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PRODUCT & MARKET STUDY

for

•LOS ALAMOS NATIONAL LABORATORY•

Building Resources for Technology Commercialization:
The SciBus Analytical, Inc. Paradigm

February 1, 1996

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Scope of Work

The Study project was undertaken to investigate how entrepreneurial small businesses with technology licenses can develop product and market strategies sufficiently persuasive to attract resources and exploit commercialization opportunities. The study attempts to answer two primary questions: (1) what key business development strategies are likely to make technology transfers successful, and (2) how should the plan best be presented in order to attract resources (e.g., personnel, funding, channels of distribution)? In the opinion of the investigator, Calidex Corporation, if the business strategies later prove to be successful, then the plan model has relevance for any technology licensee attempting to accumulate resources and bridge from technology resident in government laboratories to the commercial marketplace.

The Study utilized SciBus Analytical, Inc. (SciBus), a Los Alamos National Laboratory CRADA participant, as the paradigm small business technology licensee. The investigator concluded that the optimum value of the Study lay in the preparation of an actual business development plan for SciBus that might then have, hopefully, broader relevance and merit for other private sector technology transfer licensees working with various Government agencies.

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SECTION I

SUMMARY

1.1 SciBus Analytical, Inc. Background and Mission SciBus Analytical, Inc. ("SciBus") was founded in early 1995 as a California corporation by John Condren, a factory automation and robotic systems expert. Mr. Condren formed SciBus to commercialize and market more than 30 hardware and software technologies and products currently under development by a team of U.S. National Laboratories, university researchers, and corporate technology partners. These technologies and products relate to the automation and standardization of sample testing, data interpretation and information management in analytical chemistry laboratories. More than \$30 million has been invested in their development, and SciBus holds an exclusive renewable 5-year license awarded by the U.S. Department of Energy (DoE) to commercialize these products as they become available.

In an era of severely limited budgets, the DoE was especially keen to improve productivity in its analytical laboratories. The DoE created the Contaminant Analysis Automation ("CAA") Project to develop "plug & play" hardware and software components for lab automation, and to push the market to adopt new lab automation system standards. The emergence of these standards for lab automation is analogous to the office equipment market some years ago when standards for computers and computer peripherals were first introduced and then accepted.

Mr. Condren's close working relationships with the DoE and the U.S. National Laboratories became important SciBus assets. Despite its limited resources and the pressure from competing bidders like 3M and Martin-Marietta, SciBus won the DoE competition as the exclusive CAA technology recipient. **Appendix 1** presents the SciBus Letter of Contract Award from the Los Alamos National Laboratory (LANL), which acts as the lead laboratory and contracting business office for the CAA Project. **EXHIBIT 1** summarizes the history of SciBus' successful rise within the CAA program.

EXHIBIT 1

The SciBus-Los Alamos Connection: A Brief History

Source: SciBus management

As the DoE's sole technology commercialization partner, SciBus is now in position to negotiate strategic marketing alliances with larger corporate partners to accelerate industry-wide lab automation. Given a successful equity funding of \$2,850,000, *SciBus projects steady growth to FY2000 sales of \$56 million and 13.6% after-tax income.*

1.2 The Business Opportunity SciBus' current opportunity and potential for future success is shaped by five major factors: (a) the large potential market for automated lab systems, (b) the strong hard-dollar case for improving lab productivity through automation, (c) the market's pressing need for lab automation, (d) SciBus' exclusive commercialization rights to Government-funded lab automation software and hardware technologies, and (e) committed DoE CAA Project funding through 2000.

- **Large Potential Market** There are 28,500 analytical chemistry laboratories in the U.S. Most of these labs have a serious need for productivity improvement tools, and are therefore SciBus automation prospects. SciBus estimates that a total of 24,000 labs are current prospects for lab automation systems.

As laboratories move to automate both their instrumentation bench and information handling, SciBus estimates that the average lab investing in automation will spend \$275,000 for general hardware and software over a three-to-five-year period. Based on this estimate, the current U.S. market potential for automation products under exclusive SciBus license is \$6.6 billion, split nearly equally between software and hardware. EXHIBIT 2 sizes the current potential market for SciBus and its sub-licensees.

EXHIBIT 2
SciBus and SciBus Licensee Current Dollar Market Potential

Source: SciBus management estimates

• **Strong Hard-Dollar Cost Justification** A very strong case for investing in automated systems can be made by most labs. The case is especially persuasive in the Federal Government market segment. For example, unacceptably long test turnaround time is a major problem that Government labs must solve. Commercial labs normally turn an analysis around in 15 to 30 days. They can usually expedite an analysis in 5 to 7 days (faster turnaround times can double or triple the price of the analysis). However, the typical turnaround time for a non-radioactive sample from an EPA-certified Government lab is 65 to 90 days, with radioactive samples taking twice as long to test.

Systems tested at CAA program laboratory beta sites continue to prove that automated systems can cut test turnaround times from days and weeks down to hours at no extra cost to the report recipient. Furthermore, these systems can decrease the number of labor hours required to process tests, and reduce the skill levels required to conduct tests. K.C. Associates, an independent market analyst located in Wilmington, Delaware, performed a 1994 survey of lab managers that indicated that more than 50% of the labor costs involved with sample preparation could be saved by automating manual methods. Automating the interpretation of test data, e.g., by computer-comparison of complex multi-peak chromatograms with pattern standards stored in a data base, would reduce the skilled labor associated with data handling and information management in the lab by an estimated 30%.

EXHIBIT 3 compares manual testing for polychlorinated biphenyl (PCB) soil contaminants with the results obtained from a fully-automated CAA prototype lab system in operation at the Los Alamos National Laboratory since April, 1995. The system *quadrupled throughput and reduced the cost per analysis from \$280 to \$70*. The complete assessment is included in **Appendix 2**. The potential returns from automated lab systems are readily quantifiable using hard-dollar savings.

EXHIBIT 3
CAA-SciBus Automated Lab System Cost/Benefit Analysis

FACTORS COMPARED	CAA AUTO SYSTEM	MANUAL
Cost per Analysis	\$70	\$280
Standard Deviation (Low % is best)	13%	25%
Throughput (in a 24 hr period)	32 samples	8 samples
Accuracy (avg chem analysis system)	83%	28% EPA min; 70% lab avg
Waste Minimization (solvent recovered)	85%	5%

Source: Los Alamos National Laboratory

• **Substantial Market Need** All analytical labs require better solutions to sample handling, sample preparation and data interpretation. Many labs strain to provide timely, accurate service at reasonable fees. Extended operations at peak sample loads can introduce testing errors. If the errors are discovered, labor productivity falls when tests are re-run. If the errors are not found, the risk of costly litigation increases. Turnover is also high among trained chemists required to do many routine, labor-intensive sample preparations, and a decreasing pool of available new BS-degreed chemists makes recruitment more difficult. When surveyed, lab managers consistently expressed a need for operations that can be conducted by less costly personnel.

As these labor and other costs have increased, commercial lab margins have not kept up. Federal Government labs have also bogged down under the heavy demand for environmental testing. SciBus expects that the lab automation products developed under the CAA program will offer welcome relief to both private sector as well as government labs.

• **SciBus Exclusive Technology Rights** Having won the DoE competition, SciBus is now the DoE's exclusive technology commercialization partner. In this role, SciBus has the exclusive right to commercialize the products and technologies emerging from the R&D labs of CAA developers in both the Government and the private sectors. The exclusive hardware rights currently granted SciBus by DoE have a single 17-year license term. SciBus' exclusive software rights have a 5-year term renewable by SciBus for up to three successive 5-year periods upon meeting certain minimum sales goals and making the related royalty payments.

SciBus believes the CAA products will have significant value throughout the lab automation marketplace. Thirty-one individual hardware and software modules, termed a "Standard Laboratory Module™" (or SLM™, both Registered Trademarks of SciBus Analytical, Inc.), are either at beta sites undergoing evaluation, or in various stages of development in CAA Project labs.

• **Committed DoE CAA Funding** The DoE has committed \$18.2 million in additional funding to the CAA Project through 2000. Although such commitments are always subject to Congressional budget-cutting moves, there is broad support for the CAA Project within Government and a strong likelihood that CAA funding will continue as planned.

SciBus now controls 31 essential lab automation products that have required more than \$30 million in funding to bring to their present level of development. SciBus believes its business opportunity has some especially desirable characteristics: *a large market populated by many prospects who need, and can*

readily justify, the new products that only SciBus and its selected sub-licensees can supply.

1.3 Products, Technology and Applications Despite the environmentally-driven background of the CAA Project, CAA software and hardware technologies hold immense potential benefit to analytical laboratories across a broad spectrum of market segments and test applications. It is true that EPA-mandated environmental testing provided the impetus for CAA technology development; however, the CAA hardware and software technologies have direct, validated and immediate application within all major analytical test and product development categories. A good example is "Soxhlet Extraction", a popular EPA-approved method of adding a solvent to a soil sample to leach contaminants from the soil.

In the environmental application, the contaminant, once extracted and held within the solvent carrier, must be concentrated by boiling off and removing the solvent. This process, known as "concentration", is currently a predominately manual method of sample preparation. The solvent-boiling process is known in the analytical chemistry lexicon as "Kaderna Danish Processing". The procedure is very labor-intensive, requiring intense, uninterrupted concentration and exact timing on the part of the chemist or lab technician. For example, boiling the solvent for a few seconds too long could evaporate the entire solution, including the contaminant. Were that to occur, the lab would have to notify the sample provider that the sample acquisition process must be repeated. Acquiring the sample might have involved a hazardous material team in protective gear and costly hazardous material permits. Then, once another sample is obtained, preparation of the sample must be completely reworked—overall, a very expensive and time-consuming process.

The combination of a CAA automated Soxhlet SLM and a High Volume Concentrator (HVC) SLM eliminates the risk of sample loss or damage, along with the labor intensity that accompanies the analysis. One chemist or lab technician can actually oversee the operation of many automated systems simultaneously, thus lowering sample preparation costs and increasing throughput. Worker safety is enhanced, and an operative chain of custody provides legal defensibility.

This same tandem SLM configuration may be used industrially in a number of applications to produce similar benefits:

- By a 3M chemist to extract and analyze polymers for adhesive testing;
- By a Proctor & Gamble lab technician to determine chemical levels in surfactants and soaps;
- By a Texaco oil quality control chemist to extract and quantify the sulfur level in fresh crude oil;
- By a Revlon product development chemist to determine color shades for a new line of cosmetics.

Consequently, SciBus' lab automation marketplace is in no way limited because CAA products and technologies happen to be rooted in environmental concerns. It is also important to note that even though a laboratory may not be processing environmental samples in response to external demand, all laboratories—industrial, bioscience, drug as well as environmental—must conform to EPA regulations with respect to the handling, processing and disposal of chemicals, reagents and solvents used in their testing activities. Therefore, most companies with in-house labs conduct their own environmental testing to be sure that their own labs are not contaminating the environment and are operating in conformance with EPA mandates.

The SLMs to which SciBus has exclusive access can automate most of the environmental testing now conducted in this country and abroad. For example, there are more than 700 EPA-defined methodologies for organic/inorganic contaminant testing. However, 13 of the total EPA methods cover 85-90% of all U.S. environmental testing. Collectively, SciBus SLMs will be able to automate all 13 EPA methods.

The CAA Project goal is to develop effective lab automation technology. "Effective" automation reduces sample testing cost, increases lab capacity by shortening sample turnaround time, improves worker safety, and provides legal defensibility of all analytical data produced. Integral to the mission is the design of an open system architecture that can be easily interfaced with control software and various sample preparation and analytical equipment to perform a wide variety of tasks. The expected benefits of such standard systems are improved test accuracies, better audit trails, and significantly increased lab productivity.

Sample testing involves three basic operations: sample preparation, measurement/analysis and data interpretation, which includes report generation. **EXHIBIT 4** depicts these basics:

EXHIBIT 4
The Analytical Lab Testing Process

Source: SciBus management

To date, the measurement/analysis function has received the most attention from manufacturers. Analytical instruments for making physical measurements are the heart of any lab system, and include such products as liquid and gas chromatographs, thermal analyzers, and various types of spectrometers. These instruments are extremely sophisticated in their ability to make rapid and precise measurements.

