Utilities
   linker
   object file librarian
   format conversion utilities
   object file dumper
   Ada library with Ada packages for I/O and other facilities
   Intrinsics: functions for access to hardware capabilities
   online help

h. Optional Products for 680X0 Compilation System:
   (1) AdaScope Retargeting Kit
   (2) Kernel Customization Kit
   (3) Runtime Enhancement Package

Maturity: Since 1987
Education/Training:
Other languages:
Customer Base:

25. TelesSoft
   Compilers:
a. (Telesoft - Cray Ada X-MP 228, UNICOS Version 5.1)
b. (Telesoft - Cray Ada-Y-MP 1001, UNICOS Version 5.1
c. TeleGen2 Ada Cross Development System for SUN-3 to 68k Version 4.1
d. TeleGen2 Ada Cross Development System for VAX to MIPS, Version 4.1
e. (Telesoft - Cray-2 2024, UNICOS Version 5.1)
f. TeleGen2 Sun-3 Ada Development System, Version 4.01
g. TeleGen2 Ada Development System, Version 4.1 for SPARCS Systems
h. TeleGen2 Ada Development System for VAX/VMS, Version 3.23
i. TeleGen2 Ada Development System, Version 1.4
j. TeleGen2 Sun-4 Ada Development System Version 1.4

Products:

a. TeleArcs (design and support tool)
   — Ada language sensitive editor
   — automated compilation tool
   — Ada source cross referencer and browser
   — user interface customizer

b. TeleGen2 Ada Host Development System
   — compiler
   — library manager
   — library toolset
   — Ada execution environment
   — source level debugger
   — global optimizer
   — pretty printer
   — compilation order tool
   — cross referencer
   — source dependency lister

c. TeleGen2 Cross Development System
   — Object Tools
   — Library Manager
   — Library Toolset
   — Ada Execution Environment
   — cross referencer
   — source dependency lister
   — pretty printer
   — compilation order tool
   — source level debugger
   — global optimizer

Prices:

a. Sun-3 Unix Host Compiler Systems
(1) Sun-3/50,60,80,150,160,260,270,280; SPARC SLC; $4,500
(2) SPARC 1,1+,11,310,330; Sun-3/470,480; Sun-4/110,150,260,280; $7,500
(3) SPARCstation Server 370,390; $8,500
(4) SPARCstation Server 470,490; $9,500

b. VAX/VMS Host Compiler Systems
(1) All VAXStations/Server 3XXX, 4000-300; $4,500
(2) MicroVAX 2000,3100; $7,500
(3) MicroVAX II, VAX 11/730; $12,600
(4) MicroVAX 3300,3400; VAX 11/750,780,82XX; $20,100
(5) MicroVAX 3500,3600,3800,3900; VAX 83XX; VAXserver 6210,6310; VAX 6210,6310; $25,000
(6) VAX 8500,8530,86XX; $42,600
(7) VAXserver 6220,6320,6312,6410,6420; VAX 8550,8700,8810; $50,900
(8) VAXserver 6230,6330; VAX 6240,6340,6350,6420; $68,900
(9) VAX 8800,8820,8830,8840; VAXserver 6360,6430; $74,100
(10) VAX 6440,6450,6460,8840,8842,8974; $79,200
(11) VAX 8978,9210,9410,9420,9430,9440; $90,000

c. TeleArcs
(1) Sun-3 Unix systems - price ranges from $1,700 - 2,600 depending on host compilation system
(2) VAX/VMS systems - price ranges from $4,000 - $55,400 depending on host compilation system

d. 4. Cray System - Compiler (and price) only obtained from Cray.
Maturity: Since 1984
Education/Training: Courses 1-week, $1,250/attendee 3-day $750/attendee
  "Programmer’s Introduction to Ada" $1250
  "TeleGen2 Use, Tuning, & Support" $750
  "Target Adaptation, Tools, and Tuning the TeleGen2 Compiler" $1250
  "Packaging Reusable Components in Ada" $1250
  "Tasking in Ada" $1250
  "Tasking and Real-Time Applications in Ada I" $1250
  "Tasking and Real-time Applications in Ada II" $1250
  "Design of Large Ada Programs" $1250
Other languages: No.
Customer Base: 90% DOD; 3500-4500 customers (estimate)
26. Texas Instruments

Compilers:
   a. (TI for VAX/VMS)
   b. MIPS-Ada, Version 3.0

Maturity: scheduled for testing in 1991

Education/Training:

Other languages:

Customer Base:

27. Verdix

Compilers:
   a. VADS Data General Avilon, DG/UX 4.20, VAda-110-8080 Version 6.0
   b. VADS VAX/VMS=>386, VMS 5.2, VAda-110-03315, Version 6.0
   c. VAda-110-6161, Version 6.0.2
   d. VAda-110-6161, Version 6.0.2 BASE
   e. VAda-110-0202, Version 6.0
   f. VADS Sun3 SunOS VAda-110-1313, Version 6.0
   g. VADS IBM PS/2 AIX=> Intel 80386, VAda-110-35315
   h. VADS IBM PS/2 AIX=> 68K, VAda-110-35125, Version 6.0
   i. VADS Sun-4 SunOS, VAda-110-4040, Version 6.0
   j. VAda-110-4040, Version 6.0, BASE
   k. VADS Sun3 SunOS => VAda-110-13125, Version 6.0
   l. VADS IBM RISC System/6000, AIX 3.1, VAda-110-7171, Version 6.0
   m. VADS HP 9000/300, HP-UX 7.0, VAda-110-1515, Version 6.0
   n. VADS Prime EXL/320, UNIX SystemV/386 3.2, VAda-110-3232, Version 6.0
   o. VADS VAX/VMS 5.2, VAda-110-0303, Version 6.0
   p. VADS VAX/VMS=>68k, VMS 5.2, VAda-110-03125, Version 6.0
   q. VADS VAX/VMS=> Intel VAda-110-03315, Version 6.0
   r. VADS VAX/Ultrix=> 68k, Ultrix 3.1, VAda-110-02125, Version 6.0
   s. VADS DEC-RISK=>68k, Ultrix 3.1, VAda-110-61125, Version 6.0
   t. VADS IBM RISC System/6000=>68k, AIX 3.1, VAda-110-71125, Version 6.0
   u. VADS IBM RISC System/6000=>386, AIX 3.1, VAda-1110-71315, Version 6.0
   v. VADS UNIX System V/386, Rel. 4, VAda-110-3232, Version 6.0
   w. VADS Sequent Balance DYNIX V3.0, VAda-110-2323, Version 6.0
   x. VADS Sun4=> 68k, SUNOS 4.0, VAda-110-40125, Version 6.0
y. VADS Sun-4 => Sun-3, Sun OS 4.0, VAda-110-4013, Version 6.0
z. VADS AT&T 315 UNIX System V, Rel. 3.1, VAda-110-5151, Version 6.0
aa. VADS HP-9000/300 => 68k, HP-UX 7.0, VAda-110-15125, Version 6.0
ab. VADS Sun4 => SPARC, Sun OS 4.1, VAda-110-40440, Version 6.0

Products:

a. VADSSelf
b. VADSCross
c. VADSWorks
   — Verdix Ada Development System
   — compiler
   — debugger
   — library management system
   — runtime system
   — Wind River Systems VxWorks Real-time Network OS
d. VADSApse
   — Verdix Ada Development System
   — Atherton Technology Software Backplane
   — X-Windows user Interface
   — configuration management and version control system
   — Ada-oriented editor
e. VADSEdit
f. Xlib Interface
g. Statistical Profiler
h. Sun Ada Development Environment
   — Verdix compiler
   — Network software Environment
   — symbolic debugger
   — XVView Interface (to OpenWindows)
   — AdaVision (object-based user interface)
   — EditTool
   — DbTool (visual interface to symbolic debugger)
   — LRMTool (online LRM)

Maturity: Since 1984

Education/Training:

Other languages: C++ “not yet”

Customer Base:

28. Wang Laboratories
Compilers:
   a. Wang VS Ada Version 5.00.00
   b. Wang VS Ada Version 5.00.00 BASE

Maturity: Since 1990
Education/Training:
Other languages:
Customer Base:
APPENDIX B

Ada Compiler Support for Pragma Interface

(validated under ACVC 1.11)
This is a survey of validated implementations' support of pragma INTERFACE. Not all of the 160 or so implementations that have been tested under ACVC 1.11 have been analyzed, but all of those that are not included below will likely be similar to ones that are (e.g., Verdix-based or Tele-Soft-based implementations have similar support, generally). All, or nearly all of the implementa-
tions provide a pragma that enables non-Ada identifiers to be specified for the name of the
interfaced external subprogram or object.

>>> B001 supports INTERFACE for C & FORTRAN. Pragmas INTERFACE_NAME &
EXTERNAL_NAME are provided, as well as package MACHINE_CODE. NB: All verdix
& Verdix-based compilers match this, with one possible difference in pragma names--
"INTERFACE_NAME" vs. "INTERFACE_OBJECT" (e.g., see entry for B010, MIPS, &
B014, Silicon Graphics, and B028, Convex).

>>> B002 through B007 match B001.

>>> B008 supports INTERFACE for C & assembler. Pragma EXTERNAL_NAME is also
provided, to provide the external name for linkage (this differs from other implementations’
"External_Name"s, which make Ada objects visible to other routines--vs. giving the name
of an external object).

>>> B009 supports INTERFACE for "VMS" & assembler. Pragma EXTERNAL_NAME is
also provided, to provide the external name for linkage (this differs from other
implementations’ "External_Name"s, which make Ada objects visible to other routines--
vs. giving the name of an external object).

>>> B010 supports INTERFACE for C & FORTRAN. Pragmas INTERFACE_OBJECT &
EXTERNAL_NAME, are provided, as well as package MACHINE_CODE.

>>> B011 matches B010.

>>> B012 supports INTERFACE for Assembly, C, UNIX, & FORTRAN. Pragmas
LINK_NAME & INTERFACE_INFORMATION are provided to complement INTERFACE. Package MACHINE_CODE is provided.

>>> B013 supports INTERFACE for C & Assembler. Pragma INTERFACE_NAME is
provided to complement INTERFACE.
B014 through B016 match B010.

B017 through B026 match B001.

B027 supports INTERFACE for assembler, C, & FORTRAN. Pragmas INTERFACE_NAME & EXTERNAL_NAME, and package MACHINE_CODE are provided.

B028 supports INTERFACE for C & FORTRAN. Pragmas INTERFACE_OBJECT, INTERFACE_SHARED_OBJECT, & EXTERNAL_NAME are provided, as well as package MACHINE_CODE.

B029 matches B028.

B030 supports INTERFACE for "ASM," presumably an 88K assembly language. Pragmas INTERFACE_PACKAGE & EXTERNAL_SUBPROGRAM_NAME are provided.

B031 supports INTERFACE for C & Assembly. Here, INTERFACE is implemented with an optional (and non-language-defined!) third parameter, which may be used to specify a "link name".

B032 matches B031.

B033 matches B031.

B034 is like B031, but also interfaces to "microsoft_c" (and "C"). Package MACHINE_CODE is provided.

B035 matches B034.

B036 matches B034.

B037 matches B031, but also provides package MACHINE_CODE.

B038 matches B037.

B039 matches B010.

B040 and B041 match B009.

B042 supports INTERFACE for Assembler. There are a number of interface-related pragmas defined by the implementation: EXPORT_EXCEPTION, EXPORT_FUNCTION, EXPORT_OBJECT, EXPORT_PROCEDURE, and corresponding "IMPORT_" pragmas for each of the "EXPORT_" ones. Package MACHINE_CODE is provided.
B043..8 support INTERFACE to various of (the App.F is general) the languages Assembler, C, FORTRAN, or Pascal. Pragmas INTERFACE_NAME, EXTERNAL_NAME, & EXPORT are also interface related.

For B044 through B048, see B043.

B049 supports INTERFACE to HP 68K Assembly, C, Pascal, & FORTRAN 77. Pragmas INTERFACE_NAME, EXPORT, & EXPORT_NAME are also provided.

B050 supports INTERFACE for "VMS"--which is an "A-code" language that is used by the compiler. Pragma INTERFACE_SPELLING is provided. The package MACHINE_CODE is provided.

B051 supports INTERFACE for at least "AS," presumably an assembly language for the 68K. Pragma INTERFACE_SPELLING is provided. The package MACHINE_CODE is provided.

B052 supports INTERFACE for C & Fortran. Pragmas INTERFACE_NAME & EXTERNAL_NAME are also provided. Package MACHINE_CODE is provided. (But for "I..._NAME" vs. "I..._OBJECT", this matches B039.)

B053 supports INTERFACE for Fortran, and probably other languages, although this is not explicitly stated. I remember a dispute from DEC in which the presumed bogus language name "ZZZZZ" was accepted: the DEC implementation made some sort of general interface when the name wasn't recognized. There are a number of interface-related pragmas defined by the implementation: EXPORT_EXCEPTION, EXPORT_FUNCTION, EXPORT_OBJECT, EXPORT_PROCEDURE, EXPORT_VALUED_PROCEDURE, and corresponding "IMPORT_" pragmas for each of the "EXPORT_" ones.

B054 matches B053.

B055..9 support INTERFACE for Assembler, Ada, & C (the use of "Ada" isn't explained in App.F). Pragma INTERFACE_NAME is a complement.

B056 through B059 match B055.

B060 through B063 likely match B031--there was no App.F for these.
>>> B064 supports INTERFACE for "occam." It also provides the pragma INTERFACE_NAME.
>>> B065 matches B064.

>>> For B066 through B070, see B043.

>>> B071 supports INTERFACE for "Assembler." It also provides pragmas INTERFACE_NAME, EXTERNAL_NAME, & EXPORT--the latter two enabling Ada objects to be visible to external routines.
>>> B072 matches B071.

>>> B073 does not support INTERFACE, but violates 2.8(8) in providing an implementation-defined pragma LIBNAME with a similar function!

>>> B074's App.F doesn't explicitly describe INTERFACE, but it implies support for "ASM86"--Intel assembly language? There is extensive text the use of MACHINE_CODE. B074 offers pragmas INTERFACE_SPELLING & EXTERNAL_NAME.

>>> B075's App.F doesn't explicitly describe INTERFACE, but one can see e.g.s of support for "C86"--a version of C. There is extensive text the use of MACHINE_CODE, so one might guess that it's expected that machine-code insertions are used vice interfacing to assembler. B075 offers pragmas INTERFACE_SPELLING, EXTERNAL_NAME, and SHARED_DATA --this last being used to place static package data in a shared data segment for use by other programs.

>>> B076's App.F doesn't describe its support of INTERFACE; apparently, interface to "AS"--which might be a mnemonic for Sun/68K assembler--is supported ("AS" was macro $INTERFACE_LANGUAGE's value). Package MACHINE_CODE is supported.

>>> B077 through B079 matche B074.

>>> B080 matches B042.

>>> B081 supports INTERFACE for assembler ("ASM"). Complementary (and needed, for interface effect!) pragmas IMPORT_FUNCTION, IMPORT_OBJECT, IMPORT_PROCEDURE, & corresponding "EXPORT_" ones are also provided.
B082 matches B081, but has the additional complementary pragma IMPORT_VALUEd_PROCEDURE (with no corresponding EXPORT__pragma).

B083 matches B082.

B084 does NOT support INTERFACE (the Rational R1000 is pure Ada!).

B085 supports INTERFACE for assembler, C, & FORTRAN. Pragma LINKNAME is provided.

B086 supports INTERFACE for C. Pragma INTERFACE_NAME is provided.

B087 supports INTERFACE for “MASM”. Pragma INTERFACE_NAME is provided.

B088 matches B087.

B089 matches B086.

B090 supports INTERFACE for assembly, C, FORTRAN, & Pascal. Pragmas INTERFACE_INFORMATION & LINKNAME are provided. (LINKNAME is provided solely for compatibility with other TeleSoft compilers that have it but no pragma INTERFACE_INFORMATION.) Package MACHINE_CODE is provided.

B091 supports INTERFACE to “assembly”/“assembler”, & Fortran (the first two presumably being synonyms). Pragma INTERFACE_INFORMATION is also provided, with parameters Name, Link_name, Mechanism, Parameters, & Clobbered_regs. (It is interesting--irksome, to this reviewer--to note that the macro $INTERFACE_LANGUAGE has the value “C”: either the value is wrong, or else App.F has omitted one language.)

B092 matches B091.

B107 supports INTERFACE for assembler & C. Pragma EXTERNAL_NAME is also provided.

B108 supports INTERFACE for assembly & FORTRAN; INTERFACE is extended (beyond Ada!) to use an optional third parameter to designate that a procedure (Ada) is interfaced to a function (which might be necessary if the external function has parameters that are effectively “out” or “in out” in mode. Pragma EXTERNAL_NAME is also provided.

B109 matches B108, with the difference that an additional form of INTERFACE, for “FORTRAN_FUNCTION”, is provided (presumably to avoid the really illegal extension of using a third parameter--but that form is still available).

B110 matches B107.
B111 supports INTERFACE for Assembler & COBOL. Pragma EXTERNAL_NAME is also provided.

B112 matches B075.

B114 supports INTERFACE for Ada, C, FORTRAN, & Pascal. Pragmas INTERFACE_NAME & EXTERNAL_NAME, and package MACHINE_CODE are provided.

B115 matches B114.

B118 supports INTERFACE to (?)--a general form? It is stated that the interfaced external subprogram must conform to the calling conventions of the compiler. Pragma LINKAGE_NAME is a complementary pragma. Pragma FOREIGN_BODY is a competing--and thus illegal (2.8:8)--pragma.

B119 matches B118, with the addition of package MACHINE_CODE.

B120 matches B119; there is an indication that Tartan intends to have the <language-name> parameter identify the calling mechanism--either of “use-call” or “use-bal” [branch-and-link] (but that feature is not yet implemented).

B121 through B123 match B120.

B141 supports INTERFACE for assembler & “AIE_assembler”; pragma LINK_NAME is provided to interface with non-Ada identifiers.

B142 supports INTERFACE for “AIE_assembler” & “unspecified_language” (which presumably uses general calling & parameter-passing conventions); pragma LINK_NAME is also provided.

B143 matches B142.

B145 supports INTERFACE for assembly, Ada, C, & Intrinsic. Pragmas EXPORT, EXTERNAL_NAME, FOREIGN, & INTERFACE_NAME (INTERFACE_NAME’s function duplicates an optional third parameter to INTERFACE).

B146 through B148 match B145.
Appendix C -

C++ Compilers and Tools
C++ Product: .................................. AT&T C++ Release 2.0 & 2.1

Vendor Data: AT&T Unix Software Operation
1776 On the Green
Morristown, N. J. 07960
(800) 828-8649
*Wayne Hunt
*Paul Fillinich C++ Product Manager
(908) 580-4363

Operating System:
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<tr>
<td>DOS</td>
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<tr>
<td>Microsoft Windows</td>
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<td>VMS</td>
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<td>Other</td>
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Hardware Platforms:
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<tr>
<td>PC/Compatibles</td>
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<td>386/486</td>
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<tr>
<td>Mac</td>
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<tr>
<td>Workstations (Which)</td>
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Product features:
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<th>Product features</th>
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<tr>
<td>cfront (AT&amp;T)</td>
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<tr>
<td>Class library</td>
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<tr>
<td>Integrated development environment (IDE)</td>
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<tr>
<td>Multiple inheritance</td>
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<td>Version control</td>
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<td>Translator</td>
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<td>Compiler</td>
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<td>Cross compiler</td>
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<td>ANSI-C Compatible</td>
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<tr>
<td>Assembler</td>
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<tr>
<td>Debugger</td>
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<tr>
<td>Profiler</td>
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Product information:
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<td>Age of C++ marketed product:</td>
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<tr>
<td>Estimated number of licensed sites:</td>
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</tr>
<tr>
<td>List price per copy</td>
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</tbody>
</table>

Notes:
Unable to get response to follow-up call.
C++ Product: Borland C++
Vendor Data: Borland International
1800 Green Hills Road
Scotts Valley, CA 95066
(408) 438-5300

Operating System:
- DOS ........................................ Yes
- Microsoft Windows ........................ Yes
- Unix ........................................ ☐
- VMS ........................................ ☐
- Other ....................................... ☐

Hardware Platforms:
- PC/Compatibles .......................... Yes
- 386/486 .................................. Yes
- Mac. ...................................... ☐
- Workstations (Which) ................. ☐

Product features:
- cfront (AT&T) .......................... No
- Class library .............................. Yes
- Integrated development environment (IDE) .... Yes
- Multiple inheritance .................... Yes
- Version control .......................... No

- Translator .................................. No
- Compiler ................................... Yes
- Cross compiler ........................... No
- ANSI-C Compatible ...................... Yes
- Assembler .................................. Yes
- Debugger .................................. Yes
- Profiler ................................... Yes

Product Information:
- Age of C++ marketed product: ............ February 1991
- Estimated number of licensed sites: ........ @350,000
- List price per copy ....................... $495

Notes:
C++ Product: Turbo C++

Vendor Data: Borland International
1800 Green Hills Road
Scotts Valley, CA 95066
(408) 438-5300

Operating System:
- DOS .................................................... Yes
- Microsoft Windows ................................ No
- Unix ................................................. No
- VMS ................................................ No
- Other ................................................ No

Hardware Platforms:
- PC/Compatibles ...................................... Yes
- 386/486 ............................................ Yes
- Mac. .................................................. No
- Workstations (Which) ............................. No

Product features:
- cfront (AT&T) ....................................... No
- Class library ....................................... Yes
- Integrated development environment (IDE) .... Yes
- Multiple inheritance .............................. Yes
- Version control .................................... No
- Translator ......................................... No
- Compiler ........................................... Yes
- Cross compiler .................................... Yes
- ANSI-C Compatible ............................... Yes
- Assembler .......................................... Yes
- Debugger .......................................... Yes
- Profiler ............................................ Yes

Product information:
- Age of C++ marketed product: .................. May 90
- Estimated number of licensed sites ..........
- List price per copy ............................... $150

Notes:
C++ Product: C++ 2.0 & 2.1

Vendor Data: Comeau Computing
91-34 120th St.
Richmond Hill, NY 11418
Marge Behrens
(718) 849-2355

Operating System:
- DOS.............................................. Yes
- Microsoft Windows
- Unix........................................... Yes
- VMS..............................................
- Other ........................................... Yes

Hardware Platforms:
- PC/Compatibles............................ Yes
- 386/486........................................ Yes
- Mac..............................................
- Workstations (Which) ......................
- RS 6000, 3B2 (Product on request)

Product features:
- cfront (AT&T)............................... Yes
- Class library................................... Yes
- Integrated development environment (IDE) .... Yes
- Multiple inheritance ...................... Yes
- Version control............................. No
- Translator...................................... Yes
- Compiler......................................
- Cross compiler..............................
- ANSI-C Compatible ......................... Yes
- Assembler.....................................
- Debugger.....................................
- Profiler.......................................

