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"Software affords excellent economic development potential for Minnesota... Making Minnesota a recognized leader in the field of software development can benefit all Minnesotans."

The Minnesota Software Technology Commission

January 1987

Report of the Minnesota Software Technology Commission to Governor Rudy Perpich and The Minnesota State Legislature

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"So far, the program's only major shortcoming is the absence of a Software Center. Perhaps more than any other technology, Massachusetts can lay claim to being the software capital of the world, yet precious little is being done to capitalize on this homegrown industry. The governor and the Software Council should develop a more substantive policy in this area. A Software Center of Excellence, perhaps located in Cambridge's AI Alley, might be just the thing."

—MassHigh Tech,
September 15-18, 1986

"Their idea is right, but the location is wrong. A software center of excellence has been carefully researched, designed and is ready to implement in MINNESOTA."

—Minnesota Software Technology
Commission, October 16, 1986

870639

THE MINNESOTA SOFTWARE TECHNOLOGY COMMISSION

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Saint Paul, Minnesota 55101
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This report is the result of 23 months of careful study, discussion and soul searching on the part of all the members of the commission. Yet, because reports of this sort often become long winded and strewn with vague ideas, we had worked hard to distill our report into a simple, straightforward, direct document. It summarizes the key issues and makes recommendations for specific action.

We would like to take this opportunity to vigorously assert that the software industry represents a **vital** economic growth opportunity for Minnesota. The three specific recommendations included in our report clearly define the role the state can play in capitalizing on this opportunity.

But it also must be emphasized that our recommendations are based on an industry driven model. They do not call for state action alone. Rather, a strong private sector/public sector partnership is critical to the success of the program. For example, the Center for the Development of the Software Industry includes substantial software industry funding participation. In fact, the Center concept was developed such that it would ultimately be funded solely by the private sector.

To summarize, software is the fastest growing industry in the United States. By following our recommendations, Minnesota can position itself to gain an increased share of this extraordinary employment and revenue growth.

Sincerely,

Daniel J. Brennan
Chair

David T. Sebastian
Secretary

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I. Executive Summary and Conclusions

A. Introduction

In February 1985, Governor Perpich established the Minnesota Software Technology Commission to examine the software industry in Minnesota and determine if and how the state could support the economic development of this infant industry. Since that time, the Commission has set for itself a specific mission, defined objectives, strategies and tactics, and has produced this report, which summarizes our findings and recommendations concerning the software industry.

The Commission believes that software development affords excellent economic development potential for Minnesota, particularly if the recommendations contained in this report are implemented in a timely and vigorous manner.

Minnesota has a window of opportunity in an industry that shows every sign of being the foundation for the national economy in the next century. Making Minnesota a recognized leader in the field of software development can benefit all Minnesotans.

This report makes specific, action recommendations for industry development activities based on a thorough assessment of the software industry.

The Commission found the software industry well suited to Minnesota. While there is excellent economic potential, we found a clear need for government support to foster economic growth. The recommendations reflect what we, a non-partisan, private sector/public sector Commission, believe are essential steps for Minnesota to take in order to realize the software industry's potential.

B. Why Software Is Special to Minnesota

Our economy is moving from the industrial age into the technology/information age through the use of computers and associated technologies. Minnesota, often considered the birthplace of the computer, has a substantial stake in this technology business. We have five times the national proportion of employment in the computer industry. Many of the largest computer companies have major facilities here. And these companies have spun off other generations of firms that have demonstrated success in associated fields such as supercomputers and communications.

The basis for success of computer technology is functionality–the ability to apply automated systems to as broad a class of problems as possible. In short, getting computers to do things faster, more accurately, even doing things that could not have previously been done. These benefits caused the initial proliferation of computers and will spur their future growth.

It is important to recognize that the real functionality of computers is not inherent in the hardware. Software determines functionality. Future applications of computer and automation technology, in fact the information age itself, depends on the software industry. Evidence lies in the fact that software applications have emerged in virtually every industry and the simple statistical fact that software is the fastest growing industry in the United States.

The software industry is ideally suited to Minnesota. Software is an intellectual product. It requires a well-educated population from which to draw its primary resource–human talent. It requires a high "quality of life" to attract and retain these talented minds. It requires communications links, not railroads. It requires readily available support services (legal, financial, marketing, etc.) It requires proximity to hardware development to be on the leading edge. And it requires a broad diversity of industries/occupations to foster product development in all market areas. Minnesota has all of these.