In contrast, sample preparation remains extremely labor-intensive, prone to significant process errors and a potentially hazardous function. Data interpretation and information management are also time-consuming, typically absorbing half of the lab's staff resources in report generation and error checking. The functional breakdown in the typical lab between "chemistry" work and "paper" work is 49% and 51%, respectively, with sample preparation accounting for nearly half of all direct chemistry labor.

Since sample preparation and lab "paper" work offer the greatest potential for productivity improvement through automation, the SLMs being developed under the CAA program specifically address these functions. SciBus-licensed SLMs are, and will continue to be, a mix of hardware sample preparation units, software Data Interpretation Management Systems (DIMS) and Laboratory Information Management Systems (LIMS).

Tests performed by analytical labs fall into four major application categories: Product, Environmental, Bioscience and Drug. EXHIBIT 5 shows the percentage of U.S. analytical labs conducting tests in each of these categories.

Source: K.C. Associates 1994 Analytical Laboratory Market Survey

The largest application for SciBus SLMs is the analysis of chemical products in industry, e.g., petrochemicals, polymer/plastics, food & beverages, cellulose/paper, cosmetics, minerals/mining and explosives. More than half of all the labs surveyed by K.C. Associates in 1994 indicated they conducted product tests. Environmental testing for regulatory compliance, drug testing for therapeutic monitoring and substance abuse, and bioscience testing are the other major applications. Environmental tests were conducted by almost one-fourth of the labs surveyed, the second-largest test category.

Appendix 3 contains selected data sheets describing various CAA sample preparation SLMs now undergoing final development.

1.4 Markets SciBus is targeting four major U.S. analytical laboratory market segments: Industry Labs, Independent/Contract Labs, Federal Government Labs, and State/Municipal Government Labs. **EXHIBIT 6** sizes these segments .

EXHIBIT 6
SciBus Targeted U.S. Enduser Markets

Source: K.C. Associates

Industry laboratories performing product testing are the most numerous. The key industries whose labs are, in SciBus' opinion, most likely to embrace automation are the following:

- Petroleum
- Agribusiness
- Biotechnology
- Nuclear Power
- Pharmaceutical
- Mining
- Food & Beverage
- Cellulose/Paper
- Cosmetics
- Polymers/Plastics
- Energetics/Explosives

1.5 Management and Organization The current SciBus organization and recruitment plan for key management positions during 1996 is shown in **EXHIBIT 7**. Section VIII (page 65) further discusses SciBus' organizational plans and requirements, and sets forth a functional organization chart.

EXHIBIT 7
February 1, 1996 SciBus Organization

Source: SciBus management

John Condren is SciBus' founder, Chairman and CEO. Mr. Condren has over 20 years of engineering, marketing and sales experience that includes start-up company entrepreneurship and senior management positions with Ingersoll-Rand, FMC, Chimerical Corp. and Motorola. His technical background includes the engineering and marketing of acoustical sensing systems for military and commercial applications; advanced biomedical systems; nuclear geo-seismic research; and robotics, computer-controlled automation systems and custom equipment development for a variety of Fortune 1000 customers. Mr. Condren holds a B.S. in Mechanical Engineering from California State University, and a Masters Degree in International Business Marketing from St. Mary's College in Moraga, California.

Michael O'Hagan is the President of SciBus. Mr. O'Hagan came to SciBus from Combustion Power Company in Menlo Park, California where he served as Executive Vice-President and Chief Operating Officer. Under his leadership, CPC

realized a five-fold increase in revenues within three years. His skills related to the formation and management of new business units and his experience with product commercialization and strategic business planning are important SciBus strengths. Mr. O'Hagan has both a B.S. and M.S. in Mechanical Engineering from Santa Clara University.

Alan Barich is SciBus' Executive Vice-President and Chief Operating Officer. Mr. Barich was Vice-President and General Manager of IMO Corporation, a Fortune 500 company, responsible for five of the firm's largest divisions. While at IMO, he had the P&L responsibility for more than \$75 million in annual revenues. Mr. Barich holds a B.S. in Mechanical Engineering and an advanced certificate in Financial Management from Wharton College.

SciBus' Technology Transfer Marketing Manager is Andrea Pistone, who manages the SciBus Marketing Office based in Los Alamos, New Mexico. Ms. Pistone is in close daily communication with on-site members of the CAA Program management and technical team. Prior to joining SciBus, she was a Technology Marketing and Commercialization Manager for the DOE at Los Alamos. She attended the University of New Mexico, where she earned a B.A. in Business Administration with a Marketing concentration.

1.6 Sales & Marketing SciBus' sales strategy has two major thrusts:

- The direct sale to endusers of all CAA lab automation software products, e.g., LIMS and DIMS, by SciBus field sales personnel;
- The sub-licensing of hardware SLMs to general equipment and analytical instrumentation manufacturing and marketing companies, all of whom sell direct to endusers.

The CAA-developed hardware SLMs and technology licensed by SciBus for commercialization will not be fully productized. SciBus intends to license SLMs to systems integrators and instrumentation companies as the SLMs emerge from CAA beta site testing. SciBus expects its sub-licensees to productize all CAA hardware, and ship the products to endusers as either stand-alone units or as integral components of larger turn-key systems. SciBus has no plans to develop or market finished, fully productized lab automation hardware. However, SciBus intends to develop and market complete software products as well as software interfaces that link various hardware SLMs to robotic systems, task controllers and/or various software data bases in order to provide endusers with higher levels of automation.

SciBus projects that 70% of its total revenues in 2000 will come from its direct sales of lab automation software. The remainder of SciBus revenues are derived from one-time-only issue fees charged its sub-licensees as each new SLM is made available, and percentage royalties on sales made by SciBus sub-

licensees to endusers of SciBus-licensed products. **EXHIBIT 8** shows the projected split of SciBus revenues for the 1996 to 2000 period between software direct sales and sub-licensees hardware license fees and royalties.

EXHIBIT 8
Projected 1996-2000 SciBus Revenue Split, Software Sales vs. License Fees & Royalties

Source: SciBus management

SciBus is under contract to the U.S. National Laboratories to pay a 5% royalty on CAA software sales to endusers, and to split 50%-50% with the National Laboratories its royalty revenues from sub-licensees on hardware SLM sales. SciBus pays royalties to the DoE National Laboratories on sales of DoE-licensed technology only, not on sales of SciBus proprietary software or SciBus' license revenue from proprietary hardware. Section VI (page 53) discusses SciBus' sales and marketing plans in more detail, along with the structure of CAA-SciBus technology and revenue flows.

1.7 Capital Requirements SciBus is seeking \$2,850,000 in equity funding to complete its management team, build its marketing and direct sales organization, and build an in-house technical support group. In return, SciBus' management has two (2) options available to investors for securing the investment:

- By means of an equity investment, SciBus Analytical's management is willing to offer a minority interest in the Company to a participating investor or investment group.
- By means of debt financing or convertible-debt financing, SciBus has aligned itself with the TransAmerica Corporation through an investment house located in the United Kingdom. TransAmerica is currently promoting technology business relationships between US and UK companies, and as SciBus' business and product lines have direct international application, TransAmerica has approved a \$3.3 million loan guaranty bond to be applied to debt-financing for SciBus Analytical. The bond guarantees 100% of the principal loan amount. The minimum loan amount applicable to the bond is \$500,000 and can be applied to individual investors, consortiums or corporate investors.

1.8 Projected Financial Performance The highlights of SciBus' projected 1996-2000 financial performance are presented in **EXHIBIT 9**:

EXHIBIT 9
SciBus Projected 1996-2000 Financial Performance Highlights

ITEM	1996	1997	1998	1999	2000
Revenues (K\$)	\$126	\$4,348	\$16,065	\$37,395	\$55,818
% Gross Profit	68%	60%	55%	54%	54%
Net Income After-Tax	\$(1,454)	\$(817)	\$2,627	\$4,096	\$7,618
% Net Income After-Tax	-	-	16.4%	13.2%	13.6%
Year-End Cash	\$83	\$206	\$1,951	\$5,493	\$14,093
Shareholder Equity	\$(203)	\$437	\$3,347	\$8,966	\$17,449

SciBus' unaudited December 31, 1995 Balance Sheet is presented in **EXHIBIT 10** (page 15). SciBus' Pro Forma Balance Sheets, Operating Statements and Statements of Cash Flows for 1996-2000 are presented, respectively, in **EXHIBIT 11** (page 16), **EXHIBIT 11A** (page 17), and **EXHIBIT 11B** (page 18). **EXHIBIT 11C** (page 19) breaks down expected cash flow by month and category of expense for 1996, and quarterly for 1997. **EXHIBIT 11D** (page 20) lists the Notes to the Pro Forma Financial Statements.

1.9 Risk Factors There are a number of risks associated with an investment in SciBus. Budget pressures and threats to abolish federal government agencies such as the DoE are on-going. Withdrawal of CAA development funding would reduce the number of SciBus' future product offerings. SciBus could, however, still realize substantial revenue from the sale of productivity software and the licensing of hardware SLMs for which development and testing has been

completed. Furthermore, in the environmental market, clean-up activities are projected to continue even though overall federal budgets are decreasing. Also, the elimination of overseeing agencies such as the DoE would not eliminate the fundamental problems government labs currently have with respect to productivity improvement. Changing organizational structure provides no solutions for the labs and their operating problems.

The market's failure to accept the new CAA automation standards is also a risk. However, SciBus believes the federal government will specify the standards in their RFQs for purchases of government lab equipment. If so, manufacturers—the instrument suppliers and system integrators with whom SciBus intends to enter into sub-license agreements—should give the new technologies a positive reception and enthusiastic evaluation, although such treatment cannot be assured. SciBus believes the manufacturers will view the implementation of "plug and play" standards as very much in their own interest. More flexible systems that can interface formerly isolated equipment and information functions should spur sales growth, and encourage the various channels of distribution to sub-license SciBus products. In addition, the CAA products and technologies are complementary to sample preparation automation capabilities now beginning to enter the laboratory market.

Unforeseen competition may enter the market and challenge the standards and automation technology now being evolved under the CAA program. SciBus believes such competitive entry is unlikely in the near future. More than \$30 million has been invested in the new technologies, and they have the full support of the federal government. The funding requirement alone that would be necessary to supplant CAA-developed technology with other comparably effective standards and productivity tools seems likely to discourage competitive challenges.

SciBus is the DoE's sole partner responsible for all commercialization of U.S. National Laboratory CAA technology. As the exclusive "master licensee", SciBus has certain goals and obligations to meet with respect to future sales and the payment of minimum royalties. Although SciBus could lose its exclusive license to CAA intellectual property if it failed to meet its obligations to DoE, management has carefully negotiated the terms of the Technology Transfer Agreement and is confident that its performance requirements can be comfortably met.

SECTION II

THE BUSINESS OPPORTUNITY

2.1 SciBus as Exclusive CAA Project Licensee In 1995 the DoE awarded SciBus an exclusive marketing license on all of the intellectual property developed by government and private sector technologists under the Contaminant Analysis Automation Project. Major firms such as 3M and Martin-Marietta competed with SciBus for the right to commercialize CAA technology. As the DoE's exclusive licensee for CAA technology commercialization, SciBus has won a unique opportunity to catalyze the adoption of software and hardware standards for automated analytical laboratory systems throughout the U.S. and abroad.

Without expending any of its own funds, SciBus is now the beneficiary of more than \$30 million in government and private sector R&D funding invested since 1990 in lab automation hardware and software technology. More than thirty advanced software and hardware automation products are in the CAA pipeline, all planned for eventual commercialization. SciBus' business challenge is two-fold: (a) productize and market CAA-developed hardware and software technologies to analytical equipment manufacturers and laboratory endusers using all appropriate distribution channels, and (b) encourage the widespread adoption of CAA-defined lab automation system standards throughout the analytical instrumentation industry. Several key factors shape SciBus' opportunity, and its prospects for future success:

2.2 Large Potential Market SciBus estimates that nearly 85% of the analytical chemistry labs in the U.S.—approximately 24,000 labs—could justify an investment in lab automation due to their need for productivity improvement and labor cost reduction. SciBus estimates that the Industry market segment has the largest number of qualified lab prospects for automation, with some 16,300 labs. The 2,000 Federal Government laboratories, although constituting a comparatively small market segment in terms of lab numbers, are all excellent candidates for automation: they have heavy sample testing workloads, extremely high labor costs, stringent requirements for legal defensibility, and a serious need for increased worker safety when testing hazardous materials.