Product information:
- Age of C++ marketed product: ................... 1 year
- Estimated number of licensed sites: .............. Unknown
- List price per copy ......................... $250 - $5500

Notes:
1. OS/2 Not at this time
## C++ Product:

**Vendor Data:**
Digital Equipment Corporation  
111 Powdermill Road  
Maynard, MA 01754  
(508) 493-5111  
Customer Assistance  
Irwin Gerstenberger  
(301) 306-6550

### Operating System:
- DOS  
- Microsoft Windows  
- Unix  
- VMS  
- Other

### Hardware Platforms:
- PC/Compatibles  
- 386/486  
- Mac  
- Workstations (Which)

### Product features:
- cfront (AT&T)  
- Class library  
- Integrated development environment (IDE)  
- Multiple inheritance  
- Version control  
- Translator  
- Compiler  
- Cross compiler  
- ANSI-C Compatible  
- Assembler  
- Debugger  
- Profiler

### Product information:
- Age of C++ marketed product:  
- Estimated number of licensed sites:  
- List price per copy

### Notes:
1. Does not have. Provide C++ from Unipress for DEC Station only.
C++ Product: G++ 1.39 (Did not know if native or preprocessor)
Vendor Data: Free Software Foundation
675 Massachusetts Ave
Cambridge, MA 02139
(617) 876-3296

Operating System:
- DOS
- Microsoft Windows
- Unix
- VMS
- Other

Hardware Platforms:
- PC/Compatibles
- 386/486
- Mac
- Workstations (Which)

Product features:
- cfront (AT&T)
- Class library
- Integrated development environment (IDE)
- Multiple inheritance
- Version control

Translator
- Yes, but own code

Compiler
- Yes

Cross compiler
- Yes

ANSI-C Compatible
- Yes

Assembler
- Yes

Debugger
- Yes

Profiler
- Yes

Product information:
- Age of C++ marketed product: 3 years
- Estimated number of licensed sites:
- List price per copy: $200

Notes:
1. Apollo, Alliant FX8, Altos 3068, AT&T 3B1, Convex 1 & 2, Dec 3100, DEC 5000, DEC VAX, Encore Multimax, Gems 32000, harris SCX7 &9, HP UX 68020, HP BSD, IBM PS2 under AIX, Intel 386 XENIX, IRIS Mips, ISI 68000 & 68020, Pyramid, Sequent Balance, Sequent Symmetry, Sequent NS 3200, Sun 2, Sun 3, Sun 4, Sun Sparc and Sun 386i

Note: 1
Note: 2
C++ Product: Glockenspiel C++ (translator)

Vendor Data: Glockenspiel, Ltd.
39 Lower Dominick St
Dublin 1, Ireland
marketed by: Imagesoft, Inc.
2 Haven Avenue
Port Washington, NY 11050
Ramana Murthy (516) 767-2233

Operating System:
- DOS .................................. Yes
- Microsoft Windows .................. Yes
- Unix .................................. Yes
- VMS .................................. Yes
- Other .................................. OS/2

Hardware Platforms:
- PC/Compatibles ......................... Yes
- 386/486 ................................ Yes
- Mac: ................................... No
- Workstations (Which) ................. No

Product features:
- ffront (AT&T) .......................... Yes
- Class library .......................... Yes
- Integrated development environment (IDE) .......... Yes
- Multiple inheritance .................. Yes
- Version control ........................ Yes
- Translator ................................ Yes
- Compiler ................................ No
- Cross compiler ......................... No
- ANSI-C Compatible .................... No
- Assembler ............................. No
- Debugger .............................. Yes
- Profiler ................................ No

Product information:
- Age of C++ marketed product: ........ Since 85
- Estimated number of licensed sites: .... 20,000
- List price per copy .................... $499 - $9000

Notes:
- RS6000 Sun 3 & 4 & 386i, DECstation, DEC VAXStation, ICL DRS-3 & 6000, Sony News
- Fujitsu, CDC, MIPS RISC, DG Solbourne + many other platforms

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C++ Product: HCR & SCO/C++

Vendor Data: HCR Corporation (bought SCO)
130 Bloor Street West
(416) 922-1937
Brian Wadsworth 1-(408) 425-7222x5568
Toronto, Ontario

Operating System:
- DOS
- Microsoft Windows
- Unix
- VMS
- Other: Open Desktop

Hardware Platforms:
- PC/Compatibles
- 386/486: Yes
- Mac
- Workstations (Which)

Product features:
- cfront (AT&T): Yes
- Class library: Yes
- Integrated development environment (IDE)
- Multiple inheritance: Yes
- Version control: Yes
- Translator: Yes
- Compiler: No
- Cross compiler
- ANSI-C Compatible: Yes
- Assembler: No
- Debugger: Yes
- Profiler: No

Product Information:
- Age of C++ marketed product: 2 years
- Estimated number of licensed sites: 450
- List price per copy: $1,195

Notes:
C++ Product: C++ Softbench SE Environment (is also subdivided into two separate products (C++ & Developer's Kit))

Vendor Data: Hewlett Packard
3000 Hanover St.
Palo Alto, CA 94304
(415) 857-1501
Dmitry Lenkov
(408)447-5279

Operating System:
- DOS
- Microsoft Windows
- Unix
- VMS
- Other

Hardware Platforms:
- PC/Compatibles
- 386/486
- Mac
- Workstations (Which): Yes HP - 300, 700, 800..

Product features:
- cfront (AT&T)
- Class library
- Integrated development environment (IDE)
- Multiple inheritance
- Version control
- Translator
- Compiler
- Cross compiler
- ANSI-C Compatible
- Assembler
- Debugger
- Profiler

Product Information:
- Age of C++ marketed product: October 1990
- Estimated number of licensed sites: 2000
- List price per copy: $2500

Notes:

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C++ Product:

Vendor Data: HFSI
Honeywell
Honeywell Plaza
Minneapolis, MN 55408
(612) 870-5200
Elizabeth Fox (Unix)
(703) 827-3160
Laura O'Connor (Mainframe)
827-3382

Operating System:
- DOS
- Microsoft Windows
- Unix
- VMS
- Other

Hardware Platforms:
- PC/Compatibles
- 386/486
- Mac
- Workstations (Which)
- Bull

Product features:
- cfront (AT&T)
- Class library
- Integrated development environment (IDE)
- Multiple inheritance
- Version control
- Translator
- Compiler
- Cross compiler
- ANSI-C Compatible
- Assembler
- Debugger
- Profiler

Product information:
- Age of C++ marketed product: 1 year
- Estimated number of licensed sites: 3-main frame
- List price per copy: $1500 - $19,800

Notes:
Could not reach correct people.
C++ Product: Intek C++ 2.0a

Vendor Data: Intek Integration Technologies
1400 112th Ave., SE
Bellevue, WA 98004
Karen Harris
Mac Cutchins
(206) 455-9935

Operating System:
- DOS ........................................... Yes
- Microsoft Windows ........................ Yes
- Unix ........................................... Yes
- VMS ........................................... ☐
- Other ...........................................

Hardware Platforms:
- PC/Compatibles ............................ Yes
- 386/486 ....................................... Yes
- Mac .............................................
- Workstations (Which) ..................... No

Product features:
- cfront (AT&T) .............................. Yes
- Class library ................................ No
- Integrated development environment (IDE) .... No
- Multiple inheritance ..................... Yes
- Version control ............................ No
- Translator ................................. Yes
- Compiler .................................... No
- Cross compiler ............................ ☐
- ANSI-C Compatible ...................... ☐
- Assembler .................................. ☐
- Debugger ................................... No
- Profiler ..................................... ☐

Product information:
- Age of C++ marketed product: ........ 3 years
- Estimated number of licensed sites: .... 60 since Sep
- List price per copy ....................... $495

Notes:
C++ Product: XCL Compiler 1.0 (They use Glockenspiel C++)

Vendor Data:
International Business Machines
Old Orchard Road
Armonk, NY 10504
(914) 765-1900
Judy Griffen
(301) 493-1273
Rick Cimina (general point of contact) (301) 564-2329
Ken Singer (301) 564-7662

Operating System:
- DOS
- Microsoft Windows
- Unix
- VMS
- Other

Hardware Platforms:
- PC/Compatibles
- 386/486
- Mac.
- Workstations (Which): Yes IBM RS6000.

Product features:
- cfront (AT&T)
- Class library
- Integrated development environment (IDE)
- Multiple inheritance
- Version control
- Translator
- Compiler
- Cross compiler
- ANSI-C Compatible
- Assembler
- Debugger
- Profiler

Product information:
- Age of C++ marketed product: 1 - yr
- Estimated number of licensed sites: 30,000
- List price per copy: Provided with O.S.

Notes:
C++ Product:

Vendor Data: Microsoft Corp.
One Microsoft Way
Redmond, WA 98073
(206) 882-8080
(800) 426-9400

Operating System:
- DOS .................................. U
- Microsoft Windows .................. U
- Unix .................................. U
- VMS .................................. U
- Other .................................. U

Hardware Platforms:
- PC/Compatibles ....................... UQ
- 386/486 .................................. E
- Mac ................................... UE
- Workstations (Which) .................. U

Product features:
- cfront (AT&T) ......................... U
- Class library .......................... U
- Integrated development environment (IDE) ................. U
- Multiple inheritance .................... U
- Version control ......................... U
- Translator ................................ U
- Compiler ................................ U
- Cross compiler .......................... U
- ANSI-C Compatible ....................... U
- Assembler ................................ U
- Debugger ................................ U
- Profiler ................................ U

Product information:
- Age of C++ marketed product:
- Estimated number of licensed sites:
- List price per copy ...........................

Notes:
Do not have one.
C++ Product:

Vendor Data: NCR
1700 S. Patterson Blvd.
Dayton, OH
(513) 445-5000
(301) 258-6500
Blaise Fanucchi
(301) 921-6402

Operating System:
- DOS
- Microsoft Windows
- Unix
- VMS
- Other

Hardware Platforms:
- PC/Compatibles
- 386/486
- Mac
- Workstations (Which)

Product features:
- cfront (AT&T)
- Class library
- Integrated development environment (IDE)
- Multiple inheritance
- Version control
- Translator
- Compiler
- Cross compiler
- ANSI-C Compatible
- Assembler
- Debugger
- Profiler

Product information:
- Age of C++ marketed product:
- Estimated number of licensed sites:
- List price per copy

Notes:
- Resell Glockenspiel 2.0, and AT&T 2.0
  Both products are tied to cooperative agreements and will not be available until July and November respectively.
C++ Product: Green Hills C++
Vendor Data: Oasys
One Cranberry Hill
Lexington, MA 02173
Norm Donchin
Kevin Gallagher
(617) 862-2002

Operating System:
- DOS .................
- Microsoft Windows ..
- Unix ................ Yes
- VMS ................. Yes
- Other ............... 

Hardware Platforms:
- PC/Compatibles ....
- 386/486 ............. Yes
- Mac ................. 
- Workstations (Which) ... Yes

Product features:
- cfront (AT&T) ........ Also
- Class library ........ Yes (AT&T)
- Integrated development environment (IDE) . No
- Multiple inheritance .... Yes
- Version control ....... No
- Translator ........... Also
- Compiler ............ Yes
- Cross compiler ....... Yes
- ANSI-C Compatible .... Yes
- Assembler .......... Yes
- Debugger ............ No
- Profiler ............. No

Product information:
- Age of C++ marketed product: ............. 18 mo
- Estimated number of licensed sites: ........ 2000
- List price per copy ...... $1,000 to 5,250Cross $2,200 to 20,000

Notes:
1 ............................................................... Micro Vax, Sun, IBM, MIPS
2 ............................................................... 680x0, 88000, 386, i860
3. Have compiler and translator

Note: 1 & 2.
C++ Product: Oregon C++
Data: Oregon Software, Inc.
7352 SW Durham Road
Portland, OR 97224
Michael Stearns
(503) 624-6883

Operating System:
- DOS
- Microsoft Windows
- Unix
- VMS
- Other: HP, Sun OS, NCR, News

Hardware Platforms:
- PC/Compatibles
- 386/486
- Mac
- Workstations (Which): See Notes

Product features:
- cfront (AT&T)
- Class library
- Integrated development environment (IDE)
- Multiple inheritance
- Version control
- Translator
- Compiler
- Cross compiler
- ANSI-C Compatible
- Assembler
- Debugger
- Profiler

Product information:
- Age of C++ marketed product: June 1988
- Estimated number of licensed sites: 2000
- List price per copy: 386 - $995, Unix - $1700, MicroVAX, Micro VAX II, 2xx, 31xx, 32xx, 33xx, 34xx, 35xx, 36xx, 37xx, 39xx
- VAX 730, 750, 780, 8250, 8350, 8800, 8810, 85xx, 86xx, 87xx, 8820, 8830, 8840, 8850, 8860, 8870, 8880, 8890
- VAX 6210, 6220, 6230, 6240, 6310, 6320, 6330, 6340, 6350, 6360, 6410, 6420, 6430, 6440, 6450, 6460
- VAX 656510, 6520, 6530, 6540, 6550, 6560
- VAX 4000
- VAX 9000
- VAXstation 2xxx, 3xxx, 8xxx, II, DECstation 21xx, 31xx, 51xx
- VAXserver 3xxx, Dec 5000/200, DECSys 54xx, 5500, 5810, 5820, 5830, 5840
- 80386 Unix
- SunOS 3.1, XA 200

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- Sony News 3710
- Solbourne 4xx, 5xx, 6xx, 8xx
- IBM RS/600 320, 520, 530, 540, 550, 730, 930
- EG Aviion 2xx, 3xx, 3xxx, 4xx, 4xxx, 5xxx, 6xxx
- MIPS RS1210, RISC Magnum 3000, RC3230, RS2030, RC3240, M/2000, RC6280
C++ Product: Peritus C++//Ansi C

Vendor Data: Peritus International (purchased by Lucid)
10201 Torre Ave, Suite 295
Cupertino, CA 95014
Rick Bedigo
(415) 329-8400

*Compiler is not yet released (anticipate @3rd quarter)

Operating System:
- DOS ............................................. ☐
- Microsoft Windows .......................... ☐
- Unix ........................................... Yes
- VMS ............................................. ☐
- Other ........................................... ☐

Hardware Platforms:
- PC/Composites .................................. ☐
- 386,486 ......................................... Yes
- Mac ............................................. ☐
- Workstations (Which) .......................... Yes Sun / Sun Sparc.

Product features:
- cfront (AT&T) ..................................... ☐
- Class library .................................... ☐
- Integrated development environment (IDE) .......... ☐
- Multiple inheritance ......................... ☐
- Version control .................................. ☐
- Translator ....................................... ☐
- Compiler .......................................... ☐
- Cross compiler ................................... ☐
- ANSI-C Compatible .............................. ☐
- Assembler ........................................ ☐
- Debugger ......................................... ☐
- Profiler .......................................... ☐

Product information:
- Age of C++ marketed product: .................. 2 Yrs
- Estimated number of licensed sites: ............ 25
- List price per copy .............................. 1000

Notes:
Some old copies of Peritus are out there, but we will not release C++ compiler until the third quarter of this year.
C++ Product:
Vendor Data: Saber Software
185 Alewife Brook Parkway
Cambridge, MA 02138
(617) 876-7636

Operating System:
- DOS
- Microsoft Windows
- Unix
- VMS
- Other

Hardware Platforms:
- PC/Compatibles
- 386/486
- Mac
- Workstations (Which): Sun

Product features:
- cfront (AT&T)
- Class library
- Integrated development environment (IDE)
- Multiple inheritance
- Version control
- Translator
- Compiler
- Cross compiler
- ANSI-C Compatible
- Assembler
- Debugger
- Profiler

Product information:
- Age of C++ marketed product: December 1990
- Estimated number of licensed sites: 1000
- List price per copy: $2696 - $3696

Notes:
C++ Product:

Vendor Data: Silicon Graphics
(415) 960-1980
Michelle Chambers
Dave Bagshaw

Operating System:
- DOS
- Microsoft Windows
- Unix
- VMS
- Other

Hardware Platforms:
- PC/Compatibles
- 386/486
- Mac
- Workstations (Which) Yes Iris.

Product features:
- cfront (AT&T) Yes
- Class library Unknown
- Integrated development environment (IDE)
- Multiple inheritance Unknown
- Version control

Translator
- Compiler Yes
- Cross compiler No
- ANSI-C Compatible
- Assembler Unknown
- Debugger Yes
- Profiler Unknown

Product information:
- Age of C++ marketed product: 6 months
- Estimated number of licensed sites: Not a lot
- List price per copy $1195

Notes:
C++ Product: Sun C++ Version 2.1
Vendor Data: Sun Microsystems, Inc
5500 Garcia Ave.
Mountain View, CA
(415) 960-1300
Aaron Masciocra
(800) 872-4786

Operating System:
- DOS
- Microsoft Windows
- Unix
- VMS
- Other

Hardware Platforms:
- PC/Compatibles
- 386/486
- Mac
- Workstations (Which) Sun 3, Sun 4, Sparc

Product features:
- cfront (AT&T) Yes
- Class library Yes
- Integrated development environment (IDE) Yes
- Multiple inheritance No
- Version control
- Translator Yes
- Compiler
- Cross compiler
- ANSI-C Compatible
- Assembler
- Debugger Yes
- Profiler

Product Information:
- Age of C++ marketed product: Apr 12, 91
- Estimated number of licensed sites: unknown
- List price per copy: $2,000

Notes:
C++ Product:
Vendor Data: Tammetric
1094 Cudahy Pl.
Suite 302
San Diego, CA 92110
Steve Clamadge
(619) 697-7607
Developed for Oregon does not sell to end users

Operating System:
- DOS
- Microsoft Windows
- Unix Yes
- VMS Yes
- Other

Hardware Platforms:
- PC/Compatibles
- 386/486 Yes
- Mac
- Workstations (Which) Yes Sun 3, HP9000, Sun 4.

Product features:
- cfront (AT&T) No
- Class library No
- Integrated development environment (IDE) No
- Multiple inheritance No
- Version control

- Translator No
- Compiler Yes
- Cross compiler No
- ANSI-C Compatible Yes
- Assembler No
- Debugger No
- Profiler

Product Information:
- Age of C++ marketed product: Feb 1988
- Estimated number of licensed sites: 3 Vendors
- List price per copy Translator C (soon) $35,000 Compiler front end $50,000

Notes:
- Has sold to three companies, Oregon and could not release names of other two.
C++ Product: Zortech C++ Developers Edition

Vendor Data: Zortech
4-c Gill St.
Woburn, MA 01801
Renee Pace
(617) 937-0696

Operating System:

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<td>Microsoft Windows</td>
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<td>Unix</td>
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<td>Mac</td>
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<td>Workstations (Which)</td>
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Product features:

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<td>Class library</td>
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<td>Integrated development environment (IDE)</td>
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<td>Multiple inheritance</td>
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</tr>
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<td>Version control</td>
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<td>Compiler</td>
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<td>ANSI-C Compatible</td>
<td>Yes</td>
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<td>Assembler</td>
<td>No in line</td>
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<td>Debugger</td>
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<td>Profiler</td>
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Product information:

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<td>List price per copy</td>
<td>$200 - $1000</td>
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Notes:

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Appendix D -

C++ Standardization Sponsors
Accredited Standards Committee Doc No: X3J16/91-0001R2
X3, INFORMATION PROCESSING SYSTEMS* Date: May 13, 1991
Project: 738-D (PL C++)
*Operating under the procedures of the Ref Doc:
American National Standards Institute Reply to: William M. Miller
Standards Secretariat, Computer and wmm@world.std.com
Business Equipment Manufacturers Association BIX: wmillr
(CBEMA), 311 First St. NW, Ste. 500, CompuServe: 72105,1744
Washington, DC 20001-2178

ANSI X3J16 membership list
(Liaisons and representatives with no voting rights:)

Affiliation: SPARC Liaison to X3J16

Membership: Ex Officio
Name: Scott Jameson
Address: Sun Microsystems Federal
2550 Garcia Ave., M6-94
Mountain View, CA 94043
Tel: (408) 276-3642
Fax: (408) 945-9483
Email: skj@ebay.sun.com

Affiliation: X3 Secretariat

Membership: Ex Officio
Name: Kathleen M. McMillan
Address: X3 Secretariat, CBEMA
311 First Street NW, Suite 500
Washington DC 20001
Tel: (202) 626-5742
Email:

Affiliation: X3J9 (Pascal)

Membership: Liaison

D-3
Name: Thomas N. Turba
Address: Unisys Corp.
MS 4672
P. O. Box 64942
St. Paul, MN 55164-0942
Tel: (612) 635-6774
Fax: (612) 635-3899
Email: turba@rsvl.Unisys.com

Members who have voting rights for the June, 1991 meeting

Affiliation: Amdahl, Inc.

Membership : Principal
Name : Wolfgang Pieb
Address : 1250 E. Arques Ave. (M/S 580)
P. O. Box 3470
Sunnyvale, CA 94088-3470
Tel : (415) 623-2105
Fax :
Email : wolfy@vienna.key.com

Membership : Alternate
Name : Neal Weidenhofer
Address : same as above
Tel : (408) 737-5007
Fax :
Email : nw@amdahl.com

Membership : Observer
Name : Judy Smith
Address : UTS Languages
Amdahl Corporation
1250 East Arques Ave., M/S 316
Sunnyvale, CA 94088
Tel :
Fax :
Email: jas@uts.amdahl.com

Affiliation: Apple Computer Inc.

Membership: Principal
Name: Bill Gibbons
Address: Apple Computer Inc.
20525 Mariani Avenue, MS 37-CL
Cupertino, CA 95014
Tel: (408) 974-7803
Fax: (408) 974-1763
Email: bgibbons@apple.com

Membership: Alternate
Name: Richard Meyers
Address: same as above
Tel: (408) 974-3285
Fax: (408) 974-1763
Email: meyers@apple.com

Membership: Alternate (Second)
Name: Elizabeth Crockett
Address: same as above
Tel: (408) 974-5084
Fax: (408) 974-1763
Email: eec1@apple.com

Membership: Alternate (Third)
Name: Norris Boyd
Address: same as above
Tel: (408) 974-4391
Fax: (408) 974-1763
Email: norris@apple.com

Affiliation: AT&T

Membership: Principal
Name: Jonathan E. Shopiro
Address: AT&T
184 Liberty Corner Rd., Rm.4N-C05
Warren, NJ 07059-0908
Tel: (908) 580-4229
Fax: (908) 580-5631
Email: shopiro@research.att.com

Membership: Alternate
Name: Margaret Quinn
Address: AT&T
190 River Rd.
Summit, NJ 07901
Tel: (201) 522-5088
Fax: (201) 522-6621
Email: meq@attunix.att.com