Software offers Minnesota the opportunity for visible leadership. Though many concentrations of software development exist around the country, none has established a truly dominant position. Minnesota can do that with the proper focus. The advantage will be a visible industry– a flagship that can lead to recognition and development of other important opportunities.

Recognition is important. Minnesota has long played a leading role in a number of industries without proper recognition. This is one critical element that powers economic development.

Finally, software is currently the sixth greatest source of new employment in Minnesota. It has grown at a rate of 300% over the last eight years. With proper encouragement, this growth can be even stronger– benefiting the entire state.

C. Why Should Anything Be Done At All?

Skeptics will say an industry with software's growth record does not require support, assistance or government intervention. However, the Minnesota software industry has critical needs that, if not met, will cause the industry to stagnate or, at least, fall behind other leading software centers.

These needs are inexpensive to meet. They require almost no bureaucratic structure on the part of the state. In fact, a large state office devoted to software would probably be counterproductive.

The needs are simple:

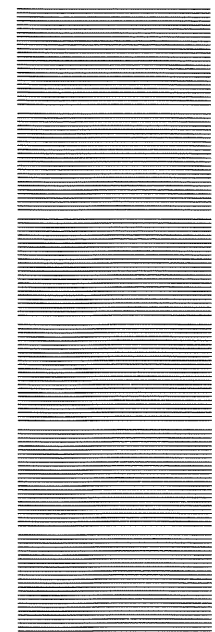
- A focal point for referrals, both among the industry and with support services, and access to information.
- Access to capital to fund product development, commercialization and marketing.
- A coordinated research, development and technology transfer effort actively involving the University of Minnesota.
- An economic environment that both induces entrepreneurship within the state and makes the state an attractive location for the formation of new software companies.

These needs can be addressed by acting on the following recommendations. The result, the Commission believes, will be a dynamic, thriving software industry, creating employment and revenues for Minnesota.

II. Commission Recommendations

1. The Commission recommends the funding of a Center for the Development of the Software Industry. The Center would be a public/private joint venture that expands and replaces the services presently being delivered by the Office of Software Technology Development (OSTD).
2. The Commission recommends the establishment of three chairs at the University of Minnesota in the following areas:
   - Supercomputers
   - Software Engineering
   - Knowledge Engineering
3. The Commission recommends that policy/legislation measures designed to improve the likelihood of success of small entrepreneurial companies be adopted.

The above recommendations are addressed in more detail in Section IV of this document.



III. The Software Industry– Minnesota Vs. The U.S.

A. A Brief Look At The Industry

Software is an infant industry–an industry without companies with large shares of the market, clearly defined distribution channels or product standards. But it is a large infant, growing larger at an extraordinary rate. It is estimated that the U.S. used $16 billion in software in 1984. By 1988, this figure is forecasted to be $30 billion. And by 1995, $100 + billion. No other industry comes close to this projected rate of growth.

Still, the industry lacks many elements that make it a unified, homogenous "industry." To a vast extent, it is comprised of small, entrepreneurial business units. Software companies have a higher birthrate and death rate than other industries. A major software industry trade organization indicates there are approximately 7,400 software companies in the U.S. Each works feverishly to develop products which, it hopes, will capture the imagination of the marketplace so that the company will reap substantial rewards for its labors. These activities lead to the development of 11,000 new products each year.

These companies have remarkably little interaction, both among themselves and with support service networks (attorneys, accountants, marketing firms, etc.). This interaction is required to turn their software idea into a successful business. Software companies tend to focus on technology rather than business or marketing. Thus, few are equipped to understand the needs of their market or to capitalize on business opportunities these markets represent. As a consequence, there is a great deal of resource waste and development of redundant or "market-less" products.

Although, it doesn't take much capital to start a software company, taking a product out of R&D and into the marketplace requires substantial capital. To date, major capital investors have shown only limited interest in software. The product is "intangible," the risks are perceived to be high, and a clearly defined understanding of the software market and its dynamics has not yet been developed.

Finally, to a great extent, the industry appears to be customer driven rather than market driven. Software companies tend to focus on the specifics of a uniquely individual application rather than understanding the similarities of applications within market segments. Thus, much of their effort is either misdirected or unleverageable beyond the immediate situation.

Combine the preceeding factors with the rapid technological advancements in both computer software and hardware, and you have an industry without clear focus, direction or infrastructure. Any state that can serve as a catalyst, pulling these diverse factions together and organizing the industry, stands to reap extraordinary rewards.