As shown in **EXHIBIT 2** (page 3), SciBus estimates its current market potential for standardized lab automation products to be \$6.6 billion. SciBus expects that over a three-to-five year term the average lab investing in automation will spend \$135,000 on software and \$140,000 on hardware elements such as sample preparation SLMs. **EXHIBIT 12** shows SciBus' estimates of the number of higher-

activity labs in each major market segment that are currently considered to have automated systems potential for SciBus and its sub-licensees.

EXHIBIT 12

Estimated Percent of U.S. Analytical Labs w/ High/Low Test Activity, by Major Market

Source: K.C. Associates and SciBus management estimates

Laboratories conducting a high proportion of general product or environmental tests are especially good automation prospects. Growing competitive pressure as well as growth in testing demand is driving these labs toward increased investment in automated systems. In the environmental category, the International Association of Environmental Testing Laboratories (IAETL) counts 7,800 U.S. members as "environmental labs"; they constitute approximately 23% of the total U.S. analytical laboratory population. The *Environmental Business Journal* and Environmental Business International, an independent market research firm, project 1995 worldwide environmental testing services revenues of \$70 billion to grow to \$82 billion by 2000.

2.3 Strong Hard-Dollar Cost Justification As shown in EXHIBIT 3 (page 4), automation of sample preparation and certain "paper" work functions can have a dramatic impact on productivity improvement. Actual automated system tests conducted by the Los Alamos National Laboratory proved that sample turn-

around times can be shortened from weeks when tests are manually run to just hours with automated systems. The automated tests could also be conducted by lesser-qualified lab personnel, which reduced labor expense and eased the problem of finding qualified replacements.

The breakdown between "paper" work and "chemistry" work in the lab is shown in **EXHIBIT 13**. More than half of the labor in the typical analytical laboratory is consumed by "paper" work such as data interpretation and report generation, while almost a quarter of the "chemistry" work is expended on manual sample preparation and other labor-intensive tasks.

EXHIBIT 13
Breakdown of Typical U.S. Analytical Laboratory Labor, by Major Function

Source: K.C. Associates

Communication by Design of Mountain View, California conducted a 1995 marketing study wherein they concluded, given the Government's projected 100 million contaminated environmental samples requiring characterization by the year 2000, that implementation of the CAA technologies at the DoE and DoD would save the U.S. Government \$16 billion per year. The same study also estimated that commercial labs could save up to 75% of their current labor

expense with CAA technologies implemented at optimum processing volumes and maximum system utilization. The study analyzed the operations of analytical labs using both manual and automated systems. The investigators estimated the total operating costs incurred by a typical analytical lab as the number of analyses per 24-hr period increased, and the financial break-even points on investments in automated systems as a function of daily test volumes.

EXHIBIT 14 compares the difference in annual operating costs to run EPA Standard Analytical Methods 3520 and 3550 for PCB analysis using a manual system vs. a CAA fully-automated system. The cost comparison is made as a function of the number of analyses performed within a 24-hr period. The analysis shows that for the two EPA tests defined, it becomes more economical to operate a lab using a CAA fully-automated system when the daily test volume exceeds approximately 50 tests per day—a daily volume of analyses equaled or exceeded, according to a K.C. Associates survey, by an estimated 80% of U.S. analytical laboratories.

EXHIBIT 14
Comparative Annual Lab Operating Costs of Manual vs. CAA Fully-Automated Systems,
for Different 24-hr Day Test Volumes

Source: Communication by Design Marketing Study of May 30, 1995

The Communication by Design study also investigated the financial break-even points for CAA fully-automated systems at various test volumes transacted in a 24-hr day compared to a manual system. The payback analyses were based on present-valued costs that included the capital equipment investment, facilities preparation cost, and the cumulative operating expense. For a lab performing 60 analyses per 24-hr period, the break-even point for a CAA system compared to the manual system was approximately 16 months. For a lab performing 200 analyses per 24-hr day, the estimated break-even point for the applicable fully-automated CAA system was 8 months. **EXHIBIT 15** shows the payback comparison at a lab activity level of 60 analyses per day.

EXHIBIT 15
CAA Fully-Automated System Financial Payback @ 60 Analyses per 24-Hr Day

Source: Communication by Design Marketing Study of May 30, 1995

2.4 Substantial Market Need The 7,800 environmental labs in the U.S. are good examples of operations with a pressing need for productivity improvement. The Environmental Protection Agency (EPA) has identified over one million hazardous waste sites in the U.S. Characterization and remediation of these sites is a huge \$390 billion effort that has created a rapidly rising demand for contaminant testing. In 1992 DoE and Department of Defense (DoD) labs conducted approximately 13 million tests of hazardous materials. According to 1993 figures released by the DoE, the two agencies planned to conduct 55

million environmental tests during 1997, and upwards of *100 million tests* by 2000. Laboratory throughput constraints and budgetary restrictions have now reduced the 1997 forecast to 25 million characterizations, with 50 million analyses, respectively, to be completed in 2000; still a sizeable business opportunity.

As the exclusive CAA commercialization licensee, SciBus expects to gain special entrée into the Federal Government market segment. SciBus anticipates a rapid sale of CAA technology-based products within the community of Federal Government labs once the CAA prototypes have been appropriately productized. **EXHIBIT 16** charts the rapid historic and projected growth of environmental testing in the federal government.

Sources: Communication By Design; K.C. Associates

2.5 The Case for Lab Automation "Plug-and-Play" Standards The rationale for lab automation is based on the proven capability of analytical systems using automated sample preparation and data interpretation modules to dramatically increase labor productivity, raise sample throughput, decrease cost per sample, and shorten test report turn-around times. The case for the standardization of system components is rooted in the same series of user benefits. Many individual analytical instruments are automated for such tasks as sample injection and data analysis. Most instruments, however, perform in isolation and

are very difficult to integrate into larger multi-vendor automated systems that can deliver more operational benefits. This lack of integration standards now requires that any automated system be custom-built by the instrument vendor, the enduser or a third-party system integrator. With standard hardware interfaces and communications protocols for lab equipment, as with office equipment, multiple SLMs can be quickly combined and reconfigured by automated task controllers to perform different tests. Separate systems, for example, would no longer be necessary to test soil and water. The result is great system flexibility that maximizes the dollar benefits of lab automation for the enduser.

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SECTION III

PRODUCTS & APPLICATIONS

3.1 Analytical Chemistry Applications Thousands of different organic and inorganic materials are tested in analytical chemistry labs to determine composition, i.e., the identities of constituent compounds and their relative amounts, or to develop new chemical-based products for industrial and commercial applications. Common to all of these tests is the necessity to prepare a sample, subject the sample to measurement and analysis, interpret the test results and report the conclusions of the interpreter.

Sample preparation involves such tasks as *sonication* (extracting analytes from soil samples by acoustic energy), *digestion* (dissolving samples in an appropriate media using acids or thermal/microwave energy), *concentration* (reducing liquid sample sizes to manageable volumes), and *filtration* (separating sample components based on differences in particle size). Sample analysis is performed by a variety of instruments each specialized in its measurement technique, sample parameters and sensitivity. Gas chromatographs, liquid chromatographs, mass spectrometers and UV analyzers are examples of instruments that perform the actual sample analysis. Interpretation of results is typically done by an expert, e.g., a Ph.D chemist who compares the test output with reference standards to determine sample composition, or an expert software program performing the same function of data and/or pattern comparison.

3.2 The U.S. Department of Energy Contaminant Analysis Automation (CAA) Project The extensive environmental remediation programs of the DoE and DoD have spurred great demand for tests that characterize soil, water and air samples. The DoE launched and funded the CAA Project to improve methods for the chemical analysis of environmental samples, although the Project is now heavily involved in all areas of chemical analysis that include industrial and commercial applications in addition to environmental. The CAA Project's mission is to promote the development and commercialization of automation standards and related technologies necessary for the automation of the analytical chemistry laboratory. Although driven by the intense need for faster, lower-cost environmental testing, the CAA systems under development have relevance for any industry conducting a high volume of repetitive tests.

LANL, the CAA Project Manager, assembled a consortium of U.S. National Laboratories, universities and private manufacturing and engineering firms to develop the automated systems. LANL entered into development agreements with certain team members that involve the assignment of developed technology marketing rights to LANL and the CAA Project for the future licensing of

technology. Other CAA team members serve as contract developers and/or consultants. After selection by the DoE as its sole CAA technology commercializer in February, 1995, SciBus joined the team. The current structure of the CAA Project Development Team is shown in **EXHIBIT 17**.

EXHIBIT 17
The CAA Project Development Team

Source: SciBus management; Los Alamos National Laboratory

The members of the team and their individual responsibilities are described in EXHIBIT 18. The structure of SciBus' team role is shown in EXHIBIT 30 (page 54).

EXHIBIT 18
CAA Project Development Team Responsibilities

ORGANIZATION	TASKS & RESPONSIBILITIES
SciBus Analytical, Inc.	Commercialization under exclusive license of all CAA Project technology and products.
The National Laboratories	
1. Los Alamos Natl Lab	The lead engineering & business/contracting lab. Developing SLM hardware & software, and integrating prototype systems at beta sites.
2. Oak Ridge Natl Lab	Development of Data Interpretation Management System (DIMS) software and SLM hardware.
3. Sandia Natl Lab	Development of system software.
4. Pacific Northwest Natl Lab	Development of SLM hardware.
5. Idaho Natl Engineering lab	Development of SLM hardware.
University Researchers	
1. University of Tennessee	Development of Neural Network SLM and object-oriented database software.
2. University of Florida	Development of maintenance & training software.
3. University of Texas	Development of sample material handling and storage & retrieval systems.
4. University of California	Oversees LANL.
Private Firms	
1. Thru-Put Systems, Inc.	Development of database software and DIMS algorithms.
2. Martin-Marietta Energy Syst	Development of SLM hardware and software.
3. 3M Corporation	Beta test site consultant and test evaluator.
4. Gilson Equipment	Development of SLM hardware.
5. Batelle Corporation	Oversees PNNL.
6. ABC Instruments, Inc.	Development of SLM hardware.
7. Lockheed-Martin Corp	Oversees INEL, ORNL and SNL; strategic marketing consultant.
8. Raytheon/E-Sys, Inc. (APTI)	Development of laser-based SLM hardware and software; beta test site.

Source: Los Alamos National Lab

Basically, the National Laboratories serve the CAA Project by investigating new systems architecture, proofing new technology concepts, creating prototype hardware and software, conducting alpha site tests, and funding the beta tests of lab automation components. The industry members of the CAA development team are charged with the responsibility to bring their CAA product developments

to first-article manufacturability and reasonably reliable operation as quickly as possible. Throughout the product development process, SciBus manages all CAA team members with respect to their transition of CAA technologies into well-engineered products that SciBus can bring to market.

3.3 Contaminant Analysis Automation Systems Described The CAA systems under development are based on "plug-and-play" hardware and software components—the standard building blocks of an automated laboratory—and Standard Analytical Methods (SAMs) that define the tools and tasks required to complete an entire analytical test method. The basic component of the CAA system is the Standard Laboratory Module™ (SLM). Each hardware SLM performs a group of laboratory unit operations (LUOs) required by an analytical procedure. An embedded microprocessor in the SLM is programmed to direct execution of the LUOs. Software interfaces and protocols are designed to coordinate the human systems operator with the master system controller and the Laboratory Information Management System (LIMS), and the system database with the SLMs. **EXHIBIT 19** is a block diagram of a fully-automated CAA SAM lab system for the analysis of PCBs in soils. With appropriate substitution of SLMs, the diagram is representative of other automated systems for various commercial, industrial and environmental applications.