Membership: Observer
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Appendix E - Status of Training and Education
C++ Education and Training
<table>
<thead>
<tr>
<th><strong>Provider</strong></th>
<th><strong>Courses Provided</strong></th>
<th><strong>Address</strong></th>
<th><strong>City</strong></th>
<th><strong>State</strong></th>
<th><strong>Zip Code</strong></th>
<th><strong>Point of Contact</strong></th>
<th><strong>Phone Number</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Mark V Systems, Ltd</td>
<td>In-house and hands-on training in C++</td>
<td>16400 Ventura Blvd, Ste 303</td>
<td>Encino</td>
<td>California</td>
<td>91436</td>
<td>Mo Bjornesdad</td>
<td>818-995-7671</td>
</tr>
<tr>
<td>2 ParcPlace Systems, Inc.</td>
<td>Intro to Object-Oriented Concepts and C++ - 5 day course taught in-house ($1400/person) or at the customer site ($15000 for up to 10 students, additional $1200 each with max of 20)</td>
<td>1550 Plymouth Street</td>
<td>Mountain View</td>
<td>California</td>
<td>94043</td>
<td>Debbie Hudson</td>
<td>415-691-6755</td>
</tr>
<tr>
<td>3 Santa Clara University</td>
<td>C++</td>
<td></td>
<td>Santa Clara</td>
<td>California</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Rational Consulting</td>
<td>1-Design workshop - 6 session (5 2-day sessions &amp; wrap-up session) for 12 students ($30,000) 2- Intro course - 1 week ($12,500) 3- Adv course - 1 week ($12500)</td>
<td>3320 Scott Boulevard</td>
<td>Santa Clara</td>
<td>California</td>
<td>95054</td>
<td>Brock Peterson</td>
<td>408-496-3684</td>
</tr>
<tr>
<td>5 Hewlett-Packard</td>
<td>Public seminars, in-house training and hands-on training in C++</td>
<td>1266 Kifer Road</td>
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<td>6 Versant Object Technology</td>
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<td></td>
<td>Sandra Philpott</td>
<td>415-325-2380</td>
</tr>
<tr>
<td>7 Fowler Software Design</td>
<td>In-house training and hands-on training in C++</td>
<td>P.O. Box 365</td>
<td>Eldorado Springs</td>
<td>Colorado</td>
<td>80025</td>
<td>Jan Fowler</td>
<td>303-494-5755</td>
</tr>
<tr>
<td>8 Florida Institute of Technology</td>
<td>C++ courses available in 1992</td>
<td>Department of CS 150 West University Blvd</td>
<td>Melbourne</td>
<td>Florida</td>
<td>32901</td>
<td>Charles Engle</td>
<td>407-768-8000</td>
</tr>
<tr>
<td>Provider</td>
<td>Courses Provided</td>
<td>Address</td>
<td>City</td>
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<tr>
<td>Capital College</td>
<td>1-Object Oriented Programming 2-Advanced C course</td>
<td></td>
<td>Laurel</td>
<td>Maryland</td>
<td></td>
<td>Jack Bieter Harry Harrison</td>
<td>703-941-8888 301-953-0060</td>
</tr>
<tr>
<td>Object Design Support Services (training facil. in Mass and CA)</td>
<td>1-Intro to OOP and C++ (2 days, $695/person with max of 10 people) 2-Mastering C++ (2 days, $695/person with max of 10 people) All course available on-site or at training centers</td>
<td>One New England Exec Park</td>
<td>Burlington</td>
<td>Massachusetts</td>
<td>1803</td>
<td>Cheryl Fiust</td>
<td>617-270-9797 ext. 132</td>
</tr>
<tr>
<td>Technology Exchange Co./Addison-Wesley</td>
<td>Public seminars, in-house training and hands-on training in C++</td>
<td>Rte 128</td>
<td>Reading</td>
<td>Massachusetts</td>
<td>1867</td>
<td></td>
<td>800-333-0088 617-944-3700</td>
</tr>
<tr>
<td>MacGregor Group</td>
<td>In-house C++ training</td>
<td>34 Summit Road</td>
<td>Wellesley</td>
<td>Massachusetts</td>
<td>2181</td>
<td>Steven Levy</td>
<td>Phone number changed-now unlisted</td>
</tr>
<tr>
<td>Empathy</td>
<td>1-OOP using C++ (4 days, max 20 people, $9,900) 2-Advanced C++ and Design Techniques (4 days, max 20 people, $9,900) 3- OOD (3 days, max 20 people, $7,900)</td>
<td>P.O. Box 632</td>
<td>Cambridge</td>
<td>Massachusetts</td>
<td>2142</td>
<td>Rich Mitchell</td>
<td>617-787-3089</td>
</tr>
<tr>
<td>Semaphore Training</td>
<td>1- Introduction to C++ and OOD (5 days at $11,495 for 15 people - incl lab) 2-Efficient Impl of OOD in C++ 3-Advanced C++ &amp; OOD (4 days at $10,995 for 15 people - incl. lab)</td>
<td>800 Turnpike Street, Suite 200</td>
<td>North Andover</td>
<td>Massachusetts</td>
<td>1845</td>
<td>Ted Cannie</td>
<td>508-794-3366</td>
</tr>
<tr>
<td>Object Resources</td>
<td>In process of developing C++ courses and will customize courses for the customer as needed</td>
<td>39500 14 Mile Road, Suite 206</td>
<td>Walled Lake</td>
<td>MI</td>
<td>48088</td>
<td>John Killis</td>
<td>313-661-5343</td>
</tr>
<tr>
<td>Arbor Intelligent Systems, Inc.</td>
<td>C++ Training on the MAC - Introduction and Advance courses that run 5 days for approximately $1400/person. Will do on site-training and develop C++ course for platform other than MAC</td>
<td>Ann Arbor</td>
<td>Michigan</td>
<td></td>
<td>Ron Suarez</td>
<td>313-996-4238</td>
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<tr>
<td>Provider</td>
<td>Courses Provided</td>
<td>Address</td>
<td>City</td>
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<tr>
<td>17 Invention Software</td>
<td>Public seminars, in-house training and hands-on training in C++</td>
<td>P.O. Box 3168</td>
<td>Ann Arbor</td>
<td>Michigan</td>
<td>48106</td>
<td>Mike Davidson</td>
<td>Phone disconnected</td>
</tr>
<tr>
<td>18 EDP Consultants, Inc.</td>
<td>In-house and hands-on training in C++</td>
<td>77 Meredith Road</td>
<td>Colonia</td>
<td>New Jersey</td>
<td>7067</td>
<td>Richard Estock</td>
<td></td>
</tr>
<tr>
<td>19 Institute for Zero Defect Software</td>
<td>Both courses taught at customer site: 1-C++ Prog for C Programmers (5 day hands-on workshop, $8500)(16 people) 2-OODesign for C++ (5 day hands-on workshop, $8500) (max 16 people)</td>
<td>85 Poplar Drive</td>
<td>Sterling</td>
<td>New Jersey</td>
<td>7980</td>
<td>Hwe-Chu Tu</td>
<td>201-604-8701</td>
</tr>
<tr>
<td>20 DeerWorks</td>
<td>1-Intro to C++ and OOD - 4 days hands-on course ($2,000/day at customer site, $350/person public seminar) 2-OOD mapped into C++ - 3 day course with case studies (same price)</td>
<td>411 Valentine Street</td>
<td>Highland Park</td>
<td>New Jersey</td>
<td>8900</td>
<td>Tsvi Bar-David</td>
<td>201-985-7427</td>
</tr>
<tr>
<td>21 Center for Object-Oriented Training</td>
<td>1-Stepping Up from C to C++ 2-Advanced programming in C++</td>
<td>588 Broadway, #604</td>
<td>New York</td>
<td>New York</td>
<td>10012</td>
<td>Melanie Younossi</td>
<td>212-274-0640</td>
</tr>
<tr>
<td>22 ImageSoft</td>
<td>5 day lab-intensive C++ course taught at the New York Office or on-site. $1750/student with max of 15 people. Fee includes notes, and 2 textbooks</td>
<td>2 Haven Ave</td>
<td>Port Washington</td>
<td>New York</td>
<td>11050</td>
<td>Ramana Murthy</td>
<td>516-767-2233 800-245-8840</td>
</tr>
<tr>
<td>23 Saks &amp; Associates</td>
<td>In-house training and hands-on training in C++</td>
<td>287 W. McCreight Avenue</td>
<td>Springfield</td>
<td>Ohio</td>
<td>45504</td>
<td>Dan Saks</td>
<td>513-324-3601</td>
</tr>
<tr>
<td>24 Quality Software Engineering</td>
<td>1-C++: Programming, Paradigms and Techniques (4 days, hands-on lab) 2-Structured Approach to OOD (4 days, hands-on lab) All courses $2,000/day for up to 20 students</td>
<td>P.O. Box 303</td>
<td>Beaverton</td>
<td>Oregon</td>
<td>97075</td>
<td>Paul Blattner</td>
<td>503-538-8256</td>
</tr>
<tr>
<td>Provider</td>
<td>Courses Provided</td>
<td>Address</td>
<td>City</td>
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<td>26 Instantiations</td>
<td>On-site courses that consist of 2 days of OOD and 3 days of programming using C++. If hands-on course, is limited to 14 people, if not, course limited to 20. $10,000 + instructor's expenses.</td>
<td>Portland</td>
<td>Oregon</td>
<td></td>
<td></td>
<td>Leslie Menashe</td>
<td>503-242-0725</td>
</tr>
<tr>
<td>26 Revolution 2</td>
<td>In-house training and hands-on training in C++</td>
<td>P.O. Box 760</td>
<td>Kenneth Square</td>
<td>Pennsylvania</td>
<td>19348</td>
<td>Bruck Eckel</td>
<td>Phone disconnected</td>
</tr>
<tr>
<td>27 Object International, Inc.</td>
<td>Public seminars, in-house training and hands-on training in C++</td>
<td>9430 Research Blvd. IV-400</td>
<td>Austin</td>
<td>Texas</td>
<td>78759</td>
<td>Sylvia Owens</td>
<td>512-343-4549</td>
</tr>
<tr>
<td>28 Genesis Development Corp.</td>
<td>Public seminars and in-house training in C++</td>
<td>1303 Columbia Dr., Ste 209</td>
<td>Richardson</td>
<td>Texas</td>
<td>75081</td>
<td>Susan Estes</td>
<td>214-644-8559</td>
</tr>
<tr>
<td>29 George Washington University</td>
<td>1-Software Engineering (in Fall 91) 2-Software Engineering - graduate level</td>
<td>Computer Science Department</td>
<td>Washington D.C.</td>
<td></td>
<td></td>
<td>Shmuel Rotenstreich</td>
<td>202-994-5252</td>
</tr>
<tr>
<td></td>
<td>Company/Institution</td>
<td>Course Description</td>
<td>Address</td>
<td>City</td>
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<tr>
<td>1</td>
<td>Telesoft</td>
<td>Introduction to Ada - comprehensive series of new Ada training targeting</td>
<td>5959 Cornerstone Court West</td>
<td>San Diego</td>
<td>CA</td>
<td>92121</td>
<td>Jeff Kelley</td>
</tr>
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<td></td>
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<td>large-scale and embedded real-time programming issues.</td>
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<td>2</td>
<td>Systems Engineering Research Corporation</td>
<td>Advanced Ada Topics Series - includes several Ada topics and language issues</td>
<td>415 Clyde Avenue Suite D</td>
<td>Mountain</td>
<td>View</td>
<td>94043</td>
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<td>California</td>
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<td>3</td>
<td>Ada Technology Group</td>
<td>Ada Software Engineering for Defense Systems - 10 day hands on program on Ada</td>
<td>1900 L. Street, Suite 500</td>
<td>Washington</td>
<td>D.C.</td>
<td>20036</td>
<td>Walter Rollins</td>
</tr>
<tr>
<td>4</td>
<td>Integrated Software</td>
<td>Ada For Real-Time Systems - a two day seminar that addresses the practical</td>
<td>P.O. Box 060295</td>
<td>Palm Bay</td>
<td>Florida</td>
<td>32906</td>
<td>Marilyn Pelo</td>
</tr>
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<td></td>
<td></td>
<td>considerations of real-time programming in Ada. ($4000 - may include up to 25</td>
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<td>attendees)</td>
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<td>5</td>
<td>Advanced Software Technology Specialists</td>
<td>Ada Design and Coding: 1 - 5 days</td>
<td>4 Lutz Road</td>
<td>Ossian</td>
<td>Indiana</td>
<td>46777</td>
<td>Donald G. Firesmith</td>
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<tr>
<td></td>
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<td>($11000) [All courses are taught at the customer's site]</td>
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<tr>
<td>6</td>
<td>Advanced Software Technology Specialists</td>
<td>Ada Design and Coding: 2 - 5 days</td>
<td>4 Lutz Road</td>
<td>Ossian</td>
<td>Indiana</td>
<td>46777</td>
<td>Donald G. Firesmith</td>
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<td>($1100)</td>
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<tr>
<td>7</td>
<td>Advanced Software Technology Specialists</td>
<td>Ada Design and Coding: 3 - 5 days</td>
<td>4 Lutz Road</td>
<td>Ossian</td>
<td>Indiana</td>
<td>46777</td>
<td>Donald G. Firesmith</td>
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<td>($1100)</td>
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<td>8</td>
<td>Advanced Software Technology Specialists</td>
<td>Ada Project Management - 4 days</td>
<td>4 Lutz Road</td>
<td>Ossian</td>
<td>Indiana</td>
<td>46777</td>
<td>Donald G. Firesmith</td>
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<td>($12500)</td>
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<td>9</td>
<td>Advanced Software Technology Specialists</td>
<td>Ada Technology Transition - An Executive Overview - 1 day ($3000)</td>
<td>4 Lutz Road</td>
<td>Ossian</td>
<td>Indiana</td>
<td>46777</td>
<td>Donald G. Firesmith</td>
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<tr>
<td>No.</td>
<td>Provider</td>
<td>Course Description</td>
<td>Location</td>
<td>City</td>
<td>State</td>
<td>Contact Person</td>
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<td>10</td>
<td>Advanced Software Technology Specialists</td>
<td>Ada Testing, Qualification Assurance and IV&amp;V - 3 days ($7000)</td>
<td>4 Lutz Road</td>
<td>Ossian</td>
<td>Indiana</td>
<td>Donald G. Firesmith</td>
<td>219-639-6305</td>
</tr>
<tr>
<td>11</td>
<td>Advanced Software Technology Specialists</td>
<td>Ada Tools and Environments - 2 days ($5500)</td>
<td>4 Lutz Road</td>
<td>Ossian</td>
<td>Indiana</td>
<td>Donald G. Firesmith</td>
<td>219-639-6305</td>
</tr>
<tr>
<td>12</td>
<td>Advanced Software Technology Specialists</td>
<td>DoD-STD-2167A and Tailoring for Ada Projects - 2 days ($5500)</td>
<td>4 Lutz Road</td>
<td>Ossian</td>
<td>Indiana</td>
<td>Donald G. Firesmith</td>
<td>219-639-6305</td>
</tr>
<tr>
<td>13</td>
<td>Advanced Software Technology Specialists</td>
<td>Object-Oriented Development in Ada - 5 days ($12500)</td>
<td>4 Lutz Road</td>
<td>Ossian</td>
<td>Indiana</td>
<td>Donald G. Firesmith</td>
<td>219-639-6305</td>
</tr>
<tr>
<td>14</td>
<td>Advanced Software Technology Specialists</td>
<td>Object-Oriented Requirements Analysis - 1 day ($3000)</td>
<td>4 Lutz Road</td>
<td>Ossian</td>
<td>Indiana</td>
<td>Donald G. Firesmith</td>
<td>219-639-6305</td>
</tr>
<tr>
<td>15</td>
<td>Advanced Software Technology Specialists</td>
<td>Software Economics in Ada - 2 days ($5500)</td>
<td>4 Lutz Road</td>
<td>Ossian</td>
<td>Indiana</td>
<td>Donald G. Firesmith</td>
<td>219-639-6305</td>
</tr>
<tr>
<td>16</td>
<td>Advanced Software Technology Specialists</td>
<td>Software Engineering and Methods in Ada - 2 days ($5500)</td>
<td>4 Lutz Road</td>
<td>Ossian</td>
<td>Indiana</td>
<td>Donald G. Firesmith</td>
<td>219-639-6305</td>
</tr>
<tr>
<td>17</td>
<td>Fastrak Training, Inc.</td>
<td>Ada - Management Perspective - a 3 day seminar for managers and senior technical staff - available upon request</td>
<td>9175 Guilford Road, Suite 300</td>
<td>Columbia</td>
<td>Maryland</td>
<td>Abby Eden</td>
<td>301-498-5601</td>
</tr>
<tr>
<td>18</td>
<td>Fastrak Training, Inc.</td>
<td>Ada Cost Modeling - one day seminar designed for technical managers and staff responsible for estimating size, effort and schedule on Ada software development projects</td>
<td>9175 Guilford Road, Suite 300</td>
<td>Columbia</td>
<td>Maryland</td>
<td>Abby Eden</td>
<td>301-498-5601</td>
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<tr>
<td>Course Number</td>
<td>Course Provider</td>
<td>Course Description</td>
<td>Course Location</td>
<td>City, State</td>
<td>Registration</td>
<td>Instructor</td>
<td>Phone Number</td>
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<td>19</td>
<td>Fastrak Training, Inc.</td>
<td>Advanced Ada Programming - 5 day hands on workshop created for software engineers with previous Ada experience and/or training - available upon request</td>
<td>9175 Guilford Road, Suite 300</td>
<td>Columbia, Maryland</td>
<td>21046</td>
<td>Abby Eden</td>
<td>301-498-5601</td>
</tr>
<tr>
<td>20</td>
<td>Fastrak Training, Inc.</td>
<td>Designing Ada Software - 4 day workshop for programmers and software designers to introduce a methodical design process for OOD in a 4-step approach</td>
<td>9175 Guilford Road, Suite 300</td>
<td>Columbia, Maryland</td>
<td>21046</td>
<td>Abby Eden</td>
<td>301-498-5601</td>
</tr>
<tr>
<td>21</td>
<td>Fastrak Training, Inc.</td>
<td>Evaluating Ada Code - 5 day seminar designed for government personnel and IV&amp;V contractors who read and evaluate compiled Ada PDL or code - available upon request</td>
<td>9175 Guilford Road, Suite 300</td>
<td>Columbia, Maryland</td>
<td>21046</td>
<td>Abby Eden</td>
<td>301-498-5601</td>
</tr>
<tr>
<td>22</td>
<td>Fastrak Training, Inc.</td>
<td>Introduction to Ada Programming - 5 day hands-on workshop for software engineers with no prior experience programming in Ada - available upon request</td>
<td>9175 Guilford Road, Suite 300</td>
<td>Columbia, Maryland</td>
<td>21046</td>
<td>Abby Eden</td>
<td>301-498-5601</td>
</tr>
<tr>
<td>23</td>
<td>Fastrak Training, Inc.</td>
<td>Software Engineering in the Ada Environment - 4 day seminar for technical staff participating in Ada software development and maintenance for large systems</td>
<td>9175 Guilford Road, Suite 300</td>
<td>Columbia, Maryland</td>
<td>21046</td>
<td>Abby Eden</td>
<td>301-498-5601</td>
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<tr>
<td>24</td>
<td>EVB Software Engineering, Inc.</td>
<td>Advanced Ada Programming Workshop - 5 day seminar designed for programmers, analysts, and managers ($10,000)</td>
<td>5320 Spectrum Drive</td>
<td>Frederick, Maryland</td>
<td>21701</td>
<td>Jennifer Lott Ann Hawkins</td>
<td>301-695-6960</td>
</tr>
<tr>
<td>25</td>
<td>EVB Software Engineering, Inc.</td>
<td>Creating Reusable Ada Software - 5 day seminar for technical software professionals with a reading knowledge of Ada ($10,000)</td>
<td>5320 Spectrum Drive</td>
<td>Frederick, Maryland</td>
<td>21701</td>
<td>Jennifer Lott Ann Hawkins</td>
<td>301-695-6960</td>
</tr>
<tr>
<td>26</td>
<td>EVB Software Engineering, Inc.</td>
<td>Fundamental Object Oriented Concepts - 5 day seminar for those interested in an OOD approach to Ada software developing ($10,000)</td>
<td>5320 Spectrum Drive</td>
<td>Frederick, Maryland</td>
<td>21701</td>
<td>Jennifer Lott Ann Hawkins</td>
<td>301-695-6960</td>
</tr>
<tr>
<td>27</td>
<td>EVB Software Engineering, Inc.</td>
<td>Object Oriented Development for Ada Software - 5 day seminar intended for software engineers and technical managers using OOD as a methodology for Ada development ($10,000)</td>
<td>5320 Spectrum Drive</td>
<td>Frederick, Maryland</td>
<td>21701</td>
<td>Jennifer Lott Ann Hawkins</td>
<td>301-695-6960</td>
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<tr>
<td>No.</td>
<td>Provider</td>
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<td>Instructor</td>
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<td>28</td>
<td>EVB Software Engineering, Inc.</td>
<td>Testing Ada Software - 3 day seminar for programmers, analysts and managers who are interested in various software testing techniques and strategies ($6000)</td>
<td>5320 Spectrum Drive</td>
<td>Frederick</td>
<td>Maryland</td>
<td>21701</td>
<td>301-695-6960</td>
</tr>
<tr>
<td>29</td>
<td>IIT Research Institute</td>
<td>Ada For Managers - 4 hour course - explore philosophy of Ada and maximizing benefits ($800 - up to 10 students)</td>
<td>4600 Forbes Blvd.</td>
<td>Lanham</td>
<td>Maryland</td>
<td>20706</td>
<td>301-731-8894</td>
</tr>
<tr>
<td>30</td>
<td>IIT Research Institute</td>
<td>Ada For Software Engineers - 20 hour discussion and 20 hour hands-on. Provides a summary of syntax and how best to utilize the Ada features. ($8000 - up to 10 students)</td>
<td>4600 Forbes Blvd.</td>
<td>Lanham</td>
<td>Maryland</td>
<td>20706</td>
<td>301-731-8894</td>
</tr>
<tr>
<td>31</td>
<td>IIT Research Institute</td>
<td>Executive Overview of Ada - 2 hour discussion of the types of contracts an Ada software lab can expect to acquire and the up-front investments that must be made ($400)</td>
<td>4600 Forbes Blvd.</td>
<td>Lanham</td>
<td>Maryland</td>
<td>20706</td>
<td>301-731-8894</td>
</tr>
<tr>
<td>32</td>
<td>IIT Research Institute</td>
<td>Object-Oriented Development in Ada - 10 hours discussion and 30 hours hands-on. Introduce the software engineer to state-of-the-art software development theory ($8000 - up to 10 students)</td>
<td>4600 Forbes Blvd.</td>
<td>Lanham</td>
<td>Maryland</td>
<td>20706</td>
<td>301-731-8894</td>
</tr>
<tr>
<td>33</td>
<td>IMR Systems Corp</td>
<td>Ada Training Laboratory - training focuses on software development and compliance with DoD standards - lab has a validated Ada compiler and Ada development environment</td>
<td>11400 Rockville Pike, Suite 501</td>
<td>Rockville</td>
<td>Maryland</td>
<td>20852</td>
<td>301-468-1160</td>
</tr>
<tr>
<td>34</td>
<td>Alays Inc. - courses taught at customer site for up to 20 students</td>
<td>Ada Software Engineering Design Methodologies - 5 day seminar for those who need to understand how Ada cna best be used and hwo to establish a coherent Ada-based methodology</td>
<td>14 Main Street</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2154</td>
<td>Dr. Benjamin M. Brosigol</td>
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<tr>
<td>35</td>
<td>Alays Inc. - courses taught at customer site for up to 20 students</td>
<td>Ada Software for Managers - 3 day seminar on the management issues of Ada use for large systems development</td>
<td>14 Main Street</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2154</td>
<td>Dr. Benjamin M. Brosigol</td>
</tr>
<tr>
<td>36</td>
<td>Alays Inc. - courses taught at customer site for up to 20 students</td>
<td>Ada Technology Issues - 2 1/2 day seminar for the computer executive who needs to know what the advantages, risks, etc. are in choosing Ada for software development</td>
<td>14 Main Street</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2154</td>
<td>Dr. Benjamin M. Brosigol</td>
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<tr>
<td>#</td>
<td>Provider</td>
<td>Course Description</td>
<td>Location</td>
<td>City</td>
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<td>Contact Person</td>
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<td>37</td>
<td>Alys Inc. - courses taught at customer site for up to 20 students</td>
<td>Advanced Ada Topics and Real-Time Systems in Ada - 7 day seminar for those who need to understand possible peculiarities of Ada real-time systems.</td>
<td>14 Main Street</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2154</td>
<td>Dr. Benjamin M. Brosgoi</td>
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<tr>
<td>38</td>
<td>Alys Inc. - courses taught at customer site for up to 20 students</td>
<td>Intermediate Ada - 5 day seminar for those who need to know the strengths and weaknesses of the language in order to design and develop Ada programs.</td>
<td>14 Main Street</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2154</td>
<td>Dr. Benjamin M. Brosgoi</td>
</tr>
<tr>
<td>39</td>
<td>Alys Inc. - courses taught at customer site for up to 20 students</td>
<td>Introduction to the Ada Language - one day seminar for software project managers or others who wish to gain a broad view of Ada and its implications.</td>
<td>14 Main Street</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2154</td>
<td>Dr. Benjamin M. Brosgoi</td>
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<tr>
<td>40</td>
<td>Alys Inc. - courses taught at customer site for up to 20 students</td>
<td>Introductory Ada - 5 day seminar for software engineers, etc. who need to become familiar with Ada and its features in order to write Ada programs.</td>
<td>14 Main Street</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2154</td>
<td>Dr. Benjamin M. Brosgoi</td>
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<tr>
<td>41</td>
<td>SofTech</td>
<td>Ada for Software Managers - 3 day presentation of Ada's in its entirety from the viewpoint of a technical manager</td>
<td>460 Totten Pond Road</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2254</td>
<td>Ada Training Department</td>
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<td>42</td>
<td>SofTech</td>
<td>Ada Management Overview for COBOL Background - 4 day course that presents an overview of software engineering in Ada to managers in business applications</td>
<td>460 Totten Pond Road</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2254</td>
<td>Ada Training Department</td>
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<td>43</td>
<td>SofTech</td>
<td>Ada Orientation for Managers - 1 day overview of Ada's development and features</td>
<td>460 Totten Pond Road</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2254</td>
<td>Ada Training Department</td>
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<td>44</td>
<td>SofTech</td>
<td>Ada Program Design Language -3/4/5 day course that teaches how to use Ada program design language (PDL) as a design tool</td>
<td>460 Totten Pond Road</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2254</td>
<td>Ada Training Department</td>
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<td>45</td>
<td>SofTech</td>
<td>Ada Programming Support Environment Overview - 1 day course that provides an understanding of the complete software development environment</td>
<td>460 Totten Pond Road</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2254</td>
<td>Ada Training Department</td>
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<td>46</td>
<td>SofTech</td>
<td>Ada Technical Overview - 1 day overview for software engineers, programmers, system analysts and software engineering managers</td>
<td>460 Totten Pond Road</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2254</td>
<td>Ada Training Department</td>
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<tr>
<td>47</td>
<td>SofTech</td>
<td>Ada Technical Overview for COBOL Background - 4 day course that presents a technical overview of software engineering for business applications</td>
<td>460 Totten Pond Road</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2254</td>
<td>Ada Training Department</td>
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<td>48</td>
<td>SofTech</td>
<td>Advanced Ada Topics - 5/10 day course that teaches modern abstraction concepts and the related facilities of Ada</td>
<td>460 Totten Pond Road</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2254</td>
<td>Ada Training Department</td>
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<td>49</td>
<td>SofTech</td>
<td>Advanced Ada/Concurrent Processing Topics - 10 day course that introduces advanced techniques in the proper Ada context and Ada design concepts in the context of examples</td>
<td>460 Totten Pond Road</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2254</td>
<td>Ada Training Department</td>
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<td>50</td>
<td>SofTech</td>
<td>Basic Ada Programming 5/10 day course teaching how to write basic Ada programs</td>
<td>460 Totten Pond Road</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2254</td>
<td>Ada Training Department</td>
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<td>51</td>
<td>SofTech</td>
<td>Instructor's Course Module - 1 to 5 day course that trains students to become effective instructors.</td>
<td>460 Totten Pond Road</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2254</td>
<td>Ada Training Department</td>
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<tr>
<td>52</td>
<td>SofTech</td>
<td>Introduction to Ada - 1 day overview of Ada</td>
<td>460 Totten Pond Road</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2254</td>
<td>Ada Training Department</td>
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<tr>
<td>53</td>
<td>SofTech</td>
<td>Introduction to Software Engineering - teaches the fundamental concepts of software engineering to programmers and software designers</td>
<td>460 Totten Pond Road</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2254</td>
<td>Ada Training Department</td>
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<td>54</td>
<td>SofTech</td>
<td>Programming Methodology - 1 1/2 day course that teaches a practical approach to writing reliable, readable, and maintainable Ada software</td>
<td>460 Totten Pond Road</td>
<td>Waltham</td>
<td>Massachusetts</td>
<td>2254</td>
<td>Ada Training Department</td>
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<td>55</td>
<td>SofTech</td>
<td>Real-time Concepts - 1 day course teaching approaches to real-time programming</td>
<td>460 Totten Pond Road, Waltham, Massachusetts</td>
<td>02254</td>
<td>Ada Training Department</td>
<td>617-890-6900</td>
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<tr>
<td>56</td>
<td>SofTech</td>
<td>Real-Time Systems in Ada - 5/10 day course in concepts of concurrent programming.</td>
<td>460 Totten Pond Road, Waltham, Massachusetts</td>
<td>02254</td>
<td>Ada Training Department</td>
<td>617-890-6900</td>
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<tr>
<td>57</td>
<td>SofTech</td>
<td>Software Engineering for Managers - 1 day course that teaches managers modern software engineering concepts</td>
<td>460 Totten Pond Road, Waltham, Massachusetts</td>
<td>02254</td>
<td>Ada Training Department</td>
<td>617-890-6900</td>
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<tr>
<td>58</td>
<td>SofTech</td>
<td>Software Engineering Methodologies - 5 day course that provides a thorough understanding of software methodologies and how they can be used with Ada</td>
<td>460 Totten Pond Road, Waltham, Massachusetts</td>
<td>02254</td>
<td>Ada Training Department</td>
<td>617-890-6900</td>
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<tr>
<td>59</td>
<td>SofTech</td>
<td>Systems Engineering Methodology - 3 day course learning to understand systems requirements through the use of structured analysis techniques</td>
<td>460 Totten Pond Road, Waltham, Massachusetts</td>
<td>02254</td>
<td>Ada Training Department</td>
<td>617-890-6900</td>
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<tr>
<td>60</td>
<td>SofTech</td>
<td>Using the Ada Language Reference Manual - 2 day course to learn how to use the reference manual</td>
<td>460 Totten Pond Road, Waltham, Massachusetts</td>
<td>02254</td>
<td>Ada Training Department</td>
<td>617-890-6900</td>
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</tr>
<tr>
<td>61</td>
<td>Texel and Company</td>
<td>Mgt Track - Ada impact issues (1/2 day), Ada for Technical Management (2 1/2 days), Ada: Bids and Proposal (1 day) and Ada: Software Development Plan (1 day)</td>
<td>Victorial Plaza, 615 Hope Road, Eatontown, New Jersey</td>
<td>7724</td>
<td>Harry Copperswayte</td>
<td>201-922-6323</td>
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</tr>
<tr>
<td>62</td>
<td>ADAPLUS, INC.</td>
<td>5 day workshop with lab and lecture taught at customer site ($20,000/week) Sept 91 have 5 day advanced training course OOD+Ada+Windows</td>
<td>P.O. Box 77113, Houston, Texas</td>
<td>77215</td>
<td>Stephen J. Hyland</td>
<td>713-488-1480</td>
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</tr>
<tr>
<td>63</td>
<td>GHG Corporation</td>
<td>Advanced Ada Language Features - continuation of the introductory course and intended for those who require the utmost in Ada literacy.</td>
<td>1300 Hercules, Suite 111, Houston, Texas</td>
<td>77058</td>
<td>Gary O'Neal</td>
<td>713-488-8806</td>
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<td>No.</td>
<td>Organization</td>
<td>Course Description</td>
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<td>64</td>
<td>GHG Corporation</td>
<td>Concurrent Programming in Ada - specialized class that focuses on the nature of concurrent programming and the use of the Ada language in applications.</td>
<td>1300</td>
<td>Hercules</td>
<td>Texas</td>
<td>77058</td>
<td>Gary O'Neal</td>
</tr>
<tr>
<td>65</td>
<td>GHG Corporation</td>
<td>Embedded/Realtime Programming in Ada - approaches the Ada language from the point of view of embedded real-time systems.</td>
<td>1300</td>
<td>Hercules</td>
<td>Texas</td>
<td>77058</td>
<td>Gary O'Neal</td>
</tr>
<tr>
<td>66</td>
<td>GHG Corporation</td>
<td>Introduction to High Order Language - provides necessary background material for those who have experience in languages which differ significantly from the Ada language</td>
<td>1300</td>
<td>Hercules</td>
<td>Texas</td>
<td>77058</td>
<td>Gary O'Neal</td>
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<tr>
<td>67</td>
<td>GHG Corporation</td>
<td>Introduction to the Ada Language - provides bases for using Ada in a broad class of applications</td>
<td>1300</td>
<td>Hercules</td>
<td>Texas</td>
<td>77058</td>
<td>Gary O'Neal</td>
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<tr>
<td>68</td>
<td>GHG Corporation</td>
<td>Programming with X Window System - examines X Window System and focuses on developing Ada software that will run any X Window system environment</td>
<td>1300</td>
<td>Hercules</td>
<td>Texas</td>
<td>77058</td>
<td>Gary O'Neal</td>
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<tr>
<td>69</td>
<td>Computer Sciences</td>
<td>Ada for Project Managers - 2 day seminar for software development managers ($4600) Seminar may be presented at customer site</td>
<td>3160</td>
<td>Falls Church</td>
<td>Virginia</td>
<td>22042</td>
<td>Jeff Seigle</td>
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<td>70</td>
<td>Computer Sciences</td>
<td>Ada Orientation for Managers - 1/2 day for senior and mid-level managers - non-technical ($2300) Seminar may be presented at customer site</td>
<td>3160</td>
<td>Falls Church</td>
<td>Virginia</td>
<td>22042</td>
<td>Jeff Seigle</td>
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<tr>
<td>71</td>
<td>Computer Sciences</td>
<td>Ada Technical Overview - 2 day seminar for people with experience in a high-level language and have had some exposure to Ada ($4600) Seminar may be presented at customer site</td>
<td>3160</td>
<td>Falls Church</td>
<td>Virginia</td>
<td>22042</td>
<td>Jeff Seigle</td>
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<tr>
<td>72</td>
<td>Computer Sciences</td>
<td>Advanced Ada Programming - 20 hours of lecture and 20 hours of hands on exercises ($9500) Seminar may be presented at customer site</td>
<td>3160</td>
<td>Falls Church</td>
<td>Virginia</td>
<td>22042</td>
<td>Jeff Seigle</td>
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<td>No.</td>
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<td>73</td>
<td>Computer Sciences Corporation</td>
<td>Introductory Ada Programming - 2 week course that introduces the attendee to language features in the context of modern software engineering practices ($18500) May be a customer's site</td>
<td>3160 Fairview Park Drive</td>
<td>Falls Church</td>
<td>Virginia</td>
<td>22042</td>
<td>Jeff Seigle</td>
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<tr>
<td>74</td>
<td>Computer Sciences Corporation</td>
<td>Object-Oriented Design with Ada - 4 day workshop illustrating how object-oriented techniques can be used to construct high quality, maintainable Ada software systems ($7900)</td>
<td>3160 Fairview Park Drive</td>
<td>Falls Church</td>
<td>Virginia</td>
<td>22042</td>
<td>Jeff Seigle</td>
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<tr>
<td>75</td>
<td>Computer Sciences Corporation</td>
<td>Object-Oriented Requirements Analysis - 4 day workshop ($7900) (still under development) Workshop may be taught at customer's site</td>
<td>3160 Fairview Park Drive</td>
<td>Falls Church</td>
<td>Virginia</td>
<td>22042</td>
<td>Jeff Seigle</td>
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<tr>
<td>76</td>
<td>Computer Sciences Corporation</td>
<td>QA and CM for Ada Projects - 3 day workshop under development ($5900) Workshop may be taught at customer's site</td>
<td>3160 Fairview Park Drive</td>
<td>Falls Church</td>
<td>Virginia</td>
<td>22042</td>
<td>Jeff Seigle</td>
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<tr>
<td>77</td>
<td>Honeywell Federal Systems, Inc.</td>
<td>Ada Application Programming - 10 day course designed for programmers, software analysts and software engineers. Defines goals and principles of Ada and software engineering</td>
<td>1861 Wiehle Avenue</td>
<td>Reston</td>
<td>Virginia</td>
<td>22090</td>
<td>Willie Griffin</td>
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<tr>
<td>78</td>
<td>Honeywell Federal Systems, Inc.</td>
<td>Ada for Managers - 1 day course to introduce non-technical managers to the concepts and issues involved in the administration of Ada projects.</td>
<td>1861 Wiehle Avenue</td>
<td>Reston</td>
<td>Virginia</td>
<td>22090</td>
<td>Willie Griffin</td>
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<td>79</td>
<td>Honeywell Federal Systems, Inc.</td>
<td>Ada for Project Managers - 5 day course to develop skills for managing an Ada project.</td>
<td>1861 Wiehle Avenue</td>
<td>Reston</td>
<td>Virginia</td>
<td>22090</td>
<td>Willie Griffin</td>
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<td>80</td>
<td>Honeywell Federal Systems, Inc.</td>
<td>Ada Programming - 10 day course designed to teach programmers experienced in a high-level language</td>
<td>1861 Wiehle Avenue</td>
<td>Reston</td>
<td>Virginia</td>
<td>22090</td>
<td>Willie Griffin</td>
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<td>82</td>
<td>Honeywell Federal Systems, Inc.</td>
<td>Ada Programming Tools - 5 day course</td>
<td>Designed for systems managers and engineers involved in the development</td>
<td>1861 Wiehe</td>
<td>Virginia</td>
<td>22090</td>
<td>Willie Griffin</td>
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<td>of an Ada system</td>
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<td>Avenue</td>
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<td>83</td>
<td>Honeywell Federal Systems, Inc.</td>
<td>Ada Software Applied Design - 5 day course</td>
<td>Discussing aspects of object-oriented design as it relates to software</td>
<td>1861 Wiehe</td>
<td>Virginia</td>
<td>22090</td>
<td>Willie Griffin</td>
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<td>discussing aspects of object-oriented design</td>
<td>software life cycles.</td>
<td>Avenue</td>
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<td>84</td>
<td>Honeywell Federal Systems, Inc.</td>
<td>Advanced Ada Programming - 10 day course</td>
<td>Designed to teach programmers experienced in Ada how to code I/O statements</td>
<td>1861 Wiehe</td>
<td>Virginia</td>
<td>22090</td>
<td>Willie Griffin</td>
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<td>and develop code with exception handlers, tasks and generics.</td>
<td>Avenue</td>
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<td>85</td>
<td>Honeywell Federal Systems, Inc.</td>
<td>Advanced Ada Programming - 15 day course</td>
<td>Where attendees design, encodes and tests complete programs.</td>
<td>1861 Wiehe</td>
<td>Virginia</td>
<td>22090</td>
<td>Willie Griffin</td>
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Ada Education and Training
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<th>University</th>
<th>Courses Provided</th>
<th>Address</th>
<th>City</th>
<th>State</th>
<th>Zip Code</th>
<th>Point of Contact</th>
<th>Phone Number</th>
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<tr>
<td>Auburn University</td>
<td>Advanced Programming in Ada</td>
<td>Comp Sci and Eng Dept</td>
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110 Cummington St | Boston | Massachusetts | 02215 | Dr. Richard Vidale | 617-353-2808 |
| 103 Southeast Mass University | 1-Software System Design with Ada  
2- Process Based Design | Computer Science Department | N. Dartmouth | Massachusetts | 02747 | Jan Bergandy | 617-999-8293 |
| 104 North Adams State College | 1- Advanced Programming Languages  
2- Systems Software Design  
3- Comparative Prog Languages | Dept of Computer Science | North Adams | Massachusetts | 01247 | Ernie Giangrande  
Beverly Smith | 413-664-4511 |
| 105 Western New England College | 1- Data Structures  
2- Organization of Programming Languages | Dept of Math and Computer Science | Springfield | Massachusetts | 01119 | Prof. L.S. Tang  
Prof. Lloyd Emerson | 413-782-3111 |
| 106 University of Michigan | Ada Based Software Engineering | Computer Science  
3314 EACS Building | Ann Arbor | Michigan | 48109-2122 | Dr. Richard Volz | 313-763-0035 |
| 107 Michigan State | Ada: An Introduction | 2244 Lansing Avenue | Detroit | Michigan | 44657 | Malcolm Davis | 800-778-9009 |
| 108 Western Michigan University | Programming Languages | Dept. of Computer Science | Kalamazoo | Michigan | 49008 | Dr. Kenneth Williams | 616-383-6151 |
| 109 Central Michigan University | Alternative Programming Languages | Dept of Comp Sci  
Pearce Hall | Mt. Pleasant | Michigan | 48859 | Cindy Burt | 517-774-3774 |
| 110 Oakland University | Short Course in Ada Programming | Dept of Comp Sci & Eng.  
Dodge Hall of Eng. | Rochester | Michigan | 48063 | Dr. Frank Ciocchi | 313-370-2200 |
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2-Specification of Software Systems  
3-Principles & Applications of SW Design  
4-Software Generation and Maintenance  
5-Software Verification & Validation | AFIT/ENG      | Wright-Patterson AFB               | Ohio    | 45433    | LtCol Pat Lawlis       | 513-255-7913 |
| 10  | Air Force Institute of Technology (graduate & undergraduate) | 1-Intro to Data Structures and Program Design  
2-Advanced Information Structures  
3-Software Engineering  
4-Software Analysis and Design I | AFIT/ENG      | Wright-Patterson AFB               | Ohio    | 45433    | Major Paul Bailor     | 513-255-3708 |
| 11  | Air Force Institute of Technology (Graduate Level courses) | 5-Software Analysis and Design II  
6-Software Generation and Maintenance  
7-Principles of Embedded Software  
8-Advanced Software Environments  
9-Formal-Based Methods in SE | AFIT/ENG      | Wright-Patterson AFB               | Ohio    | 45433    | Major Paul Bailor     | 513-255-3708 |
| 12  | ALCM School of Engineering and Logistics | 1-Software Engineering Using Ada I  
2-Software Engineering Using Ada II  
3-Simulation Using Ada  
4-Advanced Microprocessors  
5-Software Engineering Workshop | Department of Engineering Red River Army Depot | Texarkana | Texas    | 75507    | Mark D. Oestmann       | 214-334-3335 |
| 13  | Defense Systems Management College | 1-Technical Foundations  
2-Management of Software Acquisition | SE-T          | Fort Belvoir                      | Virginia | 22060   | Ronald P. Higuera     | 703-664-3474 |
2-Ada Orientation  
3-Ada Overview | COMMANDER, Prof Dev Center  
Stop H-18, Bldg 1465 | Fort Belvoir                      | Virginia    | 22060   | Mr. John Hovell       | 703-285-9839 |
Appendix F -