B. Minnesota Vs. The U.S.

Like all industries, the software industry is made up of individuals with their own stories. Section III.D. of this report includes brief "snap-shots" of a few Minnesota software companies to illustrate their successes, failures and needs.

Looking at the Minnesota software industry from a statistical standpoint, however, gives a valuable sense of our size and growth compared to the industry as a whole.

The statistics represented here are based on the *latest* government economic data available, some from as far back as 1977. These statistics paint a totally inadequate picture, especially since personal computers did not exist in 1977. To remedy this, two things are being done.

- First, the federal government is assigning three separate Standard Industrial Codes (SIC) to the software industry for the next economic census. (This alone indicates the growing importance of software as an industry.)
- Second, in Minnesota, the Office of Software Technology Development is conducting detailed research into the software industry. This information will be used for both future policy-making decisions and, more importantly, as a benchmark to measure the economic impact of implementing this report's recommendations.

Minnesota Department of Energy and Economic Development (DEED) industrial economist, Brian Zucker, presented a report to the Commission containing detailed statistical comparisons between Minnesota and other software centers. The report, in Appendix 1, was used by the Commission to prepare its recommendations. The most pertinent facts are:

1. OSTD estimates that Minnesota has a 2.7% share of the national software market. Estimated total software revenues were $600 million in 1985. The national software and data processing market was $22 billion.
2. The Policy division of DEED estimates that 10,745 Minnesotans were employed in software in 1984. This reflects 2.3% of the 473,000 persons employed by the industry, nationwide, in 1984.
3. The Policy division of DEED reports the increase in employment in the Minnesota software industry between 1977 and 1984 was 270.8% compared to the national increase of 153.9%.
4. Federal statistics indicate that between 1977 and 1982, U.S. revenues from software sales increased by 182%. During that same period, Minnesota's revenues increased 149%, indicating a lag in software growth.

C. Minnesota Vs. Other Software Development Hubs

With the sophistication of today's electronic communications networks, many software applications can be developed outside of

major metropolitan areas. In fact, a number of Minnesota's most successful software development firms are not located in the metropolitan area.

Historically, however, the software industry has tended to develop in major metropolitan areas. In order to assess our performance against competitors, it is best to compare the performance of the Minneapolis/St. Paul software industry to other software development hubs.

For purposes of comparison, the Commission evaluated the Minneapolis/St. Paul software industry against Boston's software industry–a recognized leader. Following are key points of difference (see Appendix 1 for additional detail):

1. In the period from 1977-1982, Boston's revenues for software increased 248%. Minneapolis/St. Paul's were up 149%.
2. The revenue patterns by type of product/service were quite different. Boston derived the vast majority of its revenues from the development of prepackaged software, custom software development and the sale of turnkey systems, making it a software exporter. The Twin Cities derived the greatest revenue from the maintenance of existing software packages for Minnesota companies and not by exporting software.

These facts lead to two important conclusions. First, Minnesota has not kept pace with other software hubs. Second, Minnesota's software revenues are based on servicing our own internal market. Although no specific statistical data exists, it is reasonable to conclude from the data that does exist that *Minnesota is a net importer of software.* These imports were estimated to exceed $500 million for 1985. Our recommendations are designed to make Minnesota a software exporter.

D. Some Examples Of Minnesota Software Companies

Following are brief overviews of three Minnesota software firms. these examples were chosen because they are common stories within the Minnesota software industry.

#1–RIVER SYSTEMS

River Systems, founded in 1984, produces software that links Honeywell mainframe computers to personal computers. The company currently employs three full-time and two part-time employees. Future plans include expanding into software development for different languages and different brands of mainframes.

One of the company's major problems in developing new programs has been obtaining mainframe computers, which cost from $100,000 to several million dollars. To create software that links all the different mainframes and mainframe languages with personal computers, the company would need 20 mainframes. Renting time is also expensive. Therefore, River Systems seeks organizations that will swap computer time for the finished product.

The company has sold the Honeywell version for one year, and it planned to introduce two other mainframe products by the end of 1986. It did not meet this goal, partially due to the difficulty in locating computer hardware. Karen Ackerman, vice president and co-founder, believes the Center for the Development of the Software Industry can quickly locate the nearest hardware and identify the appropriate contact.

Other ways the Center for the Development of the Software Industry would help River Systems include:

- Offering a source of qualified business associates and service providers. River Systems went through three lawyers and spent a lot of time and resources identifying lawyers that fit their need and budget. The Center

would have criteria, qualifications and references available.