EXHIBIT 19
CAA Fully-Automated Laboratory System for PCB Soil Analysis

Source: Los Alamos National Laboratory

EXHIBIT 20 illustrates the hardware SLMs and other components that make up the CAA fully-automated SAM system for analysis of PCBs in soil.

EXHIBIT 20
CAA Fully-Automated SAM System Hardware for PCB Soil Analysis

Source: Los Alamos National Laboratory

To date, the CAA Project has designed and constructed prototypes of all the major components (SLMs, master system controller, HCI, DIMs, and database) required to demonstrate an integrated fully-automated system for the analysis of polychlorinated biphenyls and semi-volatile organic compounds by gas

chromatography. CAA components, however, need not be fully automated to deliver productivity benefits to labs conducting tests for any of these chemicals. Three major types of systems may be configured from CAA-based products: Fully-Automated Systems, Stand-Alone Modules, and Semi-Automated or "Mini-SAM" Systems. These configurations and the major differences among them are discussed below:

- **Fully-Automated Systems** With fully-automated CAA systems conducting Standard Analysis Methods (SAMs), the configuration of SLMs and the directions for each SAM are stored in the system's data base. In addition to information on analytical methods, the database contains maintenance procedures, SLM capabilities, sample characteristics and sample processing instructions, raw and processed sample data, operator qualifications and final test results. Audit trails and processing diaries for each sample are also stored in the database.

The operator through his or her human computer interface (HCI), which is typically a Graphical User Interface or GUI, enters and tracks samples, monitors the system, maintains the modules and accesses the database. After the operator selects a SAM and an SLM system configuration, the system's master controller or "Task Sequence Controller" (TSC) checks that the configuration is correct for the selected procedure and retrieves the detailed information to run the SAM from the database. Sample transfer between sample preparation SLMs and the analytical instrument can optionally be performed by a robotic manipulator. The TSC manages sample and data flow through the system.

- **Stand-Alone Modules** Importantly, the SLMs emerging from the CAA Project can all perform as stand-alone units in a broad variety of organic and inorganic test applications. The SLMs do not have to be made components of fully-automated, test-specific SAM systems in order to deliver productivity improvement benefits. Any industrial or commercial lab conducting product tests for which the individual unit functionality of CAA SLMs is applicable can realize the productivity benefits of improved sample preparation. Embedded SLM intelligence enables the operator to program the SLM's operational parameters. **Appendix 3** includes a selection of SLM data sheets from the population of 31 SLMs now in development.

- **Semi-Automated or "Mini-SAM" Systems** A "Mini-SAM" system is an intermediate mode of system integration between the stand-alone capabilities of individual SLMs and a fully-automated system conducting a SAM. The Mini-SAM system is a group of two or more SLMs that perform several tasks required by a SAM, but not the complete method. The block diagram in **EXHIBIT 21** illustrates a generalized sample preparation process with a number of SLM extraction alternatives. For PCB testing,

the analytes could be extracted from the sample by a Sonicator or Soxhlet SLM, and the resulting solution rapidly concentrated and transferred to a Gel Permeation Chromatograph for clean-up prior to analysis by a Gas Chromatograph. Samples are transferred among the SLMs by a lab technician rather than a robot. Such a combination of SLMs could eliminate sample preparation bottlenecks in many organic and inorganic (metals) test methods.

EXHIBIT 21

CAA Semi-Automated or "Mini-SAM" Laboratory System for Sample Preparation

Source: Los Alamos National Laboratory

3.4 Fully-Automated CAA System Operation Conducting a test for the presence of PCBs in soil with the CAA fully-automated system depicted in **EXHIBITS 19** and **20** (pages 32 and 33, respectively) begins with the human operator's selection of an applicable test method or SAM. In this example, the operator selects a test procedure using the Soxhlet Extraction SLM for thermally extracting analytes from an aqueous soil sample. The operator bar-codes the sample container, weighs the sample, and adds any required reagents. The sample container is placed in a rack at the sample entry station that is accessible to a robotic SLM or automated fluid transfer device. Via the Human Computer Interface (HCI), the operator enters the sample data into the system, and configures the system to perform the test. The TSC validates the configuration and accesses the database for SAM instructions.

The Soxhlet SLM contains liquid handling and heating apparatus that is controlled by the SLM's embedded microprocessor. Through a standard serial (RS232 or Ethernet) or parallel (GBIB or IEEE-4880) hardware interface, the SLM communicates with the TSC. The software interface is a set of standard commands and events that are independent of the internal operations of the SLM. Each SLM, however, must respond to standard commands and queries from the TSC from its own set of standard responses. Once sample processing is initiated by TSC command, the SLM requires no further interaction with the system to process the sample. The SLM notifies the TSC when processing is complete (or interrupted), and the sample is sequentially routed by the optional robotic manipulator or lab technician to the Filtration, Concentration and GPC SLMs for additional processing. Once sample preparation is complete, the sample vial is presented to the analytical instrument, in this case to the gas chromatograph (GC).

Embedded intelligence in the GC enables the analysis to proceed once initiated by the TSC without further system interaction. The test output data from the GC is communicated to a software Data Interpretation Management System (DIMS) for appropriate interpretation, and the raw data from the GC now becomes "information". This information is stored in the database and transmitted to the Laboratory Information Management System (LIMS) for report generation and eventual dissemination to the test consumer.

Removing the Soxhlet Extraction SLM from the system and replacing it with the Sonicator SLM would permit analytes to be extracted from soil by acoustic agitation, a process used for the testing of non-aqueous samples. If selected by the operator, the TSC would identify the new SLM component through a system data base call-up, obtain new operating commands, then reconfigure the system based on the new application. Once the new test is initiated, sample flow into, and data out of, the GC would occur as before.

3.5 Data Interpretation Management Systems (DIMS) The chemical category-specific DIMS that constitute a lab's overall Data Interpretation Management System are a major portion of the CAA software products SciBus intends to sell direct to endusers. The first DIMS developed under the CAA Project automates the interpretation of gas chromatograms for organochlorine compounds and polychlorinated biphenyls. The analyses of chromatograms for aroclors (combinations of polychlorinated biphenyls), petroleum hydrocarbons, and other multicomponent materials are among the most difficult analyses to perform. Typical manual procedures involve the subjective recognition of multi-peak patterns by trained chemists. Pattern recognition data processing techniques are required in order to replace such labor-intensive, time-consuming intuitive methods.

The DIMS utilized in the aforementioned PCB test-system analysis is a combination of expert system, neural network and principal component analysis

tools that include an algorithm derived from a software product known as "MATLAB" from Mathworks, Inc. (Natick, Massachusetts). The interpretive techniques employed by the DIMS depends on an accessible data base of peak patterns from known aroclors. The input to the DIMS is a table of retention times and peak areas obtained from the GC's raw signal. An artificial neural network is used to establish the distinctive relationships between retention times, peak areas and aroclor concentration. The DIMS will support any system that uses a GC for the analysis of organochlorine compounds and polychlorinated biphenyls. DIMS for other types of compounds that include metals and inorganics are currently under development by CAA team members.

SciBus has defined two DIMS software packages that it intends to sell direct to enduser labs: Level 1 and Level 2 DIMS Software. The basic difference between the two packages is the number of test applications for which automated data interpretation is available. Level 1 DIMS is a "starter" package for labs just beginning to move into test automation; Level 2 DIMS is a more comprehensive applications package for the lab implementing automation across a broader spectrum of tests. SciBus expects the average Level 1 DIMS Software package to sell for \$15,000 per lab, and Level 2 DIMS Software to sell for \$30,000.

3.6 Laboratory Information Management Systems (LIMS) The LIMS interfaces the laboratory's overall database with the SAM system database. When fully implemented, a LIMS is used to log samples into the system, track samples, establish audit trails and chains of custody, respond to system and sample queries, archive information, assist with regulatory compliance, provide security and produce customer reports. Report generation is a particularly critical function of the LIMS since most reports must be tailored to the particular needs of each customer. Labor costs are especially high for report generation if the lab lacks the capability to automatically capture and enter test information into the LIMS, and format customer-specific reports.

Similar to its software product definition for DIMS, SciBus has defined three LIMS software packages that it intends to sell direct to enduser labs: Level 1, Level 2 and Level 3 LIMS Software. Again, the basic differences among the three packages relate to the extent to which the lab is implementing automation of information handling. Level 1 LIMS is a SciBus entry level package for labs looking for basic enhancements to their currently-installed LIMS, or labs without a LIMS beginning to move into an early stage of information handling automation. Level 2 LIMS includes additional functionality such as user qualification checking and bar-coded sample data entry. Level 3 LIMS enables labs to implement full automation of their lab information handling, provides many management decision-making and presentational tools, and automates data capture from all analytical instruments on the bench.

SciBus expects the average Level 1 LIMS Software package to sell for \$40,000 per lab, Level 2 LIMS Software to sell for \$75,000, and Level 3 Advanced LIMS or "Systems" Software for \$100,000 per lab. EXHIBIT 22 shows the functional breakdown for each of the three LIMS Levels.

EXHIBIT 22
SciBus Laboratory Information Management System (LIMS) Product Functionality

LEVEL 1: MINIMUM LIMS						
GLOBAL ISSUES	LIMS DATABASE	DATA/INF CAPTURE	DATA ANALYSIS	REPORTING	LAB MGMT	SYS MGMT
<ul style="list-style-type: none"> •Change control •Documentation •Quality •Security •User interface •Validation 	<ul style="list-style-type: none"> •Fixed database structure •Limited capacity •Limited performance •Flat files 	<ul style="list-style-type: none"> •Manual sample log-in •Manual result entry 	<ul style="list-style-type: none"> •Result verification •Results checking for inputs •Basic calculations 	<ul style="list-style-type: none"> •Pre-defined reports •Sample labels 	<ul style="list-style-type: none"> •Sample/order status •Sample/order tracking •Backlog report 	<ul style="list-style-type: none"> •Back-up and recovery

LEVEL 2: INTERMEDIATE LIMS						
GLOBAL ISSUES	LIMS DATABASE	DATA/INF CAPTURE	DATA ANALYSIS	REPORTING	LAB MGMT	SYS MGMT
<ul style="list-style-type: none"> •On-line document •Group security •On-line training •Graphic User Intfc •Validation tools •Chain of Custody •Configuratrtn tools •Audit trail 	<ul style="list-style-type: none"> •Intermed cpcty/perf •Referential integrity •User-defined fields •User-defined indices •User-defined tables •Transactional integrity •RDBMS 	<ul style="list-style-type: none"> •On-line from instrumts (one-way upload) •File transfers one-way •Bar code entry •User qualification checking 	<ul style="list-style-type: none"> •Comparison of result to specification •Pre-defined math functions •Intra-test calcs •Graphical presntn •Basic statistics •QA/QC on sample 	<ul style="list-style-type: none"> •User-defined reports •Queries, sort filters •Basic graphics •Ad hoc querying & reporting 	<ul style="list-style-type: none"> •Work scheduling •Locatn of sample •Workload predict •Pricing/invoicing •Time (shelf life) schedule •Sample inventory 	<ul style="list-style-type: none"> •Archiving •Manual performance tuning •System fault tolerance

LEVEL 3: ADVANCED LIMS						
GLOBAL ISSUES	LIMS DATABASE	DATA/INF CAPTURE	DATA ANALYSIS	REPORTING	LAB MGMT	SYS MGMT
<ul style="list-style-type: none"> •Version control •Static table revision control •Security by object •Advanced validation tools •Multi-tasking user interface •Multimedia •Advanced configuration tools 	<ul style="list-style-type: none"> •SQL-2 compatible •High cpcty/perf •Natural language-based •Client/server •Transaction rules •Distributed + central info/processng •OODB, RDBMS •Enforced integrity 	<ul style="list-style-type: none"> •Bidirectnl communicatn (to/from instruments) •IR, UV, NMR spectra •File transfers; 2-way links to external systms •Instrument control •Multimedia/imaging •Electronic notebook •Run lists multi-instrument work stations •Trigger LMS functions from ext sys & run parameters 	<ul style="list-style-type: none"> •Inter test/sample calcs •Advanced math functions •User-defined functions •3-D graphics •Advanced statistics •Dynamic links to prior results and other systems 	<ul style="list-style-type: none"> •Natural language reporting methods •Batch reports •Event triggers •Export to external systems •Bulk data transfrs •Advanced graphics •Multi-site LIMS reports 	<ul style="list-style-type: none"> •Resource management •External system scheduling work •All decision-making tools •Revenue/cost tracking •Advanced QC management •Multi-site LIMS management 	<ul style="list-style-type: none"> •Dynamic perf tuning •Advanced system fault tolerance •Redundant systems •Advanced comm links to external systems

Source: SciBus management

3.7 Current SciBus CAA Product Availability SciBus' estimate of post-beta site product availability from the CAA Project, including SciBus proprietary product development, is shown in **EXHIBIT 23**.