Software Design Paradigms
Software engineering currently employs a variety of paradigms in the development of software. A "paradigm" is a mechanism that illustrates a concept through the use of an example or idea that is commonly understood. These paradigms, which are used throughout the software lifecycle, provide a particular perspective of the software process. A couple of issues arise in the use of these paradigms. Is there an advantage to using the same paradigm consistently throughout the lifecycle? And secondly, is there a paradigm for software development that is superior to the others?

There are three major categories of paradigms we are considering: (1) object-oriented, (2) process-oriented, and (3) behavior or state-oriented. The object-oriented paradigm allows the software engineer to structure software around the conceptual objects of the system. Objects possess attributes and have specific functions associated with them. A process-oriented paradigm takes a functional view, highlighting system processes and data flows between those processes. A behavior-oriented paradigm provides a view based upon the system states. Objects and processes do not have to be explicitly defined in a state-based notation.

The idea of three complementary views or paradigms has been noted in both the design and requirements community. Buhr (Buhr,91) notes the existence of the structural, functional, and temporal "domains." These domains correspond to the categories of paradigms, where the structural is the object-oriented, the functional is the process-oriented, and the temporal is the behavior-oriented. Rumbaugh (Rumbaugh,91) also notes that a system can be viewed with an "object model, dynamic model, or functional model."

Techniques within the object-oriented paradigm are object-oriented design (OOD) (Booch,87) and object-oriented requirements analysis (OOA) (Coad,90). Popular techniques within the process-oriented paradigm are structured analysis (Yourdon,89) and structured design. Behavior-oriented techniques include finite state machines, Statecharts (Harel,87) and Petri nets.

One of the major advantages of using Ada is the ability to design software in an object-oriented fashion. This approach allows a software engineer to produce software that hides many of the "implementation details." Given the use of OOD, should we employ an object-oriented perspective during requirements? Not entirely. The object-oriented paradigm serves a useful role in managing software complexity during the design and implementation stages. However, an object-oriented perspective alone is not sufficient to describe requirements adequately. OOA, like its counterpart, Structured Analysis, provides the requirements reader a picture of the system objects and processes. While this is useful, we still need a way of describing the behaviors required by the implemented system. For this, we use a state machine or Petri net. Structured Analysis and OOA use some form of a state machine (finite state machine, state-event-response table) for defining the timing and behavioral requirements of a system. This use of a state machine is not part of the primary notation for either of these techniques but is an augmentation.
In addition, the goals for the different phases are not the same. During design, we want to define a structure to our software that hides unnecessary detail, promotes reliability by defining interfaces explicitly, and supports modifiability by localizing the possible changes. During requirements, we want to ascertain and describe all the desired functionality, features, and behaviors of a system that are externally visible to the user(s) and/or to other systems. From a pure requirements standpoint, we should not know how the system will be implemented (Davis, 90).

Thus, we should employ a variety paradigms (i.e., perspectives) during the requirements definition phase. And the choice of paradigms(s) should be based upon the demands of the system itself, not necessarily the intended design and implementation technique.
References


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Table 7: Independent Reverse Engineering Tools
Table 8: Stand-Alone Testing and Measurement Tools
Table 9: Integration Frameworks
Table 10: Other Tools

Key for tables:

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- s  Some support provided
- o  Support expected with in the next 18 months
- B  Bridge to independent tool
- T  Templates
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TABLE 3. General Information
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<td>(203) 397-2998</td>
<td>Foundry</td>
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<tr>
<td></td>
<td>(800) 777-8888</td>
<td>Customizer</td>
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<td>InterSystems Ltd</td>
<td>(310) 605-7671</td>
<td>Tool Development Kit</td>
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<td>Mark V Systems Ltd</td>
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<td>Systematica Ltd.</td>
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**TABLE 4. Customization and Meta CASE Tools**
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<td>CinCom Systems Ltd.</td>
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<td>CorVision</td>
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<td>Intersolve</td>
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<td>PVCS, APS</td>
<td>COBOL</td>
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<td>KnowledgeWare</td>
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**TABLE 5. Application Generators**
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**TABLE 6. Bridges Between CASE Tools**