EXHIBIT 23
Estimated CAA Product Availability

Source: SciBus management

3.8 Competitive Products Potential competition for the CAA products that SciBus plans to bring to market falls into three primary categories:

- ***Automated Analytical Instruments*** Analytical instrument manufacturers such as Varian, Hewlett-Packard, Perkin-Elmer, Fisons, Shimadzu and Thermo Instruments have made substantial progress in automating the performance of individual analytical instruments. Embedded intelligence, autosamplers, keypad programmability and other enhancements have made these instruments flexible and efficient. However, due to the lack of standard interfaces for analytical instrumentation, these instruments are not easily integrated into multi-vendor systems that can automate an entire multi-step analytical methodology, from sample input and preparation to data interpretation. Consequently, SciBus believes the instrument manufacturers will not obstruct acceptance of the new CAA system standards, but instead view the standards as a means to encourage more individual instrument sales once implemented in their future products.

- ***Customized, Application-Specific Turn-key Systems*** At significant cost to the enduser, system integrators can modify hardware and produce custom software to automate a particular test application. SciBus believes this customized turn-key system approach is suitable for only the highest-volume laboratories, and well beyond the capital budgeting reach of most U.S. analytical labs, of which fewer than 3% have annual capital budgets exceeding \$500,000. With the advent of comparatively inexpensive CAA standard hardware and software components to automate a wide variety of test applications, labs can use the open architecture platform to build their own systems. Consequently, SciBus believes the turn-key system approach will become even less appealing to analytical labs, and not serve as a threat to CAA product acceptance.

- ***Laboratory Information Management Systems*** Many existing software management systems, or LIMS, address the information handling and regulatory compliance needs of analytical labs. The average cost per lab for a LIMS is steadily increasing, and is currently some \$300,000 per system. A number of these products are supplied by large, well-established companies that maintain a sharp focus on the analytical lab market. Automated Compliance Systems, Laboratory Micro Systems, Beckman Instrument, Varian, Hewlett-Packard, Telecation, and Fisons/VG are collectively the major suppliers of PC/Microcomputer and Minicomputer-based LIMS to the U.S. and international markets. SciBus anticipates that its CAA LIMS products will meet more competition than any other of the products it plans to introduce from the CAA ensemble. However, SciBus expects to offer its lab customers some distinct, cost-effective advantages with modular LIMS products designed in the context of the new CAA system standards.

For example, the 1995 IAETL survey of U.S. analytical labs indicated that over 50% of the labs do not have instruments directly interfaced to their LIMS, and more than 80% of labs are entering data manually into their LIMS. SciBus expects to offer extensive interfacing capability with its three levels of PC/Microcomputer-based LIMS, enabling the lab to pull together its data bases, analyses output and report generation with minimum human data entry. As lab automation based on CAA standards gains increasing market acceptance, SciBus expects its LIMS products to become the systems of choice because of their easy fit into the lab's new, automated information handling environment, and their persuasive cost-effectiveness.

3.9 CAA Technology Breadth of Applications Despite the environmentally-driven background of the CAA Project, CAA software and hardware technologies hold immense potential to benefit analytical laboratories across a broad spectrum of market segments and test applications. A good example is "Soxhlet Extraction", a popular EPA-approved method of adding a solvent to a soil sample to leach contaminants from the soil.

In the environmental application, the contaminant, once extracted, must be concentrated by boiling off and removing the solvent. This "concentration" process is currently a predominately manual method of sample preparation, designated in the analytical chemistry lexicon as "Kaderna Danish Processing". The procedure is very labor-intensive, requiring intense, uninterrupted concentration and exact timing on the part of the chemist or lab technician. For example, boiling the solvent for a few seconds too long could evaporate the entire solution, including the contaminant. Were that to occur, the lab would have to notify the sample provider that the sample acquisition process must be repeated. Acquiring the sample might have involved a hazardous material team in protective gear and costly hazardous material permits. Then, once another sample is obtained, preparation of the sample must be completely reworked—overall, a very expensive and time-consuming process.

The combination of a CAA automated Soxhlet SLM and a High Volume Concentrator (HVC) SLM eliminates the risk of sample loss or damage, along with the labor intensity that accompanies the analysis. One chemist or lab technician can actually oversee the operation of many automated systems simultaneously, thus lowering sample preparation costs and increasing throughput. Worker safety is enhanced, and an operative chain of custody provides legal defensibility.

This same tandem SLM configuration may be used industrially in a number of applications to produce similar benefits:

- By a 3M chemist to extract and analyze polymers for adhesive testing;
- By a Proctor & Gamble lab technician to determine chemical levels in surfactants and soaps;
- By a Texaco oil quality control chemist to extract and quantify the sulfur level in fresh crude oil;
- By a Revlon product development chemist to determine color shades for a new line of cosmetics.

Consequently, SciBus' lab automation marketplace is in no way limited because CAA products and technologies happen to be rooted in environmental concerns. It is also important to note that even though a laboratory may not be processing environmental samples in response to external demand, all laboratories—industrial, bioscience, drug as well as environmental—must conform to EPA regulations with respect to the handling, processing and disposal of chemicals, reagents and solvents used in their testing activities. Therefore, most companies with in-house labs conduct their own environmental testing to be sure that their own labs are not contaminating the environment and are operating in conformance with EPA mandates.

SECTION IV

MARKETS

4.1 The U.S. Analytical Laboratory Market As shown in EXHIBIT 6 (page 9), there are 28,500 analytical laboratories in the U.S. In 1994, these labs purchased approximately \$2.1 billion of analytical instrumentation. 1994 worldwide sales of analytical instrumentation were \$5.6 billion, of which the U.S. share was approximately 37%, as shown in EXHIBIT 24.

EXHIBIT 24

1994 Worldwide Analytical Instrumentation Sales, U.S. vs. International

Total 1994 Worldwide Analytical Instrumentation Sales: \$5.6 Billion

Source: K.C. Associates

Overall U.S. sales of analytical instrumentation have been nearly flat for the past five years, averaging about 2% annual growth.

4.2 Major Analytical Laboratory Equipment Buyers More than 80% of the analytical lab equipment purchased goes to SciBus' four major Market Segments of Industry, Independent/Contract, State & Municipal Government, and Federal Government laboratories. Approximately 20% of the equipment is purchased by hospitals, colleges and universities. EXHIBIT 25 shows the breakdown of 1994 U.S. analytical instrumentation sales by laboratory market segment. Buyers, e.g., an industrial firm, typically have multiple users across various departments such as R&D, Process Control, Quality Assurance and Analytical Services.

EXHIBIT 25

1994 Percent of U.S. Analytical Instrumentation Sales, by Laboratory Market Segment

Source: K.C. Associates September 1995 "U.S. Analytical Market Survey" Report

4.3 The Automated Laboratory Systems Market Currently, the analytical equipment industry maintains no market figures on the sales of automated systems to analytical labs. This absence of data is largely due to the historically small number of automated systems that have been sold. Most pieces of lab automation equipment are stand-alone items that have neither the controllability or interconnectability to form automated systems as have been described in Section III. Without standardized interfaces for communications and computer control, today's automated systems are custom-designed engineering monoliths that are in constant danger of becoming obsolete if their process or application changes, even a little.

The pharmaceutical industry is perhaps the prime example: the industry has evolved huge pieces of equipment dedicated to a single application that perform a multiplicity of tasks much like a system. However, when preventive maintenance is necessary, or if malfunctions occur, the entire machine must be taken down for repair—there is no modular replacement of function. The CAA-SciBus concept of standardized, modular systems flexibly addressing a variety of applications through speedy reconfiguration of system components represents a brand new approach for the analytical lab. Yet despite the drawbacks of expensive, customized one-of-a-kind automated systems, the productivity benefits of automated systems are so significant and the paybacks so swift that even these systems are enjoying strong sales growth. Zymark and Sagian—companies supplying customized automation solutions for analytical laboratories—are forecasting annual dollar sales growth in excess of 20%.

4.4 The LIMS Market A 1995 Strategic Directions, Inc. (SDI) market survey indicates that approximately 550 LIMS were sold in the U.S. during 1994 at an average unit price of \$240,000 (including both hardware and software), for a total U.S. market size of \$132 million. The survey also suggested near-term annual dollar sales growth of 10%, with other industry observers such as K.C. Associates and Environmental Business International (EBI, San Diego, California) projecting 13-20% annual growth. The reasons for LIMS sales growth are three-fold: (a) the average system price is climbing as the systems offer more functionality, (b) more labs are buying for the first time due to their great need for productivity improvement on the "paper" side of their businesses, and (c) regulatory compliance is becoming increasingly important. Almost one out of three LIMS sales is a replacement sale for an existing system as labs search for better ways to handle information.

According to the SDI market study, the largest percentage of LIMS installations are located in Pharmaceuticals/Biotechnology firms, accounting for 16% of the total LIMS-equipped labs surveyed. The Environmental market segment follows closely at 15% of total LIMS installations. **EXHIBIT 26** shows the percentage breakdown of U.S. LIMS installations by major industry:

EXHIBIT 26

1994 Estimated Percentage of U.S. LIMS Installations by Major Industry

PC/Micro-based LIMS are fast becoming the preferred LIMS hardware platform for analytical services labs, especially among environmental labs. More than half of the LIMS-equipped environmental labs in the U.S. currently have PC/Micro-based LIMS. Approximately 40% of all installed LIMS in the U.S. are PC/Micro-based systems; the balance is distributed between mainframe and minicomputer platforms.

4.5 Buying Factors SciBus expects prospects for automated laboratory systems to give careful consideration to the following issues prior to making a buying decision:

- Capital Funding Availability
- Anticipated Sample Throughput and Lab Capacity
- Forecasted Labor Savings
- System Personnel Training and Qualification Requirements
- Lab Employee Turnover
- Regulatory Compliance
- Targeted Market and/or Product Mix
- Management Attitudes vis-a-vis Automation
- Current Rework Rates (Mishandled Samples; Inconsistent Data)
- Test Accuracy and Report Quality
- Worker Safety
- Number of Comparable Systems Installed; User Testimonials
- Vendor Product Support Availability

4.6 Market Influences Apart from their own internal operating pressures to reduce costs and increase throughput, several important market influences are driving analytical labs to automate:

- ***Increasing Litigation Risk*** Establishing strong legal defensibility is becoming very important as the cost and frequency of litigation increases. Automated systems can provide well-documented test accuracies, test reproducibility, and chain of custody;
- ***Increasing Burden of Regulatory Compliance*** Government regulations have imposed new burdens on chemical labs to supply analytical data with greater thoroughness, consistency and accuracy. Again, automated systems can enable the lab to meet the more stringent reporting requirements;
- ***Customer Demands for Quality Improvement*** Rising customer demands for greater product quality creates a need for stricter quality control as part of the new product development process. Automated systems can execute various test methods with a high degree of consistency, accurately monitor test outputs, and flag deviations from acceptable standards;

- **Higher Volume of Hazardous Material Testing** Demand for mixed waste testing of toxic and radioactive materials is increasing as environmental remediation progresses. In addition, the pesticide, petrochemical and specialty materials engineering businesses also engage in high levels of hazardous and/or toxic material analysis. These materials can endanger worker safety, and are best handled by automated systems involving minimum human intervention;

- **Lengthy Personnel Recruitments** A shrinking pool of B.S. Chemists has made recruiting new lab personnel more difficult. Automated systems can reduce the educational qualifications of personnel conducting tests, speed up replacement hiring, and eliminate much of the routine work that more highly-qualified lab workers would prefer to avoid.

4.7 Capital Budgets K.C. Associates' 1993 survey of the analytical chemistry industry on sample preparation and automation indicated that 46% of all laboratory chemists operated on an annual capital budget for instrumentation and automation of \$50,000 or less. Approximately 29% operated with an annual capital budget between \$50,000 and \$100,000; 18% had annual capital budgets between \$100,000 and \$250,000; and 7% of the survey's respondents had annual capital budgets between \$250,000 and \$500,000.

On a Market Segment basis, more than half of the Federal Government and Industry laboratories reporting had annual instrumentation capital budgets exceeding \$50,000. 21% of Federal Government labs and 14% of Industry labs had annual instrumentation and automation budgets between \$100,000 and \$250,000. Comparatively, State and Local Government labs had the weakest funding.

More than 86% of the labs stated that capital approvals for expenditures up to \$100,000 could be obtained in less than nine months, with the majority of labs (72%) indicating that approval could be obtained in six months or less.

SciBus projects an overall cumulative market penetration through 2000 of 3.4%—equivalent to a total of 867 SciBus customers—for SciBus software products within the community of analytical laboratories considered to be prospects for lab automation. SciBus further estimates that analytical laboratories implementing various levels of automation will each invest, on a weighted average basis, an approximate total of \$135,000 in automation software, typically over a three to five-year period.

Over a three-year investment period the aggregate amount invested in software represents an annual expenditure by the lab of approximately \$45,000; over a five-year period the average annual investment drops to approximately

\$27,000. Since more than half of the labs in SciBus' two major Market Segments are able to carry annual capital budgets exceeding \$50,000—a total of at least 11,000 laboratories—SciBus' estimates there are more than 12 times as many lab automation prospects with sufficient budgets to purchase SciBus software than SciBus has projected will buy.

4.8 The SciBus Market Model SciBus has developed a market model for automated laboratory systems, and used the model to derive its annual unit and dollar sales forecasts for the 1996-2000 period. **Appendix 4** summarizes SciBus' step-by-step approach to building its market and sales forecasting model. **Appendices 4A** through **4F** are the key structural elements of the model that detail important SciBus assumptions, targets, and policies with respect to U.S. market segmentation, market size and growth, market penetration, channels of distribution, product pricing, and license fees and royalties. The detailed revenue figures derived from the model are the basis for the total revenues presented in the 1996-2000 Pro Forma Statements of Operations.

SECTION V

THE INDUSTRY

5.1 Analytical Instrument Manufacturers There are nearly 100 different measurement/analysis techniques embodied in various analytical instruments, and more than 300 manufacturers around the world that supply the equipment. Of the world's 12 largest analytical instrument manufacturers, half are U.S. companies, three are European and three are Japanese. Four companies account for 30%, or \$2.9 billion, of total worldwide analytical instrument sales: Perkin-Elmer (U.S.), Hewlett-Packard (U.S.), Thermo Instruments (U.S.) and Shimadzu (Japan). Thermo has recently acquired Fisons Corporation and ATI, firms respectively doing \$400 million and \$150 million in sales, and is now the largest single manufacturer of analytical instrumentation in the world.

There are significant industry leaders in some instrumentation categories. For example, Hewlett-Packard is the world leader in gas chromatography, offering gas chromatographs and gas chromatograph-mass spectrometry combinations. Perkin-Elmer is the largest manufacturer of spectroscopic instruments. Fifteen companies manufacture liquid chromatographs (the largest analytical instrument product category with 1995 sales of \$280 million) and the two largest firms account for 40% of sales. In the UV/Visible Analyzer product category, 12 competitors divide up the business, and five companies account for 20% of total sales. SciBus expects to enter into strategic alliances with selected major equipment manufacturers in order to accelerate the acceptance of lab automation standards throughout the market.

5.2 Laboratory Information Management System (LIMS) Suppliers There are approximately 25 companies marketing LIMS hardware and software products in the U.S. and Canada. About a third of them are small firms with software products that require extensive manual input and offer only limited reconfiguration. They sell to small labs with limited budgets, and to schools. Half of the LIMS suppliers sell more sophisticated LIMS products to large and mid-size labs in all market segments and industries. The top 12 suppliers that account for 50% of the \$245 million worldwide LIMS market are:

• Advanced Systems Manufacturing, Inc.	• Hewlett-Packard
• Beckman Instruments	• Perkin-Elmer
• Fisons	• LMS
• NWA	• ChemWare
• Hartley	• Varian
• Telecation	• Radian

In SciBus' opinion, none of the LIMS products currently offered fully enable the customer to build information-handling capability in a modular fashion consistent with budget availability and the expansion of lab operations.

5.3 Robotics Manufacturers SciBus has surveyed the industry for manufacturers of robots suitable for CAA systems application. There are six categories of industrial robots: Assembly, Material Handling, Molding & Casting, Material Application, Processing, and Other robots. Laboratory robots fall into the "Other" category, and are defined as simple manipulators with two or three degrees of freedom (axes of motion) used primarily to dispense liquids from a reservoir or place sample sources into uniform trays of vials. Robotic CAA systems, however, require track-mountable PC-based manipulators capable of 3-meter sample transport with 5 or 6 degrees of freedom. Such robots are more properly characterized as Material Handling robots despite their laboratory venue, and are offered at an average unit price of \$35,000 by five manufacturers: Sagian (U.S.), Zymark (U.S.), CRS (Canada), Mitsubishi (Japan) and Staubli (Switzerland).

5.4 System Integrators System integrators typically do not manufacture products; instead, they integrate equipment from other manufacturers and suppliers to develop functional automated systems. The system integrator is responsible for the overall design, assembly, installation and test of the system, and to supply any custom components required by the system. Often a system integrator will serve as a Value-Added Retailer (VAR) by developing custom software or fabricating a specialized piece of hardware to complete a system.

There are an estimated 3,000 system integration companies in the U.S. and Canada, most of which are ensconced in small geographical and/or technical market niches. Many system integrators specialize in particular technologies, e.g., hydraulics system integration or robotics system integration. Many of these specialties proliferate sub-specialties, e.g., the system integration of welding robots, hazardous material handling robots and electronic assembly robots. Some 85% of these firms generate annual revenues of less than \$10 million, with gross margins averaging 30-35%.

There are, however, a few significant regional and national system integrators with revenues well in excess of \$100 million that embrace many engineering disciplines and mount a broad market attack. Often these firms have parent companies that utilize their services for various in-house business developments, e.g., FMC Material Handling Systems (FMC Corporation parent), Productivity Technologies (Ingersoll-Rand parent), and Litton Industrial Automation Systems (Litton Industries parent). SAIC headquartered in San Diego has a strong government and industrial business base; the company had 1994 revenues of \$30.2 billion to which system integration activity contributed moderately. SAIC is one of approximately fifteen companies that can offer engineering and system integration services across the entire scientific and industrial spectrum.

5.5 Analytical Laboratories Based on K.C. Associates survey data, the majority of analyses are performed by many small captive laboratories in both the private and government sectors. On the average, small labs generate less than \$3 million in annual revenue. Although there are currently few large analytical labs, i.e., labs with annual revenues in excess of \$12 million, the trend is toward larger laboratories, with growth coming about primarily through acquisition and/or consolidation of smaller operations.

5.6 Channels of Distribution Direct sales, independent sales representatives and stocking distributors are the primary distribution channels used in the analytical instrumentation industry. Manufacturers selling capital equipment at unit prices in excess of \$10,000 to technically-sophisticated customers typically sell direct via company field sales personnel. Independent regional sales representatives are frequently appointed to market simpler, less costly products in return for sales commissions. Software suppliers also tend to utilize the direct sales channel, although a few specialized software sales rep firms have appeared within the past few years.

Robot manufacturers utilize a mix of direct sales, contract sales reps and stocking distributors. Contract sales reps working on commission are used primarily as "bird dogs" to locate sales opportunities and coordinate selling activity with the manufacturer. Robotic system integrators often act as stocking distributors when they purchase units as components of their system designs. They are also valuable as "bird dogs", identifying candidates for robot integration as part of lab automation programs.

5.7 Major Analytical Laboratory Automation Conferences and Exhibitions The Pittsburgh Conference (PittCon) is the industry's largest and most important trade show with over 1,500 exhibitors, 3,000 exhibition booths, 200 short-course symposia, and typically some 1,800 technical papers presented on analytical technologies. PittCon is unique in the opportunity it offers for "one stop shopping". Twenty-eight percent (28%) of the exhibitors say they exhibit *only* at PittCon, and less than 30% say they exhibit annually at any other conference. The two major gatherings are profiled in **EXHIBIT 27**.

EXHIBIT 27**Major Analytical Laboratory Automation Conferences and Exhibitions**

EXHIBITION/CONFERENCE	TYPE ATTENDANCE	LOCATION & FREQUENCY	MONTH	EST ATTENDANCE
PittCon (The Pittsburgh Conference)	Lab managers, analytical chemists, purchasing agents	Chicago ('96); Annual Atlanta ('97)	Mar	50,000
ICAR (International Conference on Automation, Robotics & Artificial Intelligence Applied to Analytical Chemistry)	Lab managers, analytical chemists	San Diego ('96); Annual Geneva ('97)	Feb	2,500

Source: SciBus management

5.8 Major Analytical Laboratory Media Some of the major media addressing, or influencing, analytical laboratory management and personnel are listed in EXHIBIT 28.

EXHIBIT 28**Major Analytical Laboratory Industry Media**

PUBLICATION	AUDIENCE	FREQUENCY	CIRC. *	ACCEPT ADS ?
Pollution Engineering	Analytical chemists	Monthly	58,000	Yes
American Laboratory	Lab managers, analytical chemists	Monthly	132,000	Yes
International Environmental Protection	Lab managers, analytical chemists	Monthly	140,000	Yes
Environmental Protection	Lab managers, analytical chemists	Monthly	91,000	Yes
Chemical Engineering	Lab managers, analytical chemists, chemical engineers	Weekly	284,000	Yes
Engineering News Record	Lab managers, analytical chemists, chemical engineers	Weekly	95,134	Yes
Energy Daily	DoE chemists and nuclear engineers	Daily	15,000	No
Inside Energy	DoE lab managers, analysts, chemists, chemical engineers	Weekly	27,500	No
EPA Journal	Lab managers, analytical chemists, chemical engineers	Bi-monthly	30,000	No

* - Does not include InterNet and on-line subscribers, which all publications utilize for reader service

Source: SciBus management

SECTION VI

SALES & MARKETING

6.1 SciBus Targeted Enduser Markets As its first market priority, SciBus intends to focus on labs in the Industry Market Segment performing product testing. SciBus estimates that 80% of these labs have a high potential for automation. The products range from cosmetics to explosives. SciBus' second-priority market segment contains U.S. Government labs primarily engaged in environmental remediation testing, and State and Municipal Government water district labs performing water quality analyses. SciBus' third and fourth market priorities, respectively, are private environmental and governmental forensics labs, and government labs engaged in security and intelligence work. **EXHIBIT 29** shows the SciBus market priorities.

EXHIBIT 29

SciBus Targeted Market Segment Priorities

Source: SciBus management

6.2 Commercializing CAA Technologies: The Technology Flow SciBus is the exclusive licensee for all CAA-developed products and technologies. On the basis of careful market research, SciBus will choose which of the CAA technologies to commercialize. **EXHIBIT 30** shows the structure of SciBus' relationship with CAA team members, and planned channels of distribution.

EXHIBIT 30
CAA-SciBus Technology Commercialization: The Technology Flow

6.3 Reaching the Market: Targeted Channels of Distribution As indicated previously, SciBus' channel strategy differs depending on the CAA product line. SciBus plans to sell all CAA system and SLM software direct, and sub-license individual CAA hardware SLMs to various analytical instrumentation manufacturers. Both exclusive as well as non-exclusive sub-licenses for hardware SLMs may be granted by SciBus, depending on the market situation and the magnitude of the unit sales minimums to which sub-licensees commit. SciBus sub-licensees would then be unrestricted with respect to their chosen channels of distribution and methods of reaching the enduser.