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Design/I Case Tool 0 0
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Auto-Mate Plus 0
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<td>Hindsight</td>
<td>C</td>
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<tr>
<td>ATI, Inc.</td>
<td>(212) 354-8280</td>
<td>superCASE SCI</td>
<td>ADA, C++</td>
</tr>
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<td>Advanced Systems Tech. Corp.</td>
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<td>Bachman Information Systems</td>
<td>(617) 273-9003</td>
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<tr>
<td>Bell Atlantic Systems Integration</td>
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<td>DSPS: Reengineering Environment</td>
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<td>Cadre</td>
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<td>Teamwork C/Rev</td>
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<td>Catalyst Group</td>
<td>(703) 698-5100</td>
<td>XPERT series</td>
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<td>IDE</td>
<td>(703) 848-8808</td>
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<td>InterPort Software Corp.</td>
<td>(703) 425-6425</td>
<td>InterCASE</td>
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<td>Intersolv</td>
<td>(800) 777-8858</td>
<td>PVCS, APS, XL/Recover</td>
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<tr>
<td>Language Technology, Inc.</td>
<td>(508) 741-1507</td>
<td>Inspector, Recorder, Advancell</td>
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<td>Marble Computer, Inc.</td>
<td>(800) 638-6316</td>
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<td>McCabe</td>
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<td>Nastec</td>
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<td>ParcPlace Systems</td>
<td>(415) 691-6700</td>
<td>ObjectWorks/C++</td>
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<td>Price Waterhouse Technologies</td>
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<td>ViaSoft, Inc.</td>
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<td>XA Systems Corp.</td>
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**TABLE 7. Independent Reverse Engineering Tools**
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<td>ABRAXAS Software Inc.</td>
<td>(800) 347-5214</td>
<td>CODE CHECK</td>
<td>Style analysis</td>
<td>C, C++</td>
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<tr>
<td>Cadre Technologies Inc.</td>
<td>(703) 875-8670</td>
<td>SAW</td>
<td>Coverage/perf analysis</td>
<td>Ada, C</td>
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<tr>
<td>Computer Associates</td>
<td>(203) 627-8923</td>
<td>TRAPS</td>
<td>Regression testing</td>
<td>Independent</td>
</tr>
<tr>
<td>Donatech Corporation</td>
<td>(515) 472-7474</td>
<td>Realtime Testware</td>
<td>Regression testing</td>
<td>Independent</td>
</tr>
<tr>
<td>Dynamics Research Corp.</td>
<td>(508) 475-9090</td>
<td>AdaMAT</td>
<td>Quality analysis</td>
<td>Ada</td>
</tr>
<tr>
<td>EVB Software Engineering Inc.</td>
<td>(800) 877-1815</td>
<td>DYN</td>
<td>Complexity analysis</td>
<td>Ada</td>
</tr>
<tr>
<td>General Research</td>
<td>(805) 964-7724</td>
<td>AdaQUEST</td>
<td>Coverage, quality analysis</td>
<td>Ada</td>
</tr>
<tr>
<td>Intermetrics, Inc.</td>
<td>(714) 691-4631</td>
<td>TST</td>
<td>Dynamic analysis support</td>
<td>Ada</td>
</tr>
<tr>
<td>McCabe</td>
<td>(800) 638-6316</td>
<td>Start</td>
<td>DFD-driven testing</td>
<td>Independent</td>
</tr>
<tr>
<td>McCabe</td>
<td>(800) 638-6316</td>
<td>ACT</td>
<td>Complexity analysis</td>
<td>Ada, C, COBOL, FORTRAN, Pascal</td>
</tr>
<tr>
<td>Nokia Data</td>
<td>358-31-237317</td>
<td>TBGEN</td>
<td>Test bed generation</td>
<td>Ada</td>
</tr>
<tr>
<td>Nokia Data</td>
<td>358-31-237317</td>
<td>TCMON</td>
<td>Coverage analysis</td>
<td>Ada</td>
</tr>
<tr>
<td>Programming Environments Inc.</td>
<td>(201) 918-0110</td>
<td>MALTAS</td>
<td>Test data generation</td>
<td>Independent</td>
</tr>
<tr>
<td>RTP Software Ltd</td>
<td>(0252) 711414</td>
<td>UX-METRIC</td>
<td>Static analysis</td>
<td>Ada, Pascal</td>
</tr>
<tr>
<td>Set Labs</td>
<td>(503) 289-4758</td>
<td>PC-METRIC</td>
<td>Quality analysis</td>
<td>Ada, C++, C</td>
</tr>
<tr>
<td>Set Labs</td>
<td>(503) 289-4758</td>
<td>SMART</td>
<td>Regression testing</td>
<td>Ada, C, others</td>
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<tr>
<td>Software Research Inc.</td>
<td>(415) 957-1441</td>
<td>SMART family</td>
<td>Coverage analysis (branch)</td>
<td>Ada, C, COBOL, FORTRAN, Pascal, Ada, C</td>
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<tr>
<td>Software Research Inc.</td>
<td>(415) 957-1441</td>
<td>TCAT series</td>
<td>Coverage analysis (path)</td>
<td>Ada, C, FORTRAN, Pascal</td>
</tr>
<tr>
<td>Software Research Inc.</td>
<td>(415) 957-1441</td>
<td>TCAT-PATH</td>
<td>Coverage analysis (system)</td>
<td>Ada, C, A</td>
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<tr>
<td>Software Research Inc.</td>
<td>(415) 957-1441</td>
<td>SCAT</td>
<td>Coverage animation</td>
<td>Coverage analysis</td>
</tr>
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<td>Software Research Inc.</td>
<td>(415) 957-1441</td>
<td>TSCOPE</td>
<td>Test data generation</td>
<td>Independent</td>
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<tr>
<td>Software Research Inc.</td>
<td>(415) 957-1441</td>
<td>TDGEN</td>
<td>Coverage analysis</td>
<td>Ada, C</td>
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<tr>
<td>Software System Design</td>
<td>(714) 625-6147</td>
<td>TestGen</td>
<td>Complexity analysis</td>
<td>Ada</td>
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<td>Teledyne Brown Engineering</td>
<td>(205) 726-1613</td>
<td>ACAT</td>
<td>Quality assurance</td>
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<tr>
<td>Teledyne Brown Engineering</td>
<td>(205) 726-1613</td>
<td>SMART</td>
<td>Coverage analysis</td>
<td>Ada, C, COBOL, FORTRAN, Pascal</td>
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<tr>
<td>Verilog S.A.</td>
<td>(301) 220-2430</td>
<td>Logiscope</td>
<td>Coverage analysis</td>
<td>COBOL</td>
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<tr>
<td>XA Systems Corp.</td>
<td>(800) 344-9223</td>
<td>PATHVU</td>
<td>Quality analysis</td>
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**TABLE 8. Stand-Alone Testing and Measurement Tools**
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<td>AGS Management Systems</td>
<td>(800) 678-8484</td>
<td>firstCASE</td>
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<tr>
<td>ASTEC</td>
<td>(301) 441-9036</td>
<td>Camera</td>
</tr>
<tr>
<td>Atherton Technology</td>
<td>(301) 961-1526</td>
<td>Backplane</td>
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<tr>
<td>Cadre Technologies Inc.</td>
<td>(703) 875-8670</td>
<td>Teamwork/IPSE toolkit</td>
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<tr>
<td>Cincom Systems, Inc.</td>
<td>(800) 888-0115</td>
<td>AD/Advantage</td>
</tr>
<tr>
<td>General Research Corp.</td>
<td>(805) 964-7724</td>
<td>SLCSE</td>
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<tr>
<td>IBM</td>
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<tr>
<td>InfoSpan Corp.</td>
<td>(612) 941-2829</td>
<td>AD/Cycle</td>
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<tr>
<td>Pansophic</td>
<td>(800) 323-7335</td>
<td>CaseSpan</td>
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<td>TELON/Teamwork</td>
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**TABLE 9. Integration Frameworks**
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<td>Adpae Corp.</td>
<td>(415) 974-6699</td>
<td>Design</td>
<td>Analysis/Design tool</td>
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<tr>
<td>Arthur Anderson</td>
<td>(312) 5070-5161</td>
<td>Foundation</td>
<td>CASE</td>
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<tr>
<td>Arthur Anderson</td>
<td>(312) 5070-5161</td>
<td>Design 1</td>
<td>Workstation CASE</td>
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<td>Bachman Information Systems</td>
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<td>CASE</td>
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<td>Carleton University</td>
<td>(617) 273-9003</td>
<td>TimeBench</td>
<td>Analysis/Design tool</td>
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<tr>
<td>Cognos</td>
<td>(617) 229-6600</td>
<td>Powercase</td>
<td>Analysis/Design tool</td>
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<tr>
<td>D. Appelton Company</td>
<td>(213) 546-7575</td>
<td>IDEF/Leverage</td>
<td>Analysis/Design tool</td>
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<tr>
<td>Michael Jackson Software</td>
<td>(44) 71286-1814</td>
<td>Jackson Workbench</td>
<td>Analysis/Design tool</td>
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<tr>
<td>Thought*Tools</td>
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<td>SCOOP-3</td>
<td>Analysis/Design tool</td>
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<tr>
<td>On-Line Software Inter</td>
<td>(201) 592-0009</td>
<td>Caspeac</td>
<td>Analysis/Design tool</td>
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<tr>
<td>Seer Technologies</td>
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<td>O-O CASE</td>
<td>Analysis/Design tool</td>
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<tr>
<td>Tom Software</td>
<td>(800) 777-4316</td>
<td>Application Xcellence</td>
<td>Analysis/Design tool</td>
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<tr>
<td>UES, Inc.</td>
<td>(614) 792-9993</td>
<td>KI Shell</td>
<td>Application integrator</td>
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<tr>
<td>Westmount Technology</td>
<td>(31) 15-610815/(914) 294-661</td>
<td>ISEE, TSEE, RTEE</td>
<td>Analysis/Design tool</td>
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<tr>
<td>Apollo (now HP)</td>
<td>(800) 227-6556</td>
<td>DSEE</td>
<td>Configuration management</td>
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<td>CaseWare, Inc.</td>
<td>(714) 754-0308</td>
<td>Amplify</td>
<td>Configuration management</td>
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<td>Pansophic</td>
<td>(800) 323-7335</td>
<td>PAN/LCM</td>
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<td>ProMod, Inc.</td>
<td>(800) 255-2689</td>
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<td>Procase</td>
<td>(609) 452-8848</td>
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<td>Softool</td>
<td>(805) 683-5777</td>
<td>CCC family</td>
<td>Configuration management</td>
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<td>Software Main &amp; Dev Sys</td>
<td>(508) 369-7398</td>
<td>Aide de Camp</td>
<td>Configuration management</td>
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<td>SQL Systems International</td>
<td>England 44-279-641021</td>
<td>PCMS*ADA</td>
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<td>ASYST Technologies</td>
<td>(800) 361-3673</td>
<td>The Developer</td>
<td>Database tool</td>
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<td>Informix Software, Inc.</td>
<td>(415) 322-4100</td>
<td>Informix-ESQL/Ada</td>
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<td>Ontologic</td>
<td>(508) 667-2382</td>
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<td>Oracle Systems Corp</td>
<td>(415) 506-7000</td>
<td>Deft</td>
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<td>SQL Solutions</td>
<td>(416) 249-2246</td>
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<td>Advanced Logical Software</td>
<td>(213) 653-5786</td>
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<td>Ascent Technologies, Inc.</td>
<td>(415) 940-1550</td>
<td>MetaView</td>
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<td>Cadware Group, Ltd.</td>
<td>(203) 397-2908</td>
<td>Sylva</td>
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<td>Digital Insight</td>
<td>(303) 674-5232</td>
<td>Robochart</td>
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<td>Meta Software Corp.</td>
<td>(800) 227-4106</td>
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<td>Software Originals, Inc.</td>
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<td>MacSTILE</td>
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<td>TNO</td>
<td>31 15 697 071</td>
<td>Configurable Graphical Editor</td>
<td>Diagram editor generator</td>
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<td>Tata Consultancy Services</td>
<td>(408) 720-9584</td>
<td>Essay</td>
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<td>Caine, Faber, &amp; Gordon, Inc.</td>
<td>(818) 449-3070</td>
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<td>Data General</td>
<td>(508) 366-8911</td>
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<td>Encore Computer Corp.</td>
<td>(301) 499-4700</td>
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<td>Flexible Computer Corp.</td>
<td>(214) 869-1234</td>
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<td>Gilmore Aerospace</td>
<td>(404) 728-0312</td>
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<td>GTE Government Systems Corp.</td>
<td>(617) 449-5000</td>
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<tr>
<td>IBM SITD</td>
<td>(301) 493-1448</td>
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<td>(412) 621-8888</td>
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<td>Intelligent Choice, Inc.</td>
<td>(213) 379-9680</td>
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<td>Intermetrics, Inc.</td>
<td>(617) 661-1840</td>
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<td>Loral/Rolm Mil-Spec</td>
<td>(408) 423-7701</td>
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<td>Phoenix International</td>
<td>(213) 568-1740</td>
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<td>RAMTEC</td>
<td>(201) 477-8248</td>
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<td>Sanders Associates</td>
<td>(603) 885-9208</td>
<td>PDL Tool KIT(TM)</td>
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<tr>
<td>SoftTech</td>
<td>(617) 890-6900</td>
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<td>ABT Corp</td>
<td>(212) 219-8945</td>
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<tr>
<td>American Management Systems</td>
<td>(703) 841-6000</td>
<td>Project Workbench</td>
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<td>Life-Cycle Productivity Systems</td>
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<td>Deloitte, Haskins, &amp; Sells</td>
<td>(704) 377-3560 x3131</td>
<td>MacProject II, SmartForm Manager</td>
<td>Project management</td>
</tr>
<tr>
<td>Index Technology Corporation</td>
<td>(800) 777-8858 x739</td>
<td>4Front</td>
<td>Project management</td>
</tr>
<tr>
<td>Project Software &amp; Development, Inc</td>
<td>(301) 231-8660</td>
<td>PC Prism</td>
<td>Project management</td>
</tr>
<tr>
<td>Software Publishing Corp.</td>
<td></td>
<td>Project/2</td>
<td>Project management</td>
</tr>
<tr>
<td>AST, Inc.</td>
<td>(303) 790-4242</td>
<td>Qase (PerSpective)</td>
<td>Project management</td>
</tr>
<tr>
<td>Chen &amp; Associates</td>
<td>(504) 928-5765</td>
<td>ER-Designer</td>
<td>Database tool</td>
</tr>
<tr>
<td>Cullinet Software, Inc.</td>
<td></td>
<td>IDMS/Architect</td>
<td>Database tool</td>
</tr>
<tr>
<td>Digital</td>
<td></td>
<td>Epitool</td>
<td>Expert system development</td>
</tr>
<tr>
<td>EVB Software Engineering Inc.</td>
<td>(800) 877-1815</td>
<td>GRACE library</td>
<td>Ada libraries</td>
</tr>
<tr>
<td>GSI-Data, Inc.</td>
<td>(703) 471-7130</td>
<td>OSIFPRO</td>
<td>OSI development</td>
</tr>
<tr>
<td>Holland Systems Corp.</td>
<td></td>
<td>Logical Database Design (LDD)</td>
<td>Database tool</td>
</tr>
<tr>
<td>Company</td>
<td>Contact</td>
<td>Product</td>
<td>Type</td>
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<tr>
<td>IDDK Software</td>
<td>(619) 223-5444</td>
<td>Intelligent Database Design (IDDK)</td>
<td>Database tool</td>
</tr>
<tr>
<td>IWG Corporation</td>
<td>(212) 696-3700</td>
<td>Poplink</td>
<td>Communication analysis</td>
</tr>
<tr>
<td>Information Engineering Systems Ltd.</td>
<td>(804) 744-5849</td>
<td>USER</td>
<td>Expert system development</td>
</tr>
<tr>
<td>Interact</td>
<td>(205) 539-8360</td>
<td>Integrator</td>
<td>CAE tool</td>
</tr>
<tr>
<td>Interactive Software Engineering, Inc.</td>
<td>(805) 685-1006</td>
<td>Eiffel</td>
<td>Programming environment</td>
</tr>
<tr>
<td>JADE Simulation Inter. Corp.</td>
<td>(44) 865 300579</td>
<td>JADE family</td>
<td>Simulation environment</td>
</tr>
<tr>
<td>Mass Tech, Inc.</td>
<td>(415) 965-7700</td>
<td>SPAG</td>
<td>Ada libraries</td>
</tr>
<tr>
<td>Polyhedron Software, Ltd.</td>
<td>(519) 657-8229</td>
<td>Prolog Integrated Environment</td>
<td>Formatter</td>
</tr>
<tr>
<td>Quintus Computer Systems, Inc.</td>
<td>(412) 856-3600</td>
<td>GP</td>
<td>Programming environment</td>
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<tr>
<td>Simulation Software</td>
<td>(800) 331-3729</td>
<td>SPAG</td>
<td>Simulation environment</td>
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<tr>
<td>Tartan Laboratories, Inc.</td>
<td>+39 55 301279</td>
<td>Ada Scope</td>
<td>Ada analysis tool</td>
</tr>
<tr>
<td>Unicad, Inc.</td>
<td>(703) 750-3910</td>
<td>UIMS, X-Pression</td>
<td>User interface tool</td>
</tr>
<tr>
<td>Unirel</td>
<td>(612) 379-3844</td>
<td>Unirel Openlook Toolkit</td>
<td>User interface tool</td>
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<tr>
<td>Wolverine Software Corp.</td>
<td></td>
<td>GPSS/H</td>
<td>Programming environment</td>
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<td>Xinotech Research</td>
<td></td>
<td>Program Composer</td>
<td>Ada analysis tool</td>
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</table>

**TABLE 10. Other Tools**
Appendix H

CASE Tools
ATI/superCASE

Address: Advanced Technologies, Inc, 305 5th Avenue, Suite 2420, New York, NY 10118
Tool Summary: Back end CASE tool.

1. Hardware Platforms: VMS based for VAX mainframe, microVAX, VAX clusters etc.
2. Products: superCASE and superCASE SCL licensed per machine.
   i. superCASE from $8,000 to $90,000.
   ii. XL/superCASE bridge to Excelerator/RTS, provides requirements traceability $8,500.
   iii. superCASE SCI reverse engineering $5,000 to $25,000.
3. Tool Implementation Language: Mainly C
4. Vendor Support: Technical support line, training, consultancy.
7. Methodologies/functions supported:
   i. Software design: OOD Buhr, SC methods. Capture of timing information in annotations but not used. Interface consistency checked.
   iii. Maintenance: Re-engineering for FORTRAN.
11. Database: Data dictionary implemented under DEC RDB. Import/export, split/merge.
12. Links to other tools: See XL/superCASE.
15. Adaptability: Customizable editor.
16. Planned enhancements: Port to UNIX, by summer '92.
17. Collaboration with other organizations: Negotiating with IDE (StP).
Address: 180 Rose Orchard Way, Suite 200, San Jose, CA 95134
Tool Summary: The Requirements Driven Development System Designer (RDD-100) is based upon the early steps of DCDS, providing an improved graphical user interface. Object-oriented approach to support library for re-usable components.

1. Hardware Platforms: Sun, Apollo workstations, Apple Macintosh PCs, VAXstation.
2. Components: Maintenance primary support $7,000, secondary support $5,000.
   i. System Designer. Equivalent to DCDS System Requirements Engineering Methodology (SYSREM) and it's System Specification Language (SSL), $36k for single user, $44,700 for network license. Volume discounts available.
3. Tool Implementation Language: Smalltalk
5. Marketed Since: 1988, currently RDD-100 Version 2.02, version 3.0 to be released July '91.
7. Methodologies/functions supported:
   i. System specification and design: Some semi-automatic requirements extraction from source document. Information modeling. Some allocation of functions to hw, sw, subsystem components, some timing information captured but not all used. Traceability of system requirements and decisions. Simulation facility developed for SDIO through GE, productized for version 3.0.
   ii. Implementation: Forms/screen design via customizable schema.
by the report generator. User definable entities, relationships, and attributes to existing schema and to create new schema.

15. **Planned enhancements:**
   
   i. Version 3.0 introduces stimulus-response graphs at the system level.
   
   ii. Support for Interleaf.
   
   iii. Port to HP9000 and other HP machines, IBM RISC/AIX by end of '91.
   
   iv. Working with 3rd party for knowledge-based support for requirements extraction.

16. **Collaboration with other organizations:**
   
   i. DEC and Mentor Graphics.
   
   ii. Potentially also Cadre, Iconix and others (phase new products in, starting 3rd quarter '91).
Athena Systems, Inc./Foresight

Information From: (408) 730-2100

Tool Summary: Front-end CASE, desk top simulation and modeling system for specifying and analyzing real-time embedded software.

1. **Hardware Platforms:** Sun/UNIX and HP workstations with X-Windows.

2. **Components:**
   i. Graphical Model Editor.
   ii. Model Analyzer.
   iii. Concept Prototyper.
   iv. Library elements: reusable functions and operations, mathematical and logic, signal processing, timing and validation, data manipulation, electronic I/O panel.

3. **Tool Implementation Language:** C++

4. **Tool Price:** $13,900. Training at Athena from $500 per day for 1 user to $3,000 for 6 to 10 users, on site from $1,350 for 2 days. 30 day free evaluation.

5. **Vendor Support:** Training, consultancy.


7. **Size of customer base:** 20 customers, some of whom have multiple copies.

8. **Software specification:** Merge of Ward-Mellor and Hatley-Pirbhai methods with explicit timing information and Ada-like mini-specs. For static analysis check syntax/semantics, diagram balancing, execution readiness, diagrams/data dictionary. Interactive/batch simulation with environment model showing hardware, software, and firmware with external events. Functional and constraint modeling, tests for reachability, non-determinism, deadlock conditions, and usage of transitions. Executable model for rapid prototyping with debugging and tracing. Animation. Can include Ada code and, in version 2.0 (1) external functional calls to pull in existing C code, (2) mini-spec I/O, and (3) bidirectional translator to/from Ada and executable mini-specs, to support import of existing code. Automated database population/change propagation.

9. **Documentation generation:** via FrameMaker.

10. **Environment Characteristics:** Network support via LAN.

11. **Database:** Proprietary object management system with published data formats. Database accessed by user-written application programs.

12. **Output formats:** ASCII (during simulation), PostScript, Nroff, FMT, Runoff, Interleaf, some plotting, HPGL.

13. **User interface:** Menus and mouse, on-line help, on-line documentation, windowing, some undo.

14. **Adaptability:** General-purpose editor.

15. **Standards conformance:** X-Windows, Extended Systems Modeling Language.
16. **Planned enhancements:** User-modifiable libraries.
CSC/Design Generator


1. **Hardware Platforms**: IBM PC/AT or compatible under DOS.
2. **Tool Implementation Language**: Smalltalk/V286 from Digitalk.
3. **Tool Price**: $995
4. **Vendor Support**: Support not routinely provided.
5. **Marketed Since**: 1987, Version 2.1 released May '90.
6. **Size of customer base**: <100 installations
7. **Methodologies/functions supported**:
   ii. **Software design**: Design methods/diagrams: SD generated from requirements. Checks syntax/semantics, database/diagram consistency, complexity analysis. Forms/screen design.
8. **Documentation generation**: Customize contents (not format), no 2167A support.
9. **Project management support**: Some configuration management.
10. **Database**: Data dictionary implemented as file system. Import/export facility, with split/merge.
11. **Output formats**: PostScript.
Information From: (703) 875-8670, May 8 1991.

Tool Summary: Environment that spans the design and implementation phases with real-time debug and verification tools. Supports automated transition of design to code, and helps to automate the maintenance of test information on-line as part of the CASE database.

1. **Hardware Platforms:** Sun, Apollo, DEC, HP workstations. Teamwork/OS/2 IBM PS/2 or Compaq under OS/2 includes Cadre's IPSE toolkit to allow adaptability such as customizing menus, accessing the database. RISC/AIX-based platforms. Compiler independent.

2. **Products:** Core environment $10,000 for 1st seat and $1,200 each additional. OS/2 version $6,500 with RT extensions extra $1,750. C/Rev and FORTRAN/Rev each $8,500. Ada/Rev $2,775. Maintenance 15%.
   - Teamwork/IM information modeling $1,750.
   - Teamwork/SA for Structured Analysis $1,750.
   - Teamwork/SD for Structured Design $1,750.
   - Teamwork/ADA graphic editor for Ada program design.
   - Teamwork/DPI document preparation interface,
   - Teamwork/ACCESS database utility access,
   - Teamwork/Menus for tailoring/extending Teamwork menus,
   - Teamwork/ABS an Ada source builder,
   - Teamwork/CSB a C source builder,
   - Teamwork/RqT requirements traceability (previously SAIC's THOR), $15,000 for first, $7,500 for each additional.
   - Teamwork/SIM simulation (like Statemate). Token based simulation, $12,000 for basic interactive version, with batch and additional performance analysis facilities $19,000.

3. **Tool Implementation Language:** Mainly C.

4. **Vendor Support:** Hot-line, training, consultancy, users group.

5. **Marketed Since:** 1982, currently version 4.0.

6. **Size of customer base:** 15,000 copies.

7. **Methodologies and functions at different development stages supported:**
   - **System specification:** Hardware/software allocation via RqT.
   - **Software design:** Yourdon-Constantine, Booch-Buhr and Project Technologies object-oriented methods. Show changes needed for normalization to support database design.
   - **Code generation:** SADMT, Ada, C, (C++ through Saber-C). Forms/screen design.

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v. Testing: Via Cadre's SAW product for coverage and performance analysis.
vi. Maintenance: Re-engineering for C, FORTRAN.

8. Documentation generation: User-definable formats and 2167A.

9. Project management support: Configuration management, own package or via Sun's NSE, VAX/s CMS. Baselining, security/control access. Status reporting using metric from DeMarco's Bang complexity rating.


11. Environment Characteristics: Multi-user support, network support through LAN Manager (heterogenous and external control), multiple projects.

12. Links to other tools:
   i. Import from StP.
   ii. Athena and Softbench integration environments.
   iii. SQL report writer to access data dictionary information (3rd party).
   iv. GE tools from Ada Programmers Workbench reimplemented in Teamwork.
   v. ADAS from Research Triangle Institute.


16. Standards conformance: CDIF.

17. Planned enhancements:
   i. Automatic transition from SA to SD.
   ii. FORTRAN reverse engineering.
   iii. Teamwork/T for software-based testing.

18. Collaboration with other organizations:
   i. General Electric Research and Development Center.
   ii. Associated with Project Technology.
   iii. PanSophic.
Cadware/System Developer I/II


Tool Summary: Rule-based approach with open architecture.

1. Hardware Platforms: IBM PC

2. Products:
   i. SmartCASE basic method support without data dictionary $299.
   ii. System Deverlop I is centralized around the diagram editor, with a data dictionary/repository implemented in DB3 $499.
   iii. System Deverlop II centralized around the repository (proprietary database) to provide more flexibility $3499.
   iv. IE Information Exchange customization option (rather than a formal option). Includes IA Interaction Access option.
   v. Foundry metatool to customize the development environment (e.g., methods and user-interface) based on RuleTool, a technique using the diagram editor to create own rule-based methods $4999.
   vi. User Interface Prototyper for prototyper and COBOL source code generation $499. Available with both System Developer I and II, for II supports use of a mouse.