For fixed, fully-automated laboratory systems based on CAA Standard Analytical Methods, SciBus plans to sub-license only large system integrators with strong in-house direct sales capabilities. SciBus intends for its product support staff to work closely with these yet-to-be selected integrators to minimize potential system implementation problems at the customer's site.

6.4 Identifying Prospects SciBus expects to have four major lead sources:

- **Trade Show & Technical Conferences** In 1996, SciBus plans to attend PittCon and ICAR, the two major industry trade shows and conferences, and to participate as an exhibitor in 1997. SciBus also plans to participate in various international technical conferences at which it plans to position itself as the leader in automation standards and productivity software for the chemistry market.

- **Media Advertising & Direct Mail** SciBus plans to advertise its lab automation capabilities in selected industry media during the latter half of 1996, and to obtain appropriate editorial coverage in those same media. In addition, since the population of U.S. analytical labs is well-known, SciBus intends to develop "rifle shot" direct mail programs to reach specific labs and lab managers within SciBus' targeted priority market segments.

- **Word-of-Mouth Advertising** SciBus expects to benefit from positive beta site user testimonials as lab managers proclaim the tangible benefits of CAA automation. Also, as the era of lab automation and lab equipment standardization dawns, SciBus anticipates a substantial amount of ferment in the marketplace as suppliers, endusers and CAA team members talk about the changes. SciBus expects it will be, along with its sub-licensees, the beneficiary of such growing market awareness.

- **The SciBus Direct Sales Force** SciBus intends to field a trained and professional direct sales force to work both the U.S. and international markets. SciBus expects its sales force to generate a sizeable body of

automation prospect leads in the course of networking among lab personnel.

6.5 Selling the SciBus Enduser Direct Critical to SciBus' future success is the recruitment, training and fielding of an effective applications-oriented sales force that understands the analytical chemistry marketplace and knows how to sell software-intensive systems. Over two-thirds of SciBus' projected annual revenue is expected to come from its direct sales of automation software. SciBus intends to equip its field sales people with a persuasive tool kit of CAA beta site testimonials, productivity assessment measures, and other examples of proven lab productivity improvement achieved through automation. Given the pressures on lab managers to increase throughput and lower labor costs, SciBus plans to utilize lab-specific ROI and payback analyses to prove cost-effectiveness and promote sales interest.

6.6 Selling the SciBus Sub-Licensee Equally as critical to SciBus' future commercialization success is its sub-licensing of major analytical lab equipment manufacturers and system integrators. SciBus believes these firms will embrace both the CAA standards and products/technologies as a way of fueling more market growth for their own products. SciBus intends to present CAA standards and technologies to large instrumentation manufacturers as a means of increasing market share—normally an important goal for these firms. To the smaller manufacturers, SciBus plans to offer the CAA standards and technologies as a way of becoming more competitive with the larger suppliers, and creating equipment compatibility with a variety of other products.

6.7 Supporting the Customer SciBus has two support programs it intends to implement: one for the software support of SciBus endusers, and a program for hardware sub-licensees.

- **Software Customers** For its software customers, SciBus intends to supply operating manuals and troubleshooting guides similar to those shipped with other commercially-available software products. Depending on the customer, line and/or source codes may be provided. An in-house Software Product Support group is planned to provide 24-hour technical assistance to SciBus endusers via an 800-number. SciBus also intends to perform on-site installation and customer training as defined by the terms of the sales contract.

- **SciBus Hardware Sub-Licensees** SciBus intends to supply its hardware sub-licensees with complete documentation packages that include assembly and detailed technical drawings, electrical schematics, software flow charts and line code, source code (when applicable), bills of material, and component documentation. The documentation packages will also include operating theory descriptions and machinery operating manuals applicable only to working prototypes, when such prototypes

have been supplied. Recommended spare parts lists plus repair service and preventive maintenance routines are also planned for inclusion. The documentation will be supplied by SciBus upon entering into the sub-licensing agreement. The sub-licensee would then become responsible for supplying all final documentation for the finished product, and providing any required enduser training.

6.8 The Expected Laboratory CAA-SciBus Automation Investment SciBus expects the average analytical laboratory that is implementing an automated system to make a cumulative investment of \$275,000 in automation equipment over a three-to-five year period. As indicated in **EXHIBIT 31**, SciBus estimates the aggregate investment would divide up such that the lab purchases \$135,000 of SciBus software from SciBus, and \$140,000 for hardware from SciBus sub-licensees.

EXHIBIT 31

Expected Average Cumulative Laboratory CAA-SciBus Automation Investment

Source: SciBus management

6.9 The SciBus Projected Software Sales Cycle SciBus' projected software sale of \$135,000 per analytical lab customer is a weighted average based on a 3-step sales cycle, wherein all lab customers start out by purchasing the lowest level of SciBus software capability (Level 1). In follow-on purchases some (but not all) of the labs upgrade their software at additional cost to successively higher levels (Levels 2 and 3) of capability. Each upgrade of the combined LIMS & DIMS software package produces incremental revenue for SciBus. **EXHIBIT 32** illustrates the projected software sales cycle.

EXHIBIT 32
The SciBus Projected Software Sales Cycle

Source: SciBus management

The example is based on an arbitrarily-chosen population of 100 SciBus software customers. All of the labs are assumed to start off with a Level 1 purchase of \$25,000 as the start of the cycle. During the second cycle, 90 of these customers progress to Level 2 software at an upgrade price of \$55,000, and 10 labs stay with Level 1. Ten percent (10%) of SciBus' customers, then, are assumed to purchase a maximum of \$25,000 in automation software during the sales cycle; customers moving on to Level 2 have at that point invested a total of \$80,000 in SciBus software. Within the third cycle, 70% of the Level 2 customers are assumed to upgrade to Level 3 at an incremental price of \$100,000. Level 3 software equips the lab for fully-automated SAM operation, and includes all TSC and HCI software with SLM interfaces. Each of the sixty-three Level 3 labs—equivalent to 63% of SciBus' total projected software customer base—has,

therefore, made a total software expenditure of \$180,000, and 27 labs stay behind at Level 2. There are no buyers that skip the Level 1 purchase, or Level 3 buyers that skip the Level 2 purchase, even though the different software level purchases may be made simultaneously.

6.10 SciBus Projected Market Penetration (Software Products) For its software direct sales over the 1996-2000 period, SciBus projects cumulative market penetrations at year-end 2000 that range from 2% on the low end in the State & Municipal Government Market Segment on up to 8% in the Federal Government Market Segment. Because of the large number of labs in the Industry segment, its penetration, even though smaller percentage-wise, produces the largest number of customers. Overall, SciBus' projected cumulative penetration of the analytical laboratory market is 3.4% through 2000, resulting in a total customer base of 867 laboratories. **EXHIBIT 33** shows the comparative penetration rates projected by SciBus in its four major Market Segments by year-end 2000, and the total number of labs sold within each Market Segment; **Appendix 4A** details the projected penetration and number of labs added yearly.

EXHIBIT 33
Projected Year-End 2000 SciBus Cumulative Market Penetrations,
by Major Market Segment (Software Products Only)

Source: SciBus management

6.11 SciBus Projected Sales by Major Market Segment (Software Products)
 SciBus' projected software dollar sales by Market Segment for the 1996-2000 period are shown in EXHIBIT 34.

EXHIBIT 34
Projected 1996-2000 SciBus Software Dollar Sales, by Major Market Segment

Source: SciBus management

6.12 SciBus Projected Total Revenues SciBus' projected total revenues for the 1996-2000 period are shown in EXHIBIT 8 (page 12). Total revenues are forecast to reach \$56 million in 2000. 70% of the total revenues projected for 2000 are SciBus software sales, with the balance of 30% derived from license fees and royalties generated by SciBus CAA technology sub-licensees.

Appendix 4 is an overview of the method used by SciBus to develop its market and revenue forecasting model. **Appendices 4A** through **4F** detail the basic elements of the model.

6.13 Commercializing the CAA Technologies: The Revenue Flow The structure and projected parameters of the revenue flows for all CAA team members are shown in **EXHIBIT 35**.

EXHIBIT 35

CAA-SciBus Technology Commercialization: The Revenue Flow

Source: SciBus management

6.14 Key Sales Strategies SciBus' key sales and marketing strategies for the 1996-2000 period are summarized below:

- Encourage among CAA team developers the earliest possible beta site release of proven, reliable LIMS and DIMS software, and commence direct sales of Level 1 software products as soon as qualified field sales people are recruited;
- Concentrate on industrial labs doing product testing as the first market priority, followed by federal government labs conducting environmental tests;
- Personally visit as a management team the major analytical instrumentation manufacturers and system integrators; generate enthusiasm for CAA lab automation technologies and standards, and SciBus sub-licensing;
- Evaluate in-house vs. out-sourced SLM documentation preparation, and move to implement the most economical choice as soon as first SLMs are out of beta sites
- Sub-license SLMs as soon as documentation packages for available products are completed.

6.15 Letters of Intent and Interest SciBus has received numerous inquiries about the technologies and products being developed by the CAA program. Likewise, LANL has also been contacted by both domestic and international concerns regarding the licensing of the technologies across all market segments and by equipment manufacturers.

SciBus has included **Appendix 5**, Letters of Intent and Interest, as a part of this Business Plan to emphasize the expression of interest on the part of these manufacturers, as well as direct Letters of Intent to license specific technologies held by SciBus under its exclusive contract.

Furthermore, Appendix 5 contains letters of interest by various commercial, DOE and DoD laboratories pertaining to the need, application and use of the CAA technologies in today's market. In many cases these laboratories have offered their facilities for beta- and validation testing, and in some cases, the co-development of new technologies applicable to specific market segments.

SECTION VII

OPERATIONS

7.1 Location and Facilities SciBus currently occupies rented office space in the NASA/Ames Technology Commercialization Research Center adjoining the NASA/Ames government site in Sunnyvale, California. Upon completion of its funding, SciBus plans to lease approximately 4,000 sq. ft. of stand-alone office/light manufacturing space in the Silicon Valley or similar technology locale.

7.2 Manufacturing and Quality Assurance SciBus sub-licensees and other contract system integrators are responsible for hardware SLM fabrication. SciBus does not plan to become either a hardware manufacturer or a software replicator. SciBus, however, intends to establish an ISO 9000-qualified departmental QA/QC function that sets quality standards and monitors CAA product manufacturing activity among SciBus sub-licensees and contract integrators.

7.3 Product Support Warranty and out-of-warranty SLM hardware support for the enduser is a primary responsibility of the SciBus sub-licensee/integrator. SciBus' responsibility is to provide the sub-licensee/integrator with a complete documentation package at the time the sub-license or contract is consummated. SciBus intends to publish "Guidelines for Customer Support" as a component of its document set, and will require as part of the sub-licensing agreement/contract that the sub-licensee/integrator provide endusers with a "Troubleshooting, Maintenance and Repair Manual" now being developed in CD-ROM format by the University of Florida as part of the CAA program.

To support its CAA software products, SciBus plans to build a three-person Software Product Support team of software and applications specialists at SciBus headquarters to respond to customer inquiries. Communication with SciBus support personnel would be available on a 24-hour emergency basis, and all out-of-warranty service provided would be chargeable, at the customer's option, under either a service contract or a segmented hourly billing program.

7.4 Product Development All CAA product and technology development is currently being done by the designated CAA team members, as indicated in EXHIBIT 18 (page 31). SciBus and LANL are jointly coordinating the various development programs, and LANL acts as the lead laboratory for the entire CAA Project. Under the terms of the CAA-SciBus Technology Transfer Contract, CAA hardware and systems development would start to transfer to SciBus in 1996 and continue through most of 2000. The exact nature and content of that transfer is not specified at this time, and is an issue slated for more precise resolution in the

future. Software development is currently under the full supervision of SciBus and will remain a top SciBus priority throughout the term of the CAA-SciBus Technology Transfer Contract.