3. Tool Implementation Language: C with 8-10% assembler.


7. Methodologies and functions at different development stages supported:
   i. Software specification: Gane-Sarson, DeMarco-Yourdon, Ward-Mellor methods, also flow charts. Shlaer-Mellor, ERDs for information modeling. Requirements extraction, traceability, capture of timing information in II. Automated database population and change propagation.
   ii. Software design: Constantine method. Prototype for DB3 database design.
   iii. Code generation: Forms/screen design in COBOL


9. Project management support: Configuration management, project planning, status reporting, change reporting, security/control access in System Developer II.


11. Database: Merge, import and export with System Developer II.


14. Adaptability: Methodology tailoring. Can add menu options. Cadware Ascii Netrual Diagram Interchange (CANDI) files allow definition of own diagrams, can access by CASE tool or own code for analysis etc.
15. **Planned Enhancements**: X-Windows and OS/2 support.
16. **Collaboration**: IBM's AD/Cycle.
Address: 2401 Walnut Street, Suite 402, Philadelphia, Pennsylvania 19103
Tool Summary: Uses rules and equational specification to generate engineering, real-time, distributed parallel processing software, supports testing and maintenance. Built-in intelligence for logical checking, design optimization, and self-documentation. Rapid prototyping and development. Changing name to Distributed Application Workbench. See also MODEL.

1. Hardware Platforms: VAX/VMS and IBM (VM/CMS, MVS/TSO) mainframes, Sun, DEC, IBM workstations.

2. Products: Technology transfer package (4 month license, 10 days training, 20 days consulting) for $30,000 plus travel. Range from $25,000 to $150,000 depending on environment. 25% extra for additional language. 15% annual maintenance. Components:
   i. Builder to generate Ada.
   ii. Simulator to generate Ada and C.
   iii. Manager to represent distributed run-time environment.
   iv. Configurator integrates system components to generate programs controlling initiation/termination and managing communication and control.
   v. Compiler to generate complete source language programs and produce test data for validation and debugging.
   vi. Report/Screen Generator taking pictorial input to specify reports and displays.
   vii. Test Data Generator with built-in random functions, user specifies testing rules.


5. Marketed Since: 1990

6. Size of customer base: 4 or 5 initial sites (some government).

7. Methodologies/functions supported:
   iii. Testing: User-specifiable test data generation (random provided).
   iv. Maintenance: Re-engineering for Ada, FORTRAN, C.


9. Environment Characteristics: Multi-user and network support via linked CASE.

10. Database: Repository.
11. **Links to other tools:** Cadre's Teamwork, Softool's CCC, IBM's VM/SE.

12. **Output formats:** ASCII.

13. **Planned enhancements:**
   
i. Automated database population/change propagation.
   
ii. Analyze to determine worst case time and show if satisfy timing requirements.
   
iii. Port to UNIX environments.
   
iv. Generation of FORTRAN.
   
v. Reverse engineering, currently working on FORTRAN and LISP.
   
vi. Generating programs for parallel processing.
   
vii. Accept object-oriented input.

14. **Collaboration with other organizations:** IBM for AD/Cycle.
CCC/MODEL

Information From: (215) 854-0555

Tool Summary: Back-end CASE for design through maintenance. Accepts DFDs or non-procedural specifications as input. Performs I/O and memory optimization.

1. Hardware Platforms: IBM mainframe, VAX/VMS
2. Tool Implementation Language: Ada, C.
3. Tool Price: $25,000 to $150,000
6. Size of customer base: Mainly used in-house, less than 5 installations.
7. Methodologies and functions at different development stages supported:
   i. Software design:
      iii. Testing: Automated test data generation either by user specified rules or random.
11. Database: via front-end case, separate database not maintained.
12. Links to other tools: Interface to Teamwork, StP, potentially DEC's DecDesign.
13. Output formats: ASCII.
Information From: Irene Nechaev (800) 537-4262

Address: 50 Tice Blvd., Woodcliff Lake, NJ 07675

Tool Summary: Picture Oriented Software Engineering (POSE) for systems planning and business area analysis, analysis, design, construction of information systems.


   i. Data model toolkit, any single module $595, toolkit for $1195:
      a. POSE-DMD Data Model Diagrammer
      b. POSE-DMN Data Model Normalizer
      c. POSE-LDD Log Model Database Designer
      d. POSE-DBA Database Aid
   ii. Process model toolkit, any single module $595, toolkit for $1195:
      a. POSE-DCD Decomposition Diagrammer
      b. POSE-DFD Data Flow Diagrammer
      c. POSE-SC Structure Chart Diagrammer
      d. POSE-ACD Action Chart Diagrammer
   iii. POSE-SRP Screen Report Prototyper $595.
   iv. POSE-PMD Planning Matrix Diagrammer for business analysis/planning $595.
   v. Data Model Bridge (DMB) for uploading data models to KnowledgeWare’s IEW $595.
   vi. LAN support $595.

3. Tool Implementation Language: COBOL


5. Marketed Since: 1979 in Europe, 1982 in USA. Preparing to release POSE Version 4.2 with reverse schema engineering, increased import/export functionality, complete data model integration and advanced utilities and input.


7. Methodologies/functions supported:
   ii. Software design: Constantine method. Database design.
   iv. Maintenance: Reverse schema engineering to allow importing existing database schemas to populate the DMD data dictionary for new applications.

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9. **Project management support**: Security/control access, project planning, status reporting, change reporting. Configuration management.

10. **Environment Characteristics**: Network support but not multi-user.

11. **Database**: Data dictionary implemented as a database with published interfaces. Database split/merge. Import/export function for exchange of information with other CASE tools. Also ASCII file generation.

12. **Links to other tools**:
   i. Generates code via link to FlexGen (from SINC, Inc.) which provides 4GL programming language, rapid prototyping, source code generation, user query, and report tools.
   ii. DMB for uploading data models to KnowledgeWare’s Icw.
   iii. Export via ASCII to code generators, some existing interfaces.
   iv. IBM’s CSP application generator.

13. **Output formats**: HPGL, ASCII.


15. **Adaptability**: Free-form text/graphics.

16. **Planned enhancements**:
   i. MS Windows and IBM OS/2.
   ii. Multi-user version end '91 or early '92.

17. **Collaboration with other organizations**: Conformance with IBM’s Ad/Cycle.
Information From: Irene Nechaev (800) 537-4262
Address: 50 Tice Blvd., Woodcliff Lake, NJ 07675
Tool Summary: SILVERRUN series support rule-based building and refining of data models, generation of SQL, and building/validating DFDs.

1. Hardware Platforms: Mac PC
2. Components: It consists of a Relational Data Moduler (RDM) module, a Data Flow Diagrammer (DFD) module, and an Entity Relationship Expert (ERX) module. Preparing Release 2.0.5. operates under X-Windows, OS/2. Each of the 3 modules costs $2,500.
3. Tool Implementation Language: C++
5. Marketed since: 1988
6. Size of customer base: 3000 licenses
7. Methodologies and functions at different development stages supported:
   i. Software specification: Supports Gane-Sarson, Yourdon-DeMarco with ERDs for information modeling.
   ii. Software design: Database design with schema generation for Ingres, DB2. Screen/forms prototyper.
9. Database: Data dictionary implemented as database.
10. Output formats: ASCII.
11. User interface: Menu and mouse, windowing, color.
13. Planned enhancements:
   i. Integration with POSE.
EasySpec, Inc./Object Plus

Address: 17629 El Camino Real, Suite 202, Houston, TX 77058
Tool Summary: Backend CASE tool to support requirements definition, objects analysis, and code generation, does not support graphical analysis of application problem space.

1. Hardware Platforms: IBM AT
2. Products: Basic system $1,990, with Ada code generator $2,490. Volume discounts available.
3. Tool Implementation Language: C
5. Marketed Since: 1989
6. Size of customer base: 700 licenses
7. Methodologies and functions at different development stages supported:
   ii. Software design: Object-oriented Design. Schema generation for DB2, Oracle, SQL/D, dBASE, Paradox, and others.
12. Output formats: ASCII.
15. Planned enhancements:
   i. X-Windows/Motif version.
   ii. Inheritance.
   iii. General-purpose graphical editor.
Future technology, Inc./Envision

Information From: Leon Stucki (206) 939-7552, 23 may 1991.

Tool Summary: Formerly DesignVision by Ken Orr Institute.

1. Hardware Platforms: IBM PS/2 under OS/2.
2. Tool Implementation Language: C
4. Vendor Support: Training, consultancy, support group, newsletter.
5. Marketed Since: 1986
7. Methodologies and functions at different development stages supported:
   i. Software specification: SQL interface provides some support for requirements extraction. Structured Analysis, with limited support for real-time extensions. Chen information modeling. Automated database population/change propagation.
   ii. Software design: SC.
11. Database: Object-oriented repository implemented as database. Import/export facility.
12. Links to other tools:
   i. Link to Olivetti products for forms/screen design and schema generation.
   ii. Link from Brackets to Envision (Envision to Brackets planned).
13. Output formats: ASCII.
16. Planned enhancements:
   i. Link to MicroSoft’s Project for project management support.
   ii. Reverse engineering.
   iii. Link to Olivetti products for prototyping.
   iv. Simulation.
   v. Integrate Brackets with Envision.
17. Collaboration with other Organizations: IBM AD/Cycle.
Future technology, Inc./Envision

Information From: May 6, 1991.
Address: 22 Third Avenue, Burlington, MA 01803
Tool Summary: Workstation-based graphical support for simulation and prototyping. Executable specification for real-time software, screen display forms. Test data used to emulate system environment and uncompleted portions of system. Color animation of diagrams.

1. Hardware Platforms: Sun with UNIX and SunOS, VaxStation with MicroVMS and UIS software, Apollo/Aegis with DomainIX. VAX/VMS, RISC-based Sun and DEC workstations, IBM PC/AIX.

2. Products: Each with kernel (3 graphics editors) and training for 2 people. Maintenance 15%.
   i. Statemate Analyzer $25,000.
   ii. Statemate Prototyper to generate code $30,000 (for either Ada or C).
   iii. Statemate Documentor for customized output includes Statemate Dataport to access outside elements and database, $20,000.
   iv. EXPRESS VHDL.

3. Tool Implementation Language: C


5. Marketed Since: 1987


7. Methodologies and functions at different development stages supported:
   i. System specification: System definition and specification, system requirements analysis and design (with EXPRESS VHDL for hardware specification), system integration and testing, validation testing. Simulation with state reachability, deadlocks, race conditions.
   ii. Software specification: David Herd's method with activity charts, data dictionary entries, state charts (concurrency and hierarchy, extension of state transition diagrams), module charts (physical system architecture). Some timing information, concurrency. Consistency/completeness checks of model. Automatic change propagation. Dynamic and behavioral validation, interactive/batch simulation, dynamic reachability and non-determinism testing, no dynamic timing or hardware allocation. Traceability.
   iii. Software design: Module charts (not SC). Traceability between design elements and forms (formal and informal textual information such as requirements list). Forms editor.
   iv. Code generation: Ada, C

8. Documentation generation: Text and graphics, user-definable and built-in templates (including 2167A templates).
9. **Project management support**: Configuration management, logging and versioning of files, security/control access, status reporting, change reporting.

10. **Environment Characteristics**: Multi-user, no replication.

11. **Database**: Repository of ASCII files used like native DBMS (InterBase). DATAPORT facility via C routines for import/export of ASCII data, provides bridge to other tools. Database split/merge.

12. **Links to other tools**:
   - i. **DesignAid**: Network support using IBM PC-Network and Novell Advanced NetWare.
   - ii. Uses RDB from MicroVAX, Interbase from Sun and Apollo.

13. **Output formats**: ASCII, PostScript, Interleaf, troff, nroff, HPGL.


15. **Adaptability**:
   - Graphic editors are rule-based with automatic syntax checking.

16. **Standards conformance**: EXPRESS VHDL (1076 compliant VHDL).

17. **Planned enhancements**: Design to test link for performance analysis, end of '91.
Information From: Lesley Mangeri (703) 848-8808

Tool Summary: Open architecture called Visible Connections with published interfaces.

1. **Hardware Platforms:** DEC VAXstation, Sun, HP/Apollo workstations, IBM RISC, and others under UNIX, X-Windows.

2. **Products:** $5,000 to $12,000
   i. OOSD/Ada Release 1.0. Release 1.1 will include code generation from designs, 2167A support, X-Windows support (summer '91), and reverse engineering 92.
   ii. OOSD/C++ with graphical design editor, expected end '91.
   iii. CDE Phase I released 1990. Reverse engineering and code generation in Phase II. Integrated between design and construction tools.
   v. Rapid prototyping tool.


4. **Vendor Support:** Training, quarterly newsletter, consultancy, support group, hot-line.

5. **Marketed Since:** 1985. Currently release 4.3.

6. **Size of customer base:** 4000 installations.

7. **Methodologies and functions at different development stages supported:**
   i. **Software specification:** Gane-Sarson, Yourdon-DeMarco, Hatley methods. No explicit timing or other quantitative performance information, replication, resource allocation. Chen and Jackson data structure diagrams for information modeling. Diagram and decomposition checking, consistency with database and between diagram types. Automated database population and change propagation on demand. Traceability.
   ii. **Software design:** Structure charts, mini-specs. Supports Wasserman’s User Software Engineering for interface design and prototyping. Parameter checking for static analysis. Database design with SQL schema generation for various relational databases including DB2, Informix, Ingres, Interbase, Oracle.
   iii. **Code generation:** User-definable source code templates for Ada, C, Pascal, PDL for data and type declarations from design descriptions. Structured Chart Editor templates for COBOL. RAPID/USE code for user interface development.
   iv. **Testing:** For SA/SD portion via bridge to McCabe’s tools.

8. **Documentation generation:** User-defined and 2167A templates.

9. **Project management support:** Security/control access.

10. **Environment Characteristics:** Multi-user and network (heterogeneous) support. Multiple project support.

11. **Database:** Object management library (repository) implemented as relational database, user-definable schema with data independent interface to data dictionary. Database...
split/merge, import/export with defined data formats.

12. **Links to other tools:**
   i. Atherton's Software Backplane.
   ii. 4GLS
   iii. Interleaf and FrameMaker publishing.

13. **Output formats:** PostScript, troff, UNIX pic, raster.

14. **User interface:** Menu and mouse, windowing, on-line help, undo. Database browser.

15. **Adaptability:** Object Annotation Editor to associate properties and values with diagram objects based on user-defined annotation templates. Annotation information extracted from data dictionary via Object Management Language, Documentation Preparation System, or Troll DBMS facilities. Special tool for limited methodology tailoring.

16. **Standards conformance:** CDIF.

17. **Planned enhancements:**
   i. RISC/AIX platforms 3rd quarter 90, single license $5,000 to $21,000.
   ii. Expect generation of C++ (through Saber-C) next year.
   iii. Reverse engineering.

18. **Collaboration with other organizations:**
   i. Group Bull for their internal use.
   ii. Saber Software (for C coding, testing and re-engineering).
   iii. Informix Software, joint marketing agreement. SQP support.
Iconix/PowerTools, AdaFLOW

Address: 2800 28th Street, Suite 320, Santa Monica, CA 90405

Tool Summary:


   i. AdaFLOW hierarchical Buhr/Booch diagram editing with dictionary and language sensitive editing support, $1,995.
   ii. Free Flow support for DeMarco/Hatley.
   iii. Fast Task real-time SA extensions.
   iv. DataModeler for modeling and logical database design.
   v. QuickChart shows partition of software into modules (Constantine).
   vi. SmartChart structure chart generator.
   vii. PowerPDL translates pseudo-code into trees needed for SmartChart and generates formatted documentation.
   viii. ASCII Bridge merges multiple dictionaries and import/export facility.
   ix. CoCoPro.

3. Tool Implementation Language: Pascal and C.


5. Marketed Since: 1986

6. Size of customer base: 1500 copies

7. Methodologies/functions supported:
   ii. Software design: Constantine SD with Page-Jones extensions, Structured Object-Oriented Design (SOOD) in AdaFlow. PDL with document generation. DataModeler builds textual source files containing SQL, COBOL, or other source language data definitions for database design.
   iv. Maintenance: Re-engineering via SmartCheck, PDL for software developed using tools.

Iconix/PowerTools, AdaFLOW

9. **Database**: Data dictionary implemented as file system, together with diagrams maintained as integrated encyclopedia. Multiple typing in data dictionary.

10. **Project management support**: CoCoMo cost modeling. Security/control access, configuration management via ASCII Bridge, export after date stamping.

11. **Environment Characteristics**: Multi-user, network support.

12. **Database**: Import/export to DBMS via ASCII Bridge. Split/Merge.

13. **Links to other tools**:
   i. See ASCII Bridge.
   ii. Teamwork for requirements.

14. **Output formats**: ASCII, Interleaf. In Mac environment support WordPerfect and such.

15. **User interface**: Menu and mouse, windowing, color, undo facility, database browser.

16. **Standards conformance**: CDIF

17. **Planned enhancements**:
   i. Publish and subscribe to replace cut and paste and allow automatic updating.
   ii. All tools under DOS Windows and Sun/UNIX. Release on multiple platforms e.g., combination of UNIX and DOS environments.
   iii. Requirements traceability tool, fall '91.
   iv. Potentially link to Advanced Systems Technology, Inc.'s QASE RT for simulation.

18. **Collaboration with other organizations**:
   i. Joint marketing venture with Meridian for purchase with Meridian Ada Vantage compiler.
   ii. IBM Ad/Cycle.
Index Technologies/Excelerator

Information From: Julie Kelly (800) 777-8858, hot-line (800) 888-4203. May 7 1991.
Address: One Main Street, Cambridge, MA 02142
Tool Summary: Planning, analysis, design, construction and re-engineering of information systems, supporting overview of a database and interacting application.

1. **Hardware Platforms:** IBM PC/DOS, VAXstation/VMS.

2. **Products:** Maintenance $882 per copy.
   i. Excelerator/IS, includes XLDictionary for integration project information $9,800.
   ii. Excelerator/RTS, includes XLDictionary for integration project information $9,800.
   iii. XL/DOC add-on for documentation generation to user-specified formats/scripts $4000.
   iv. PC Prism supports both IS and RTS, computer aided system planning $8000.
   v. Excelerator for Design Recovery for re-engineering of COBOL. Taking off market.
   vi. Customizer package to tailor Excelerator, modify graphs, screen descriptions $12,500.
   vii. XL/Quickstart provides on-line assistance for using Excelerator.
   viii. IDEF/LEVERAGE, a custom version of Excelerator to automate IDEF modeling.

3. **Tool Implementation Language:** C++

4. **Vendor Support:** Publishes CASE magazine. Training, consultancy, hot-line, support group and newsletter.

5. **Marketed Since:** About 1984. Currently release 1.9.

6. **Size of customer base:** 100,000 installations.

7. **Methodologies/functions supported:**
   i. **Software specification:** Yourdon, Gane-Sarson, Ward-Mellor, Hatley, SSADM methods. Chen and Merise ERDs for information modeling. Diagram balancing, syntax/semantics, database/diagram consistency checking. Automated database population/change propagation. Traceability of engineering and user requirements.
   ii. **Software design:** Constantine charts, Jackson structure diagrams. Verifies normalization to support database design.
   iii. **Code generation:** Transform database record descriptions into BASIC, C, COBOL, PL/1. Forms/screen design with prototyping in Basic, C, COBOL, PL/1.

8. **Documentation generation:** Customizable and user-definable formats, 2167A support.

9. **Project management support:** Access control, assignment to project tasks, workbreakdown structure diagrams, presentation graphs.

10. **Environment Characteristics:** Central project dictionary. Multi-user, network support. Database split/merge facility, multiple project support. Access to database by XL/Programmer Interface. Export to dBASE II, and other databases.

11. **Links to other tools:**
   i. Bridge to IBM CSP and JAD, DB2. Rep (PC Prism).
   ii. 4FRONT integration framework from Deloitte & Touche.
iii. Bridge by XL/Interface to TELON for prototyping or MicroFocus COBOL/2 Workbench.
iv. Bridge to Sage's APS Development Center.
v. XL-XPRESS bridge to PSL/PSA.
vi. Interface to Aldus PageMaker, GDDM, Ventura Publisher.
vii. Softool's CCC.
ix. Interface to other application generators for COBOL.
 x. Interface to 4GL MANTIS, PowerHouse.

12. **Output formats:** PostScript, HPGL. Interleaf for VAX version.
13. **User interface:** Menu and mouse, windowing, color, some on-line help. Database query/browser.
14. **Adaptability:** Free-form text/graphics via Customerizer package.
15. **Standards conformance:** SAA next version.
16. **Planned enhancements:**
   i. Improved static analysis, executable specs with Petri-nets.
   ii. Support for OS/2.
17. **Collaboration with other organizations:**
   i. IBM partner, AD/Cycle.
   ii. Merged with Sage, supporting APS application generator. (Sage now called Intersolve.)
Information From: Bruce Donadt (508) 393-1231, May 8 1991.
Address: 2500 Mission College Blvd., Santa Clara CA 95054-1215

Tool Summary: Graphical environment for mathematically-based design of real-time control systems with design capture, simulation and code generation in Ada, C, Fortran. Automates development of real-time software from SYSTEMBUILD's high-level graphical design. 2 and 3D plotting.

1. Hardware Platforms: VAXstation, HP/Apollo, SUN workstations, IBM PC.

2. Components: Single-user workstation from $20,000 to $43,000. Multiple licenses multiple by factor of 1.4, and factor of 2.4 for multi-user licenses. This purchases full support and use of software for 1 year, must renew at 20% each subsequent year.
   i. SYSTEMBUILD for graphical modeling and simulation of nonlinear, continuous, event driven and sampled-data systems. Includes Case Extension Module, RT/Expert Module, RT/Fuzzy Module. Simulation enhancements include Interactive Animation Module, HyperBuild Module, RemoteSim Module.
   ii. MATRIXx Analysis and Design for interactive control system analysis and design.
   iii. Xmath scientific and engineering mathematics, graphics, and programming.
   iv. AutoCode Real-Time Code Generation generates code directly from high-level SystemBuild block diagrams in Ada, C, FORTRAN.
   v. AC-100 Implementation and Testing supports testing of control software and hardware.

3. Tool Implementation Language: C++ (and others for math routines).

4. Vendor Support: Newsletter, training, consultancy, support group, hot-line.


7. Methodologies/functions supported:
   ii. Code generation: Ada, C, FORTRAN.


11. User interface: Menu and mouse, windowing, color, on-line help.
12. **Standards conformance:** Next release X-Windows under Motif.

13. **Planned enhancements:**
   
i. Document generator (summer ’91) will provide user-definable templates and documentation aids.

   ii. Open architecture allowing import/export from/to other CASE tools.
KnowledgeWare Inc./Application Development Workbench

Information From: Brenda Watkins (703) 506-0823 x7040, Jeff Wiley for technical support.
Address: 3340 Peachtree Road, N.E., Atlanta, GA 30326
Tool Summary: Set of integrated rule-based CASE tools running on micros designed to develop applications for mainframe IBM environments. Tools integrated round central object-oriented encyclopedia, likely to be kernel of IBM's repository product. Re-use support.

1. Hardware Platforms: IBM PS/2, OS/2 with Presentation Manager.

2. Products:
   i. Application Development Workbench (ADW) comprises the Design Workstation, Construction Workstation, Planning Workstation, and Analysis Workstation. The Starter Kit is $15,000. ADW/MVS operates in a mainframe environment (MVS/TSO), an open architecture framework that can be used with PWS CASE tools, IEW, and ADW.
   ii. ADW/RAD for application animation and automated generation of design information from specification. Uses object-oriented methods and a non-procedural specification language. Purchased separately costs $1,500, or with ADW/DOC for $2000. Executes on IBM PS/2. It focuses on a tactical or business area analysis project and the associated analysis and design to drive application development of the business model. It can be driven by the process and data models defined by the ADW/Analysis Workstation. Application Animator for iteratively prototyping the specification. Application Design Generator to generate the application design (screen layouts, action diagrams, structure charts and data structures) into the ADW/Design Workstation (2nd release). Initial version targeting text-base applications, subsequently GUI applications.
   iii. ADW/DOC for documentation support. Purchased separately costs $1,500, or with ADW/RAD for $2000.
   iv. GAMMA COBOL generator $209,300 for first license.
   v. Repository Enablement Facility provides a bridge between KnowledgeWare's encyclopedia and RM/MVS.
   vi. IEW Starter Kit is $15,000.

3. Tool Implementation Language: C


6. Size of customer base: 55k copies, >3k sites.

7. Methodologies/functions supported:
   i. Software specification: Yourdon-DeMarco, Gane-Sarson, Ernst-Young methods. James Martin's Object Oriented Analysis, and ERDs for information modeling. Simulation via ADW/RAD. Syntax/semantics, diagram balancing, database/diagram consistency, consistency with planning stage checking; the Knowledge Coordinator around the encyclopedia ensures referential integrity, consistency, etc. Traceability.
Automated database population and change propagation.

ii. **Software design**: SC and module action diagrams generated from specification. Screen/forms design and prototyping. Generate SQL Data Definition Language, COBOL for database.

iii. **Code generation**: Templates for C, Ada, COBOL, FORTRAN, Pascal, PL/1, and others.

iv. **Maintenance**: Re-engineering from COBOL.

8. **Documentation generation**: User-definable and 2167A templates via ADW/DOC.

9. **Project management support**: Audit trail, security/control access, some project planning.

10. **Environment Characteristics**: Multi-user, network support via LAN.

11. **Database**: Repository with split/merge, import/export facility.

12. **Links to other CASE tools**:

   i. Mark V's Adagen/KW001 interface extensions for Ada generation for IEW/AWS.

   ii. Software One Ltd. interface from Auto-Mate Plus to IEW/ADW, from Teamwork to IEW/ADW, and between IEF and IEW.

   iii. Barton Group interface IEF to IEW or ADW, and with INGRES/Pansophic.

   iv. Fina Oil interface from Excelerator to IEW and between Design/1 CASE Tool and IEF.


   vi. Cortex Ltd. interface from IEW/DWS to CorVision.

   vii. EDS interface from IEW/AWS (soon IEW/ADW) to Pacbase.


   ix. Software AG interface from IEW/ADW to Predict (also Excelerator to Predict).

   x. U.S. Sprint interface from Prokit Workbench to IEW.

13. **Links for reverse engineering**:

   i. **InterCASE** for transfer of data to IEW/AWS and IEW/DWS.

   ii. Utilities for database reverse engineering.

14. **Links to code generators**:

   a. TELON code generator for COBOL and PL/1.

   b. Barton Group working on bi-directional interface between IEW/AWS and Bachman's Data Analyst. Also Bachman interface from IEW/AWS to Data Analyst.

   c. Ernst & Young interface from IEW/DWS into Microfocus Workbench for generation of object code from IEW’s COBOL.

   d. Bi-directional interface between IEW and Uniface (4th gen application development system).

   e. Bonner & Moore Consulting interface to Netron’s Cap.

   f. Interface to Clarion code generator.

   g. APS/IEW PC Interface for bridge from IEW/AWS to Sage’s APS. Bi-directional IEW/DWS interfaces by John Deere.

   h. SAA interface from IEW/DWS to AS/SET code generator for RPG/400.

   i. KnowledgeWare's bi-directional interface to IBM's CSP and own COBOL generator.

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j. Pro-C code generator for C.

15. **Output formats**: ASCII, PostScript.


17. **Adaptability**: Free-form text/graphics, some methodology tailoring.

18. **Standards conformance**: IBM SAA, National Language Support (NIS).

19. **Planned enhancements**:

20. **Collaboration with other organizations**: IBM AD/Cycle.
Information From: Giovanna Petrone 39 11 831.1830, FAX 39 11 812.1235
Email: giovanna@lps@i2unix.uucp
Address: Via Napione 25, 10124 Torino, Italy
USA distributors for Ada products: (703) 648-1551

Tool Summary: For detailed, programming, and documentation of software projects using Ada, C, C++, FORTRAN, COBOL, Pascal, and others. Uses hypertext technology. Formerly DUAL and KEYLINE.

1. Hardware Platforms: DEC VAX/VMS, Sun and Apollo workstations, IBM PS/2 and RISC systems, PC, HP series 9000.
2. Products: The full KeyOne package (for Ada) starts at $895 for IBM PC. C++ package starts at $2,850 on workstations. Ranges up to $21,400 for Ada or C++ on VAX 8974, 8840, 8978, 6360, 6333, 8842. Maintenance is 15% of license price, with updates during maintenance period costing $300.
   i. KeyFlex hybrid editor ranges from $295 (Ada) and $1,800 (C++) to $15,000.
   ii. KeyDesign syntax directed editor for design.
   iii. KeyDoc structured documentation generator.
   iv. Off-the-shelf translators for Pascal to Ada, Ada PDL to C, HOOD PDL to Ada or C.
   v. Intermodule navigation for KeyOne for Ada 15% of Ada license price.
   vi. DoD 2167A documentation support 15% of license price.
   vii. SQL extension to standard languages (C, COBOL, Ada) 10% license price.
3. Tool Implementation Language: C
4. Vendor Support: Consultancy, training, hot-line.
6. Size of customer base: >600 installations
7. Methodologies and functions at different development stages supported:
   i. Software design: Step-wise refinement with James Martin action diagrams.
   ii. Code generation: Ada, C, C++, Pascal, FORTRAN, COBOL.
11. Database: Data dictionary implemented as file system. Import/export?

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14. Planned enhancements: Translators are being developed for Jovial to Ada, FORTRAN to Ada or C, Ada to HOOD PDL reverse translator.
Information From: Grace Farenbaugh (818) 995-7671, May 7 1991.
Address: 16400 Ventura Blvd., Suite 303, Encino CA 91436
Tool Summary: Code generation and reverse engineering for Ada, C, C++. Extensibility a major feature. Designed to facilitate rule-based integration with other methods/tools.

1. Platforms: IBM PC/DOS, MACs, and under UNIX/Windows for any workstation.
2. Products: As a whole, ObjectMaker CASE Tool (analysis/design, menu customization, and 1 language) $8,000. Volume discounts available. Maintenance 15% source price.
   i. ObjectMaker Analysis and Design, drawer, database repository, and methods support $5,000.
   ii. ObjectMaker Tool Development Kit (TDK) provides access to rules for extensive customization $25,000.
   iii. Menu customization kit for menus and acceleration keys $1,500.
   iv. Adagen language module for Ada code generation and reverse-engineering $3k.
   v. Cgen language module for C, C++ code generation and reverse-engineering $3k.
7. Methodologies/functions supported:
   ii. Software design: Many, including Constantine, Booch/Buhr methods. Some support for database design, not fully automated.
   iii. Code generation: Ada, C, C++
8. Documentation generation: Fixed. 2167A via DOCGEN2167 running on PCs and Mac, own support available by end of '91.
10. Database: Repository, import/export. Published interfaces and split/merge by end '91.
12. User interface: Menu and mouse, windowing, color, on-line help, undo. Database browser via forms/tables component later this year.
13. **Adaptability**: Tool kit allows additions or modifications of methods, graphical notations, database schema, and user interface, including custom languages and framework support.

14. **Standards conformance**: CDIF, PCTE.

15. **Planned enhancements**:
   
   i. Schema generation.
   
   ii. More hardware platforms.
   
   iii. User definable report formats and full support for 2167A.
Mentor Graphics       CASE Station

Information From: John di Fernandos (503) 685-4830, May 7 1991.

Address: 17052 Jamboree Blvd., Irvine, CA 92714

Tool Summary: Graphics modeling environment with engineering analysis, planning, simulation, and real-time code generation, optimization, and automated documentation. With MATRIXxCAE for CAE/CASE integration. Formerly TekCASE.

2. Products: $25K to $40K for a single workstation.
   i. CASE Station.
   ii. CodeLink Station.
   iii. DOC technical publishing.
3. Tool Implementation Language: C++
4. Vendor Support: Training, consultancy, support group, newsletter.
6. Size of customer base: >3k users
7. Methodologies/functions supported:
   ii. Software design: SC with prototyping and forms/screen design.
   iii. Code generation: Code frames for C.
   v. Maintenance: Re-engineering from C.
9. Project management support: Version management via Design Manager.
11. Database: Use host's file system, store data in an intermediary ASCII format.
14. Adaptability: Methodology tailoring (only things such as changing error messages).
LBMS/Structured Architect Workbench

Information From: (800) 333-6382

Tool Summary: Open architecture. Evolved from PSL/PSA which now provides repository facilities. Formerly marketed by Meta Systems, now bought out by LBMS.

1. Hardware Platforms: IBM PC
2. Products: SA Workbench $6,995. Metabase Import/Export Utilities for interface between QuickSpec, SA Workbench and PSL/PSA.
3. Tool Implementation Language: C
6. Size of customer base: 300 licenses
7. Methodologies and functions at different development stages supported:
   i. Software specification: Can accept input from QuickSpec of system specification in Microsoft Windows. SA, Ward-Mellor methods with traceability. DFDs can be created from PSL information. Information modeling. Static analysis of diagram balancing and consistency. Some resource allocation. Automatic database population, change propagation.
10. Links to other tools: Wordprocessing and desktop publishing systems.
11. Output formats: ASCII.
12. User interface: Menu and mouse, windowing, color, on-line help, undo. Database query facility only through reports.
Information From: Maria Campbell (313) 663-6027

Tool Summary: Systems Engineer is a rewrite of Auto-Mate Plus. Open-architecture for desk-top based development with adherence to Dynamic Data Exchange and Object Linking and Embedding interface standards to tool extension.

1. Hardware Platforms: IBM PS/2, network under NETBIOS compatible LAN.

   i. SE/Open component for integration of Systems Engineer with other tools.
   ii. Applications Engineer generates applications using input from System Engineer. Based on Jackson Technology.
   iii. Information Manager supports integration and control of multiple System Engineer workgroup SQL databases across an organization. Also key component of LBMS REVENG.
   iv. REVENG reverse and re-engineering toolset applies to C, COBOL, FORTRAN. Dynamic analysis capabilities based on instrumentation are being added.
   v. Strategic Planner supports business and strategic data modeling and planning to produce a phased strategic IT plan.
   vi. Project Engineer for project planning and estimating, extensions will include progress monitoring and an expert system to act as an advisor and validator of project plans.
   vii. On-Line Methods based on hypertext and hypergarphics to provide support for development.

3. Tool Implementation Language: C


6. Size of customer base: 12,000 users in Europe and USA.

7. Methodologies/functions supported:
   iv. Code Generation: COBOL, PL/1, Ada, C.

8. Documentation generation: No user-definable formats, 2167A information available but not formatted.

9. Project management support: Security/control access, version control, project planning.

11. **Database:** Repository implemented as database.

12. **Links to other tools:** SSADM Version 4.

13. **Output formats:** PostScript, ASCII, Interleaf, HPGL.


15. **Adaptability:** Free-form text/graphics and some methodology adaptability.

16. **Standards conformance:** CDIF, IRDS, AD/Cycle, Common User Access (CUA) graphical user interface.

17. **Planned enhancements:**

   i. OS/2 Presentation Manager support and Information Manager Integration, 2nd quarter 1991.
   
   ii. Improved windows based data design module, enhancements to design tools, e.g., data modeling, and full Applications Engineer Integration, 3rd quarter 1991.
   
   iii. GUI painter to generate C for Windows and Presentation Manager.
   
   iv. Object orientation approach.
   
   v. Generation of 100% GUI application code, through enhancement of System Engineer to support C and C++.
   
   vi. Matrix handling for enhanced data modeling, JSP support.
Information From: Mike Skiles (800) 872-8296

Tool Summary: Project manager workbench, requirements management and analysis system, structured analysis and design. Nastec was previously Transform Logic Corp.

1. **Hardware Platforms:** DEC VaxStation, IBM PC, AT, PS/2 and compatibles.

2. **Products:** Volume discounts available. Annual maintenance $1056 per copy, includes technical support line, maintenance and enhancement releases. On-site training $680 per day.
   i. DesignAid $6,900. Data modeling option $1500. Real-time modules $1500.
   ii. AutoDraw.
   iii. Source/Re for reverse engineering of COBOL.
   iv. (RTrace now marketed by different company. User-definable categories and attributes. VAX-based relational database. Support VMS security features.)

3. **Tool Implementation Language:** Pascal, C.

4. **Vendor Support:** Seminars and workshops (on-site and at Nastec’s Corporate Training Center), video-based training program, consultancy, support group/newsletter, hot-line.


6. **Size of customer base:** Information not available.

7. **Methodologies and functions at different development stages supported:**
   i. **Software specification:** Yourdon-DeMarco, Gane-Sarson methods with real-time modeling option for Ward/Mellor and Hatley, Jackson diagrams. Resource allocation to architectural components. Timing information as annotations. Chen data modeling (optional) for information modeling. ERD rule-based validation. Syntax/semantics, diagram parent-child balancing, text/diagram consistency, model consistency checking. Automated database population, no change propagation.
   iii. **Implementation:** Code generation via Transform and TELON. Forms/screen design.
   iv. **Maintenance:** Re-engineering from COBOL.

8. **Documentation generation:** User-definable, 2167A formats.

9. **Project management support:** On-line estimation, risk assessment, management reporting, project status, review process using electronic mail, on-line task assignment, automatic status reporting, project planning and definition. Security/control access. Change reporting.

10. **Environment Characteristics:** Multi-user, remote access to database on host or LAN file server.
11. **Database:** Data dictionary implemented as database and file systems, with published interfaces and split/merge.

12. **Links to other tools:**
   a. Nastec’s Transform repository.
   b. Desktop publishing via Pc-Paint or DEC Runoff.
   c. DesignAid: HostLink allows access to a database and document files (graphics and text) on an IBM host computer.
   d. PanSophic’s TELON COBOL Generator.
   e. Chen and Associates SchemaGen.
   f. SafeSpan: DesignAid bridge to PSL/PSA.
   g. JaDesign: support for IBM’s Joint Application Design (JAD) methodology.

13. **Output formats:** Published interfaces DEC VAXDocument with Encapsulated PostScript, Interleaf TPD for VAX, Nastec’s NRunoff interface for EC Runoff, Xerox Ventura Publisher and Aldus PageMaker for PCs. ASCII text files.

14. **User interface:** Menu and mouse, color, on-line help, undo facility. SQL-based access to dictionary, browser.

15. **Adaptability:** Free-form text/graphics. Keyboard macros for customized functions and utilities.
1. **Hardware Platforms:** DEC VAX/VMS, VAXstation, IBM PC/MS-DOS, PS/2 and compatibles, Sun/UNIX, HP 9000 workstations.

2. **Products:**
   i. ProMod/SART requirements analysis with real-time extensions. Includes ProMod/2167A report generator. PC version $3,000, VAX ranging from $3,500 to $30,000.
   ii. ProMod/TMS traceability matrix system for requirements and other development items through design $500 to $10,000.
   iii. ProMod/MD object-oriented design with architectural and detailed design, PC version $3,500, VAX ranging from microVAX $10,000 to $35,000. Includes ProMod/DC design charts.
   iv. Pro/Source source code generation in Ada and C $1,500 to $5,000.
   v. ProCap source code refinement and maintenance $1,000 to $1,500.
   vi. ProMod/CM change and configuration control, VAX only $500.
   vii. Re/Source reverse engineer code to design. (Not released in USA.)

3. **Tool Implementation Language:** Converting from Pascal to C.

4. **Vendor Support:** Training and consultancy via 3rd party.

5. **Marketed Since:** In-house use since 1980, marketed in the US since 1985.

6. **Size of customer base:** 100 users, 500 licenses in USA, 10K in Germany.

7. **Methodologies/functions supported:**
   i. **Software specification:** Yourdon-DeMarco, Hatley methods. Syntax/semantics, database/diagram consistency checking and diagram balancing. Automated database population/change propagation. Traceability.
   ii. **Software design:** Automated transform to SC from requirements, will be able to edit this transformation in next version. OOD, Constantine methods, modular hierarchy chart, or function network chart. Language independent pseudo-code.
   iii. **Code generation:** Ada, C, Pascal templates (control structures).

8. **Documentation generation:** Customizable formats, 2167A support.

9. **Environment Characteristics:** Database split/merge. Multi-project support.

10. **Database:** Data dictionary implemented by proprietary database, ASCII file import/export to other CASE tools.

11. **Output formats:** ASCII, PostScript.

12. **User interface:** Menu and mouse, windowing on VAX, on-line help, some undo.

13. **Planned enhancements:** Version 2 is under development, parts expected 3rd quarter '91.

1. **Hardware Platforms:** PC based tool runs under MS-Windows. IBM PC and compatibles under Microsoft windows.

2. **Tool Implementation Language:** C


4. **Vendor Support:** Training, consultancy, user manual includes tutorial.

5. **Marketed Since:** Since June 1988, currently Release 2.1.

6. **Size of customer base:** Over 5000 copies, approx. 7 copies per customer.

7. **Methodologies/functions supported:**
   i. **Software specification:** Requirements extraction from natural English, potentially including user-definable attributes. Gane-Sarson, Yourdon-DeMarco, Ward-Mellor methods. Optional OOD with hardware/software allocation using Booch's architectural diagram. ERDs for information modeling. Automatic diagram leveling, balancing with syntax/semantic and database/diagram consistency checking. Traceability, also testplan tracking. Automated database population/change propagation.
   ii. **Software design:** Structure charts, module specs automatically generated from mini specs. Also flowcharts, decomposition charts. Normalization and schema generation.

8. **Documentation generation:** User-definable reports, SQL custom reporting system, some desktop publishing features, matrix reporting facility, graphics. Have information needed for 2167A documentation but not yet produce these reports explicitly.

9. **Project management support:** Project planning, status reporting, change reporting, defect reporting.

10. **Environment Characteristics:** Network support, supporting 3Com, Novell, Token Ring, STARLAN and others under DOS. Data dictionary using dBASE III Plus format. Published interfaces, i.e., open architecture data dictionary/encyclopedia using dBASE III Plus file formats. Multi-user support. Database split/merge.

11. **Interfaces:** Import through ASCII and common delimiter published interface. Import command to populate requirements specification. Bulk in ASCII format (to populate data dictionary or requirements specifications). Export reports to dBASE III and spreadsheet.

12. **Links to other tools:** Spreadsheet also
   i. Currently interface with IEF/IEW and Excelerator by ASCII and Common Delimiter format. In 3rd quarter '91 a standard interface to System Architect will be supported with bridges to these tools.

13. **Output formats:** ASCII, Encapsulated PostScript. Interface to desktop publishing systems.

14. **User interface:** Menu, mouse and keyboard, windowing, some use of color. Context sensitive on-line help and novice facility. Database browser/query facility through report

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15. **Adaptability:** User-defined attributes test plan, on-line rules. User definable attributes for dictionary, definable attribute edit rules. User-defined attribute system (metadata) available for analysis including system variables and various system calculated metrics. User-definable diagram types using available icons.

16. **Planned enhancements:**
   ii. Re-engineering beginning with COBOL in 3rd quarter ’91.
   iii. Security/control access 3rd quarter ’91.
   iv. OS/2 and AIX (RISC) version.
   v. Rapid prototyping support 4th quarter ’91 for COBOL and C.
   vi. SQL server interface.
   vii. Methodology extensions for Constantine’s object-oriented notation and Coad/Yourdon design editor for checking diagram consistency.
   viii. Support for C++.
   ix. Forms/screen design 3rd quarter ’91, with prototyping in COBOL.

17. **Collaboration with other organizations:** Tool assistance program with IBM. Will conform to IBM’s repository formats. Support of IBM AD/Cycle 1st quarter 92.
Information From: Bjorn Hemdal (301) 731-3600

Tool Summary: Methodology independent with isomorphic, interchangeable graphic and text forms.

1. Hardware Platforms: Sun, DEC VAXstation, Apollo workstations, VAX systems via conventional terminals, Atari PCs.

2. Components:
   i. Auto-G comprised of graphic editor and underlying database.
   ii. Sema semantic analyzer or diagnostic facility.
   iii. Sadmt translator from specification language to SADMT.
   iv. Dbutil design file manager.
   v. T-print for translating graphical to textual representation.
   vi. T-parse for translating textual to graphical representation.
   vii. Special utility programs, such as plot generators.

3. Tool Implementation Language: Currently C, planning Ada or C++ for next version.


7. Size of customer base: 25 active users in Europe.

8. Methodologies/functions supported:
   ii. Code generation: Ada, SADMT, C.


10. Project management support: Configuration management, but relies on operating system support for file access and time-date stamping. Extensive versioning and view capabilities.


12. Database: Data dictionary implemented as flat file system (looking at object-oriented database for next version). Import/export as ASCII coded, T language statements.


14. User interface: Menu and mouse, windowing (in Sun, DEC, HP environments), some online help, undo. Query facility for locating instances on G diagrams. Data items or structure definition dumped to file for external processing.

15. Planned enhancements:
   i. 2167 report generation, perhaps user-definable formats.
ii. Datadic data dictionary program to provide selective data dictionary query facility.

iii. AI-based help facility.


Wants a copy, FAX (415) 494-8053.

Tool Summary: Software Refinery is an interactive knowledge-based programming environment to prototype complex applications using a high-level, rule-based, executable specification language, synthesize LISP code, customize to create knowledge-based environments tailored for specification of application areas, reuse knowledge in the form of rules and logic formulas.


2. Components: REFINE license from $9,900 for Sun to $12,900 for Symbolics, volume discounts available. Annual maintenance contracts $900, preferred customer maintenance $3,400, university maintenance $500. Training $2,500 for first 4 at Reasoning Systems, $8,000 on-site.
   i. High-level, wide-spectrum executable specification language with compiler to transform specification into Common LISP, syntax system to integrate REFINE with existing computer languages and to create new languages and debugging system for monitoring execution of REFINE programs and creating customized debugging tools.
   ii. Knowledge base of objects including programs, logical assertions, and documents, allows user-definable object types.
   iii. C Language Subsystem reverse engineering $1,900 to $2,600.
   v. RERUN: REFINE runtime environment to execute refinery application. >From $2,500 for Sun to $3,200 for Symbolics.
   vi. RECAST: platform on which to build C applications, includes knowledge-based representations for C programs. For development of communication systems with network modeling, reconfiguration, and simulation with automated generation of conformance tests via OSI guidelines. Interactive graphics development using state machine diagrams. $1,900 to $2,600.
   vii. INTERVISTA toolkit for building graphical user interfaces under X Windows.
   viii. User Interface Toolkit for creating interactive graphics tools used to graph (re-engineer) C, COBOL, JCL software.
   ix. DIALECT generates program language parsers and printers from grammars. Has been used for Ada, C, and others.


5. Marketed Since: July 1985


7. Methodologies and functions at different development stages supported:
   i. Software specification: Object-oriented diagrams and DFDs. No concurrency,
Reasoning Systems/REFINE

replication, timing information, or resource allocation. Information modeling using object-oriented approach. Traceability. Syntax validation, checking for dead code. Executable specification language with assertions, supports checking for communication protocols deadlock, livelock, unreachable and unused states.


iii. **Testing**: static analysis tools for C.

iv. **Maintenance**: Re-engineering for Ada, C, FORTRAN.

8. **Documentation generation**: User-definable formats.

9. **Project management support**: Configuration management.

10. **Environment Characteristics**: Knowledge base restoration to previous state saving, and sharing. No multi-user support, but network support.

11. **Database**: Repository implemented as database, with import/export, published interfaces. Support for generation/analysis of competing designs, save/restore knowledge based, sharing of knowledge base (no merging). Editor and file system interface based on EMACS text editor.

12. **Output formats**: PostScript.


14. **Adaptability**: Knowledge base allows user-definable object types. General purpose object-oriented database, and syntactical transformation tools to adapt meaning of icons. General purpose graphics editor. Ability to create, say, natural language query language, object schema for storing decisions and reasons. Static analysis capabilities can be created in terms of rules and patterns. Free-form text/graphics.