7.5 Manpower SciBus expects to develop a professional sales, marketing, engineering and software support company of approximately 80 employees by 2000. Software engineering, chemical engineering, and electromechanical engineering are key technical strengths that SciBus intends to build, with additional design capability added towards the end of the 1998-2000 period as SciBus begins to assume a more direct product development role. SciBus plans to have a total of 24 full-time employees on board within 12 months of completing its current round of funding.

SECTION VIII

MANAGEMENT

8.1 SciBus Officers John Condren is the SciBus founder, and serves SciBus as Chairman and CEO. His most immediate goals are to close a successful SciBus equity funding, and consummate one or more effective strategic partnerships with firms that can help SciBus market CAA technology as broadly and quickly as possible. Michael O'Hagan is SciBus' President, and Alan Barich serves as Executive Vice-President and Chief Operations Officer. Collectively, the three SciBus principals have extensive experience in company and program management, contract negotiations, capital equipment sales, new business development, and government marketing. Their backgrounds and experience are summarized in Section 1.5 (page 10).

8.2 Board of Directors Currently, the SciBus Board of Directors is comprised of the three SciBus officers:

John Condren, Chairman
Michael O'Hagan
Alan Barich

Depending on the interests of future investors, SciBus may add new members to its Board as appropriate. SciBus contemplates moving eventually to a 5-man Board composed of two inside Board members and three outside Directors.

8.3 Technical Advisory Board SciBus plans to assemble a group of technical advisors from relevant industries and institutions to review key issues of major importance to SciBus. For example, market regulatory requirements, product development strategies, chemical analysis methods, product validations and market need assessments would be appropriate topics for review.

8.4 Legal Services SciBus has retained the law firm of Carr, DeFilippo and Ferrell (Palo Alto, California) as Company counsel. Mr. Barry Carr, a partner in the firm, is SciBus' primary attorney.

8.5 Organization and Other Key Management SciBus' February 1, 1996 organization and key management recruiting plan for 1996 is shown in EXHIBIT 7 (page 10). Mr. Condren currently carries out the duties of the New Business Development position until an appropriately qualified person is identified and hired. Candidates for the positions of Chief Financial Officer, Chief Technology Officer and Chief Marketing Officer are currently being interviewed. SciBus intends to make offers to its preferred candidates immediately upon closing its

current round of funding. **EXHIBIT 36** indicates the longer-term functional direction SciBus intends to take in building its organization.

EXHIBIT 36
SciBus 1996-2000 Functional Organization

SECTION IX

FINANCE & CAPITAL STRUCTURE

9.1 Financial History SciBus is a development-stage company, and has not as yet established an operating record of revenue and income. SciBus was incorporated in February, 1995 and seeded with approximately \$150,000 by the founder. Since inception, outside investment in SciBus has been confined to a single investor who purchased a SciBus convertible debenture (the "Debenture") for \$100,000.

The Debenture principal of \$100,000 is secured by SciBus' right, title and interest in a purchase order currently in-house, and is payable on demand on or after October 20, 1997. Simple annual interest is payable at the rate of 10% per annum on the unpaid balance, and the Debenture is convertible into shares of SciBus Common Stock at \$2.25 per share before January 2, 1997. EXHIBIT 10 (page 15) is the SciBus unaudited December 31, 1995 balance sheet.

9.2 Capital Structure and SciBus Ownership SciBus has authorized 5,000,000 shares of Class A Common Stock. As of the date of this Plan, 532,000 shares of Common Stock have been issued and are outstanding. With the exception of the shares into which the Debenture is convertible, SciBus management at present collectively owns 100% of the shares of SciBus Common Stock, as calculated on a fully-diluted, common stock-equivalent basis.

9.3 Funding Requirements and Security SciBus is currently pursuing \$2,850,000 in funding to launch the CAA-developed technologies. In return, SciBus' management has two (2) options available to investors for securing the investment:

- By means of an equity investment, SciBus Analytical's management is willing to offer a minority interest in the Company to a participating investor or investment group.
- By means of debt financing or convertible-debt financing, SciBus has aligned itself with the TransAmerica Corporation through an investment house located in the United Kingdom. TransAmerica is currently promoting technology business relationships between US and UK companies, and as SciBus' business and product lines have direct international application, TransAmerica has approved a \$3.3 million loan guaranty bond to be applied to debt-financing for SciBus Analytical. The bond guarantees 100% of the principal loan amount. The minimum loan amount applicable to the bond is \$500,000 and can be applied to individual investors, consortiums or corporate investors.

9.4 SciBus License Fees and Royalties SciBus has two categories of license fees and royalties to manage. One category concerns the license fees and royalties it assesses its sub-licensees. Royalties are due SciBus on items sold by its sub-licensees as either stand-alone products or embedded in larger system configurations. The second category concerns the fees and royalties it pays LANL, acting as the lead lab and business/contract entity for the DoE, to acquire and sustain its exclusive master license to CAA technologies.

With respect to LANL, SciBus is obligated to pay a one-time-only "issue" fee of \$25,000 for each CAA intellectual property item SciBus chooses to license. SciBus has also agreed to pay LANL 50% of the royalties SciBus receives from its hardware sub-licensees, and a fixed 5% royalty on all SciBus sales of CAA-licensed software to endusers. To acquire its exclusive technology licensing privilege, SciBus is now obligated to make an aggregate payment of \$175,000 to LANL to cover the SLMs presently available. The terms of payment are 50% due February 1, 1997, with the balance to be paid on February 1, 1998. SciBus must also make an annual minimum royalty payment of \$200,000 to LANL in 1999 to preserve its exclusive rights to CAA technology, followed by an on-going annual minimum payment of \$300,000, starting in 2000.

9.5 Capital Requirements; Source & Uses of Funds Assuming gross proceeds of \$2,850,000 are raised in the current round of funding, SciBus intends to apply the funds as set forth in EXHIBIT 37.

EXHIBIT 37
SciBus Projected Uses of Funds

USES OF FUNDS	\$ 2,850,000 FUNDING
<i>Less: Fees & Commissions</i>	<i>\$142,500</i>
• Sales and Marketing Expenditures	\$1,110,000
• Software Product Development	\$ 900,000
• Software and CAA License Fees	\$ 385,000
• Other Working Capital	\$ 312,500
Total Use of Proceeds	\$2,850,000

Source: SciBus management

9.6 Projected Financial Performance SciBus' pro forma financial statements for 1996 through 2000 are presented in **EXHIBITS 11 through 11D** (pages 16-20). Respectively, these presentations are the Projected December 31 Balance Sheets, Projected Annual Statements of Operations, Projected Annual Statements of Cash Flows, Monthly 1996 and Quarterly 1997 Cash Flow by Expense Category, and the accompanying Notes to the Pro Forma Financial Statements. A tabular summary of SciBus' projected financial performance highlights over the 1996-2000 period is contained in **EXHIBIT 9** (page 13).

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SECTION X

RISK FACTORS

There are a number of risks associated with an investment in SciBus at this time, the most significant of which, in management's opinion, are presented below. SciBus has developed various contingency plans to deal with these issues, and invites prospective investors to discuss such plans with management.

10.1 Uncertainty of Projections The projections of sales and net income contained in SciBus' pro forma financial statements are based on assumptions made in good faith by SciBus. Such assumptions include SciBus' future ability to commercialize CAA products successfully, and organize the necessary manufacturing sub-licensee operations. SciBus' material assumptions also relate to competitive and general market and economic conditions over which SciBus has no control. There is no assurance that SciBus' assumptions are correct, or that SciBus will achieve any of the results projected in this Plan, and SciBus makes no representations as to the accuracy of the projected financial information.

10.2 Future Capital Needs; Uncertainty of Additional Funding Although SciBus believes \$2,850,000 of equity funding will be sufficient for SciBus to meet its near-term performance projections, any developments that would tend to impede SciBus' operations and business growth would likely create a need for additional financing.

10.3 Uncertainty of Enduser Market Acceptance SciBus' future business and earnings growth will depend heavily on the analytical laboratory market's acceptance of CAA-developed products. Such acceptance will be determined in large part by SciBus' ability, and that of its sub-licensees, to offer effective product performance at a low price that yields the enduser substantial operating benefits. To date, SciBus has only initial evidence on which to evaluate the market's likely reaction to its CAA products. SciBus believes such evidence is valid and applicable to the broader marketplace, as represented by the various Letters of Intent and Interest (see Appx. 5) and the involvement of non-environmental technology partners within the CAA program.

10.4 Uncertainty of Distribution Channel Acceptance In order to commercialize CAA technologies successfully, SciBus must enlist the resources of analytical instrumentation companies and system integrators to provide product engineering and market access. If these intended channels of distribution and productizers fail to enter into sub-licensing agreements with SciBus in a

timely manner, or simply refuse to enter into such agreements on any terms, SciBus' business growth would be materially harmed.

However, since most of these industry leaders have been actively involved with the CAA program in the past, SciBus believes they will view SciBus' efforts favorably, and adopt lab automation standards and equipment as a means of spurring overall market growth and, in the process, increase sales of their own instruments. SciBus also believes the industry will respond positively, rather than skeptically, to the claims of significant operational improvement made on behalf of automated lab systems. The productivity benefits of lab automation have been unequivocally demonstrated at LANL beta sites, and further confirmed by industry data accumulated as a result of the general interest in sample preparation and automation. Furthermore, the government has indicated that it will specify CAA standards in its equipment RFQs, which would provide substantial additional encouragement for the industry to adopt standards.

10.5 Loss or Delay of CAA Funding Numerous pressures from both inside and outside of government are being applied to cut back federal government expenditures. The very existence of the DoE has been threatened by demands for elimination of many large bureaucratic government agencies. Despite these threats to the continuity of the CAA Project, SciBus believes (and has been so informed by the DoE) that the intrinsic value of the technology emerging from the Project and its proven ability to save the government money will sustain CAA funding independent of any possible bureaucratic restructuring.

EXHIBIT 23 (page 39) shows the expected annual availability of CAA products through 1999. Were all CAA funding suddenly to stop now such that only the 1996 CAA products were licensable, SciBus estimates that it could build a \$6 million business in annual revenues. If funding continued for one more year into early 1997 such that all of the 1997 CAA products became available, SciBus estimates it could reach \$19 million in annual revenues. Similarly, funding into 1998 would allow SciBus to build a \$46 million business, and a \$56 million business in 2000 if CAA funding is not interrupted over the 1996-2000 period.

10.6 Loss of CAA Technology Exclusive SciBus has entered into a CAA Technology Transfer Agreement with DoE that gives SciBus exclusive rights to commercialize all of the intellectual property developed under the CAA Project umbrella. In return, SciBus has certain obligations to DoE that it must fulfill in order to preserve its competitively-won position. These obligations involve the scheduled payment of certain license fees and minimum royalties, the bulk of which are not due and payable until 1999. In SciBus' opinion, fulfilling its obligations under the Agreement will not be difficult once its CAA commercialization and sales efforts are underway.

10.7 Competitive Challenges The need for laboratory automation is international in scope. The governments of Germany and Japan have voiced

national concerns and are now funding programs similar to the CAA Project. They are two to four years behind the CAA Project in terms of hardware and systems design, and as much as five years behind in software development. However, any significant lapse in CAA progress could close the gap and bring competition from the international side into the U.S. market before the adoption of U.S. automation standards and technologies.

10.8 Loss of Key Personnel SciBus is depending on the key members of its management team to execute the Plan. Although SciBus would recruit replacements as needed in the event of the loss of a key person, such losses could cause serious delays in SciBus' ability to stay on track with its revenue projections from CAA technology commercialization.

Similarly, certain government individuals at LANL and within the DoE in Washington, D.C. are closely associated with the CAA Project and have done much to communicate its efficacy throughout government, secure the Project's funding, and protect it from disruption. Such persons as Mr. Robert Hollen, CAA Program Coordinator at LANL, and Dr. Linton Yarbrough, CAA Program Director with the DOE's Robotics Technology Development Office are extremely valuable to the effort, and their departures would call for strong and timely replacements.

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