15. **Planned enhancements**:
   i. C++ analyzers by end of '91.
   ii. CDIF and X-Windows conformance.
   iii. Translation of StP data, structure charts, and Petri-nets into REFINE and hence code generation.

Tool Summary: Design specification, modeling, and simulation tool for both hardware/software systems. Interfaces to popular CASE tools for performance analysis. Can embed C code to be executed, workbench supports all C data types and storage classes. Formerly PAWS.

1. Hardware Platforms: Sun/UNIX, HP/Apollo, DEC VAXstation workstations.

2. Components: Basic workstation version $36,000.
   i. SES/design for graphical construction of system designs, behavior specified in C.
   ii. SES/sim translates a design specification into an executable simulation model, the simulation language is an object-oriented superset of C and C++.
   iii. SES/scope animation modules for observing and debugging an executing simulation model.
   iv. SES/graph.

3. Tool Implementation Language: C, moving to C++.

4. Vendor Support: Training, consultancy, hot-line, support group and newsletter.

5. Marked Since: PAWS/GPSM introduced late 1970's. SES/workbench marketed since March 89. Currently version 2.0, 2.1 due out summer '91.


7. System specification: Object-oriented approach using directed graphs, block diagrams, DFDs (Ward-Mellor or Hatley) and flow charts for specification. Supports object types, methods, instances, references and type inheritance. Objects can have multiple dimensions and can be referred to by pointers. Hardware/software allocation. Capture of timing/behavioral information via annotations on diagrams, used in simulation. Transaction-oriented, discrete event simulation, automatically generated from system design, for performance analysis. Can attach assertions for checking design correctness. Traceability. Forms/screen design.

8. Documentation generation: Statistical reports generated by user-specifiable forms.

9. Project management support: Configuration management.


11. Database: No underlying database.

12. Links to other tools: IDE's StP.


15. Planned enhancements:
   i. Ports to other machines underway.
   ii. Summer '91 version will include enhanced debugging, color, graphical output.
iii. Ada, C++ supported '92.
iv. VHDL ASCII standard.
Information From: Lois Valley (407) 984-3370

Tool Summary: Back end CASE tool.

1. **Hardware Platforms:** VAX/VMS, Sun/UNIX, Apollo and others UNIX-based systems.
   - X-Windows.

2. **Products:**
   - i. Classic-Ada Toolset $2,000, with Persistence Toolset $3,000.
   - iii. ClassLook set of class reusable libraries to inherit capability to create X-Window environments $1,000.

3. **Tool Implementation Language:** Ada

4. **Vendor Support:** Training, consultancy, bulletin board.

5. **Marketed Since:** 2 years

6. **Size of customer base:** > 50 sites.

7. **Methodologies and functions at different development stages supported:**
   - i. **Software design:** OOD methods with automated database population/change propagation.
   - ii. **Code generation:** Ada.

8. **Environment Characteristics:** Multi-user and network support.

9. **Database:** Data dictionary implemented as open database.

10. **User interface:** Command line with on-line help.
Address: 14 E. 38th Street, 14th Floor, NY 10016

Tool Summary: For real-time, process control systems. Language-independent. Code translation for Fortran. Reuse of knowledge, design information, and planning details.

1. Hardware Platforms: Sun, Apollo, HP, DEC workstations, VAX/VMS, IBM-PC/AT/MS-DOS, Intel/iRMX, Siemens. Planned AT&T/MS-DOS, Motorola/UNIX, Data General MV series/AOS/VS.

2. Components: $14,785 up to $100,000 for
   i. EPOS Code Generation Tool System. Currently Pascal, FORTRAN, Ada, PEARL.
   ii. EPOS-R for requirements specification
   iii. EPOS-S specification language and design system for system design specification using stepwise refinement. Combines graphics with PDL.
   iv. EPOS-P project specification e.g., project structure, work structure, work packages, project schedules.
   v. EPOS-A Analysis Support Package for consistency/completeness, interface, lack of ambiguity checking.
   vi. EPOS-M Management Support Package for project control, cm, progress reporting.
   vii. EPOS-D Documentation Package for automated documentation generation.
   viii. EPOS-C Communication System for user-friendly communication command system with interactive editing.
   ix. RE-SPEC reverse engineering for EPOS design specifications, from Pascal, FORTRAN.

3. Tool Implementation Language: Proprietary.


6. Size of customer base: 500 copies in USA.

7. Methodologies/functions supported:
   iii. Software design: Function, event, module, data flow/structure, and device oriented diagrams. Consistency checking between diagrams and spec, between Ada programs and specs.
   iv. Code generation: C, 70-85% of Fortran, Pascal, 60-70% Ada code for concurrent systems.
8. **Documentation generation:** User-definable formats, with 2167A support.

9. **Project management support:** Project planning/scheduling with automated report generation in text/graphics. Project structure diagram, PERT and Gantt charts, current progress diagrams, work breakdown plans, network diagram, milestones. Status and change reporting. Configuration management.

10. **Environment Characteristics:** Some multi-user support.

11. **Database:** Proprietary with import/export in ASCII. Split/merge.

12. **Links to other tools:** Graphic input with CORE graphics editor, GOSS, Perspec?

13. **Output formats:** ASCII, PostScript.

14. **User interface:** Menu and mouse, windowing (on VAX under X, Sun/UNIX, and HP9000), on-line help. Database query.

15. **Planned enhancements:**
   i. Porting to PCs, Macintosh, IBM PS/2 OS/2. Porting to MS Windows for PC, available '92.
   ii. RE-SPEC for COBOL, C, Ada.
   iii. Configuration management.
Address: 1249 Greentree Lane, Narberth, PA 19072

2. Components: re/NuSys Workbench from $2,800 to $12,600. Components can be purchased individually.
   i. ScanFlow Designer $995.
   ii. Simulator for debugging and visual test coverage $2,800.
   iii. Program Generator for Ada, Pascal, C, COBOL, FORTRAN $3,600.
   iv. Implementor $2,800.
3. Tool Implementation Language: C
5. Marketed Since: 1989
6. Size of customer base: 100 licenses
7. Methodologies and functions at different development stages supported:
   i. Software specification: Flowform diagrams. Also used to support information modeling. Hardware/software allocation. Consistency checking.
   ii. Software design: Pseudocode with checking options for C, COBOL, FORTRAN, Pascal, Ada. Screen prototyping.
9. Project management support: Use a component approach that supports team working. No central repository, information stored in flowforms.
11. Output formats: ASCII.
12. User interface: Command line, and menu, windowing, on-line help, some undo.
13. Adaptability: Via 4GL to create high level languages.
14. Planned enhancements: Working with other vendors to provide links to repositories/libraries.

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Semaphore Tools/Pilot


Tool Summary: Full life cycle support using object-oriented approaches, with open architecture and repository. Due for release in September '91.

2. Products: PC version $5,000, Unix $5,500.
3. Tool Implementation Language: C++
5. Marketed Since: Prerelease versions will be made available to selected sites.
6. Size of customer base: Not applicable.
7. Methodologies and functions at different development stages supported:
   i. Software specification: Single diagram type supporting OOA/OOD using Booch, Coad/Yourdon, and Semaphore O0 Notation. Also supports ER. Diagrams can be annotated with text. Completeness/consistency checking of database. Automated database population/change propagation.
   ii. Code generation: C++.
   iii. Maintenance: Re-engineering for C++.
8. Documentation generation: Via SQL interface to repository.
9. Project management support: Security/control access, configuration management, version control.
11. Output formats: ASCII.
13. Adaptability: Methodology tailoring via user-defined rules for completeness/consistency checking of a model. Future versions will incorporate inferencing techniques based on forward and backward chaining and pattern matching. Allow adding entities and attributes to the repository.
14. Planned enhancements:
   ii. Code generation and reverse engineering of additional languages, likely Ada.
   iii. Timing diagrams for explicit capture of timing information.
   iv. Animation of specification.
   v. Schema generation for database design and forms/screen design.
   vi. Explicit support for 2167A documentation.
   vii. Interface to text publishing systems such as Interleaf.
15. Collaboration with other Organizations: Potentially with Saber-C.
Semaphore Tools/Pilot


Tool Summary: Graphical modeling tools, support for multiple methodologies, distributed intelligence, open architecture. Object-oriented, distributed, repository-based CASE.

1. **Hardware Platforms:** Maestro II Workstation (MVS). MS-DOS with own windowing manager and multi-tasking software. IBM PC/PS/2 compatibles with workstation connected to UNIX-based file server on DEC VAX or Philips machines through Ethernet.

2. **Components:** Tool price for single user $13,000.
   i. Object Management System (OMS) provides meta model, allows customizing data model, or integrating SoftLab and 3rd party tools. Data associated with software development process is stored in a repository organized by OMS. It provides access rights, versions and variants, distributed data storage and access, elementary and user-defined transactions. Processor and geographical distribution, with copy of data model on all servers.
   ii. MGEN application generator expected second half '90.
   iii. DDT Diagram Design Tool.
   iv. LDT Layout Design Tool.
   v. GED Graphics Editor.
   vi. TEXT Text Editor.
   vii. CMS Configuration Management System.
   viii. PMS Project Management System.
   ix. COMM Communication Packages.

3. **Tool Implementation Language:** PROLAN, C-like.

4. **Vendor Support:** Training, consultancy, newsletter.

5. **Marketed Since:** Maestro I introduced in 1978. Maestro II marketed since autumn 1989 in Europe, January 1990 in USA.

6. **Size of customer base:** 23,000 Maestro I workstations worldwide.

7. **Methodologies/functions supported:**
   i. **Software specification:** SA, LSDM, SSADM methods. Merise for information modeling. Automated database population/change propagation. Capture of timing/behavioral information? Traceability?
   ii. **Software design:** SD method. Schema generation for database design.
   iii. **Code generation:** Either by 2-way interface with generators via the data dictionary, or by knowledge-based generators that produce logic and control code, screen definitions, database definitions and schema. Uses generator engine with spec based and knowledge base parts. Currently have knowledge base support for IBM DB2, COBOL, working with HP for HP9000 and others with C.

8. **Documentation generation:** User-definable formats? 2167A support?

9. **Project management support:** Own text editor/word processor, office automation software (electronic mail, diary, etc.), Workbreakdown structure. coordination and communication.

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Workbreakdown structure. Configuration management, versioning, audit trail, change rollback, change reporting, defect reporting, security/control access.

10. **Environment Characteristics:** Multi-user support, network (heterogeneous) support via LAN, Ethernet.

11. **Database:** Server-based object-oriented repository, C interface. Database split/merge.

12. **Links to other tools:**
   i. Communication packages to link Maestro II to variety of common machines including IBM, Siemens, DEC VAX, Bull, ICL, and any UNIX computer.
   ii. Interfaces to IEW, and Micro Focus COBOL.
   iii. Trimarand, Inc. code generator METAgen in PC/LAN environment, knowledge-based generator embedded in Maestro II. Expect release mid 90.
   iv. Aeon for requirements extraction from natural English.

13. **Output formats:** Postscript. Essentially all UNIX file system devices.

14. **User interface:** Menu and mouse, windowing, on-line help (hypertext). Database browser/query facility.

15. **Adaptability:** Designed to be fully extensible and customizable. Programmable user-interface. Modifiable graphic notation for diagrams.

16. **Standards conformance:** IRDS, AD/Cycle.

17. **Planned enhancements:**
   i. UNIX, OS/2 based workstations, HP and IBM hardware.
   ii. Object editor, inheritance, and more object facilities such as functions, subtyping.
   iii. Object-oriented query language.
   iv. Additional DBMS interfaces, including DB2, Predict.
   v. Check-in/-out capabilities.

18. **Collaboration with other organizations:** IBM with AD/Cycle.
Software Systems Design, Inc./AISLE family

Information From: Thomas Radi (714) 625-6147
Address: 3627 Padua Avenue, Claremont CA 91711
Tool Summary: Set of tools to take real-time structured analysis input and support design and testing. C version (CISLE) available.

1. Hardware Platforms: VAX and MicroVAX, Sun, DEC, Apollo workstations, PCs, others.

2. Components:
   i. ADADL Ada-based PDL, $5,000 to $18,800.
   ii. DocGen document generator for MIL-STD documentation $4,600 to $17,000.
   iii. TestGen Ada design and code testing tool $4,600 to $17,000.
   iv. GrafGen graphical Ada design system $7,000 to $10,500.
   v. ASE Ada/ADADL syntax directed editor $1,390 to $7,800.
   vi. ARIS Ada/ADADL RTSA requirements interface system interfaces with Teamwork to create first cut at an Ada program structure working from DFDs, $7,500 to $14,500.
   vii. AIEM on-line debugging and analysis tools $5,200 to $15,200.
   viii. QualGen quality metrics $4,600 to $17,000.
   ix. RETT requirements traceability $4,600 to $17,000.

3. Tool Implementation Language:


5. Marketed Since: 1985

6. Size of customer base: 46 organizations

7. Methodologies and functions at different development stages supported:

   ii. Code generation: Ada

   iii. Testing: Design review expert assistant, unit test strategy generator, test effort estimator, test coverage analyer.


9. Project management support: Project planning, status reporting, Security/control access.


11. Database: Data dictionary implemented as database.
12. **Links to other tools:** Teamwork, Excelerator, StP, Structured Architect.

13. **Output formats:** Compatible with Interleaf, RUNOFF, nroff/troff and other word processors.


15. **Adaptability:** User-expandable interfaces to the database.
The Virtual Software Factory (VSF) is a meta-CASE tool. Intended to support integration at the information level rather than the tool level. Addresses method and design database integration. Providing for verifiability, traceability, and tailorability across the life cycle. Available instances: HOOD-SF and SSADM-SF. Other methods implemented by Systematica and VSF users include CORE requirement capture method, and Mascot3/Ada (British MOD standard for real-time systems development).

Supports meta-modeling constructs such as multiple inheritance across hierarchies, multiple design databases, automatic translation between methodologies, and specification and enforcement of rules for methodologies. Schemas can be described using the VSF formalisms. Engineer specifies: (1) required documentation, say 2167, via MWB; (2) traceability model between design objects or earlier/later project phases; (3) filter mechanism to implement checking rules for static diagnostics, underlying formalism is a decidable second-order logic. VSF comes with a high-level, internal logic specification language resembling PROLOG, supports beliefs, belief generation rules, pre/post-conditions, etc. No simulation. Built-in file manager, design databases created by VSF are stored in a VSF specific-format. Documents stored/retrieved using a hypertext approach. Design fragments can be conserved to another tool whose output can then be merged (with conflict checking) back into the workbench. Host environment is a shell around VSF, user uses the configuration and project management tools available in the host environment. Not multi-user. Does merge design information into a central database via VSF merge facility.

1. **Hardware Platforms:** Sun, DECstation workstations, IBM PS/2 under OS/2, IBM RS6000, VAXstation.
2. **Components:** $200,000, Systematica are also paid a percentage of licence fee from CASE tools developed with VSF.
   i. Methods Engineering Workbench (VSF/MWB). Primarily textually-oriented to define graphics environment for the workbench. Used to define methodologies and configure the design environment.
   ii. Analyst Workbench (VSF/AWB). Graphical and textual editors that were predefined for methodologies in the MWB.
3. **Tool Implementation Language:** Ada, approx. 300,000 lines of source code.
4. **Vendor Support:** Training, Consultancy.
5. **Marketed Since:** March 88.
6. **Size of customer base:** 60-70 in Europe.
7. **Planned enhancements:** Version for IBM PS/2.

8. **Collaboration with other organizations:**
   
   i. DEC.
   
   ii. COGNOS, Inc.
   
   iii. Focus.
   
   iv. IBM for AD/Cycle.
Information From: 44 202 297292

Tool Summary: Instantiation of VSF/AWB.

1. Hardware Platforms: Sun, DECstation workstations, IBM PS/2 under OS/2, IBM RS6000, VAXstation.
2. Product: 7,000 pounds
5. Marketed Since: 1988 in Europe, just starting in USA.
6. Methodologies/functions supported:
   ii. Design: Dialogue design. Database design through 3rd normal form.
   iii. Code Generation: Some.
7. Documentation generation: User definable formats only achievable through tailoring using the methodology workbench. 2167A information present but not formatted.
8. Project management support: QA support, problem reporting.
10. Database: Central repository implemented as IKBS, separate partial knowledge bases on workstations can be implemented as database or by file systems as appropriate for environment.
11. Output formats: ASCII, PostScript, interface to desktop publishing systems.
13. Adaptability: Methodology tailoring via VSF.
15. Planned enhancements: 2167A documentation support.
Information From: Chuck Williams (301) 224-3710

Tool Summary: Instantiation of VSF/AWB.

1. Hardware Platforms: Sun, DECstation workstations, IBM PS/2 under OS/2, IBM RS6000, VAXstation.
2. Product: 7,000 pounds sterling, $17,000.
6. Size of customer base: None in USA.
7. Methodologies/functions supported:
   ii. Design: Ada PDL.
   iii. Code Generation: Ada.
8. Documentation generation: User definable formats only through tailoring with the methodology workbench. 2167A information available but not formats.
11. Output formats: ASCII, PostScript, HPGL, interface to desktop publishing systems.
13. Adaptability: Methodology tailoring via VSF.
15. Planned enhancements: 2167A documentation support.
Information From: Jan Smedley (205) 837-2400

1. Hardware Platforms: Sun, VAX
2. Tool Implementation Language: Ada
3. Tool Price: Free
6. Size of customer base: >200 installations
7. Methodologies and functions at different development stages supported:
   b. Software specification: Various diagrams.
   c. Software design: Various diagrams.
   d. Code generation: Ada
9. Project management support: Configuration management, status reporting, change reporting.
12. Links to other tools:
16. Planned enhancements:
   i. Multi-user support.
   ii. X-Windows.
   iii. Potentially OOD support.

Tool Summary: For definition, analysis, and simulation of system designs based on Engineering Block Diagrams.


2. Products:
   i. TAGS $6,500. Includes:
      a. Input/Output Requirements Language (IORL),
      b. Diagnostic Analyzer (DA),
      c. Automated Configuration Management (CM),
      d. Simulation System with simulation compiler and Executable Ada Code Generator (ECG) are no longer marketed.

3. Tool Implementation Language: C


6. Size of customer base: In the hundreds.

7. Methodologies/functions supported:
   i. System specification: Functional decomposition with object-oriented. RT can import an ASCII text file and extract requirements from this. With traceability and resource allocation.
   iii. Software design: Control flow diagrams.

8. Documentation generation: Not in TAGS, with user-definable formats in RT. 2167A support via other documentation tools.

9. Project management support: Configuration management, change reporting, version identification, time stamping. Security/control access, some status reporting, defect reporting.
10. **Environment Characteristics:** Multi-user and network support.

11. **Database:** Central. RT import/export in ASCII. TAGS uses library routines accessed with user-defined C and FORTRAN programs. No database split/merge. Data dictionary has no textual descriptions.

12. **Links to other tools:** Interleaf and Mentor Graphic’s Context publishing software.

13. **Output formats:** PostScript, Interleaf for 2167A.

14. **User interface:** Menu/mouse, windowing, on-line help, some undo. Database browser/query facility,

15. **Planned enhancements:** Port to IBM’s AIX operating system.
Information From: Dick Taylor (703) 849-1481.

Tool Summary: For planning, analysis, design, construction, and maintenance.

2. Products: Price?
3. Tool Implementation Language: C++
5. Marketed Since: 1986
7. Methodologies/functions supported:
   i. Software specification: DFDs, ERs, action diagrams. Automated database population/change propagation.
   ii. Software design: SCs, screen/forms design.
   v. Maintenance:
8. Documentation generation:
9. Project management support: Security/control access, history tracking, version control.
12. Output formats:
14. Planned enhancements:
   i. CUI compliance on SAA platforms.
   ii. New diagram facilities.
   iii. Reverse engineering.
   iv. Automated first cut at design.
Verilog/AGE


2. Products:
   i. AGE $50,000 for single-user, volume discounts available. Includes:
      a. ASA for requirements analysis and system validation, includes ASA-ED editing tool, ASA-PM modeling, ASA-PG test generation.
      b. GEODE for designing and code generation, includes GEODE-ED editor, GEODE-SM simulator, GEODE-RT run time generator.
      c. MCAG linking module for traceability.
   ii. Logiscope for software quality analysis.

3. Tool Implementation Language: Pascal, C


5. Marketed Since: 1990 (as AGE), ASA and GEODE for 3 to 4 years.


7. Methodologies/functions supported:
   iii. Software design: SDL notation.
   iv. Code generation: C.


9. Project management support: Some security/control access, change reporting via tracing facility.


11. Database: Data dictionary as part of ASA, implemented as file system. All information maintained in ASCII files. Import/export facility, split/merge.


13. User interface: Menu and mouse, windowing, some color, on-line help, some undo. Database browser/query facility,


15. Planned enhancements:
   i. Generation of Ada code by June '91.
ii. Object-oriented support through LOVE programming support environment, will be made available as part of AGE and will generate C++.

iii. Tie in user-interface toolkits.
Visible Systems Corp/Visible Analyst Workbench

Information From: (617) 890-2273, May 21 1991.

1. **Hardware Platforms:** IBM PC
2. **Products:**
   i. Professional $2,795, or with prototyper $3,395.
   ii. LAN Professional (3 nodes) $7,895.
3. **Tool Implementation Language:** Mainly C.
4. **Vendor Support:** Training, consultancy, newsletter.
5. **Marketed Since:** 1985.
6. **Size of customer base:** >8000 users, >3000 installations.
7. **Methodologies and functions at different development stages supported:**
   i. **Software specification:** Yourdon-DeMarco, Gane-Sarson methods. Chen, ER diagrams for information modeling. Diagram balancing, consistency checking (diagrams are validated as created). Automatically populated database and change propagation.
   ii. **Software design:** Yourdon-Constantine, Page-Jones methods with automatic generation from specification and design complexity measurement. SQL generation for database design. Screen prototyping.
8. **Documentation generation:** Fixed document types, some contents can be customized. 2167A information available but not formatted.
9. **Project management support:** Security/control access.
10. **Environment Characteristics:** Multi-user and network support. Multi-project.
11. **Database:** Server-based repository implemented as file system and database with published interfaces. Split/merge.
12. **Output formats:** PostScript, tiff, ASCII, other.
13. **User interface:** Menu and mouse, windowing, on-line help, undo facility. Database browser/query facility.
14. **Planned enhancements:**
   i. Scheme extraction from database.
   ii. Code generation for C and COBOL later in '91.
Information From: David Stephenson (703) 758-1501
Address: 1501 Broadway, New York, NY 10035
Tool Summary: Primarily for business software.

1. Hardware Platforms: IBM PC-AT, PS/2 and compatibles, DOS.
2. Components: Tool price $1,995 single user. User Interface Generator option for screen prototyping and code generation no longer marketed.
3. Tool Implementation Language: Mainly C.
4. Vendor Support: Technical support line, training, consultancy, newsletter.
7. Methodologies/functions supported:
   i. Software specification: Some requirements extraction. DFDs, ST, etc. diagrams. Diagram balancing, database/diagram consistency checking. Traceability only through to process specs. Chen for information modeling. No automated database population, but notification of needed database changes.
11. Output formats: ASCII, PostScript, HPGL.

Tool Summary: For real-time software.

1. Hardware Platforms: UNIX under X.

2. Components: Tool price $1,995 single user, $2,495 multi-user version. Includes Code Generator (CGEN) for Ada, C, Pascal.

3. Tool Implementation Language: Mainly C.

4. Vendor Support: Technical support line, training, consultancy, newsletter.


6. Size of customer base: 20-30 customers in Europe, 6-7 USA.

7. Methodologies/functions supported:
   i. Software specification: DFDs, ST, etc. with requirements extraction. Hardware/software allocation and capture of timing information. Chen information modeling. For static analysis syntax/semantic checking, diagram balancing, database/diagram consistency. Automated database population and flagging for needed changes. Traceability through to code.
   ii. Software design: Structure charts and module specs.


9. Project management support: Configuration management, access control, change reporting.


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