- Locating experts in vertical markets.
- Offering seminars.
- Locating sources of financing appropriate for software companies and their circumstances, such as a lack of capital resources as collateral.

#2–FOURTH SHIFT CORPORATION/MICRO TECHNOLOGY SOURCES

Fourth Shift Corporation, a wholly-owned subsidiary of Micro Technology Sources, was founded in 1983 and currently employs approximately 40-50 people. The company produces a management software package for small manufacturing companies and small plants of Fortune 500 companies. By November 1986, a year after introduction of its product, approximately 150 systems had been installed nationwide and internationally. The 15-module system sells for $30,000; individual modules cost from $900 to $5,000.

President Jim Caldwell predicts the Software Center will have the greatest impact on small companies–those with fewer than five employees. Caldwell says these companies lack vital resources which the Center can provide by offering:

- Sources of software, hardware, utilities, complimentary products, subcontractors, experts, etc. "The sooner they get this critical information, the sooner they can get their products to market," Caldwell says.
- Information on marketing and distribution channels. Software companies are technically oriented and they need to realize that "building a better mousetrap will not make the world beat a path to their door."
- An opportunity for people in the industry to work together, similar to an "informal chamber of commerce." Caldwell believes a company his size would benefit most from this type of networking.

Caldwell says the industry needs an infrastructure with good programs, markets, technical people and companies. He believes the Center can be a catalyst for this infrastructure.

#3–UNISYS DEFENSE SYSTEMS DIVISION (formerly Sperry)

The Defense Systems Division of UNISYS employs approximately 4,000 programmers. Wayne Loffness, CPF program manager, works with approximately 400 programmers on just one UNISYS project. He says that at the UNISYS Defense Division, system and software programming has overtaken hardware production in terms of revenue.

Most, if not all, of Minnesota's hardware producers have sizable software departments. Like UNISYS, many of these hire subcontractors and consultants. Loffness believes this is where the Software Center will most benefit large companies.

Access to a large pool of potential subcontractors will benefit these companies by:

- Creating a more competitive environment, particularly in regard to the prices subcontractors charge.
- Making it easier to find people with the appropriate level of experience and/or specialization for a particular job.
- Finding people or companies that fit the requirements of government contracts, such as minority businesses or people with government clearance to work on classified projects.

IV. Recommendations and Rationale for the Economic Development of the Software Industry

A. The Commission recommends the funding and implementation of "The Center for the Development of the Software Industry."

The key to successful economic development of Minnesota's software industry lies in meeting the needs outlined in Section III of this report. The Center for the Development of the Software Industry is designed to meet these needs.

The Center represents a short-to medium-term strategy, one to eight years of maximum impact, compared to the other recommendations that follow. Since the Center requires some funding from state resources, the Commission has prepared a detailed model to relate the potential impact the Center can have on the economic development of the software industry. This model will also be used to measure the performance of the Center against its objectives and to assist in making adjustments to the Center's operations.

Appendix 2 contains a detailed discussion of this performance evaluation model, as well as a most conservative economic impact scenario. It is important to understand that this model represents only a small, but critical aspect of the Center's overall impact. It projects only the impact the Center's referral services would have on marginal software firms (firms that, without such services, would not survive). It does not project the impact the Center referral services would have on non-marginal firms, nor does it forecast the impact of non-referral services provided by the Center. Both of the latter will have significant additional economic benefit.

The limited, conservative projections from this performance model indicate the Center will have the following economic impact related to its assistance to marginal software firms:

1. The Center will help retain or create 5,000 + jobs in software firms over the period 1987-1995.
2. These jobs will mean $9 million in additional tax revenues to Minnesota over the period 1987-1995. During the 1987-1989 biennium, $3 million in additional tax revenues will be attributable to the efforts of the Center.

A detailed plan for the Center is available from the Office of Software Technology Development. A summary of its key components follows:

1. *Center Organization.*

The Center for the Development of the Software Industry will replace the Office of Software Technology Development. The present activities of the office and the services to be provided through the Center will be integrated into one operating unit.

2. *Linkage of Critical Services to the Software Industry.*

The industry needs access to: legal assistance, quality assurance, business planning, marketing assistance, quality assurance, business planning, marketing assistance, distribution, skilled labor and market information. The Center will have a unique capacity to link private and public suppliers to industry needs. This linkage will be based on a careful study of both the software company's specific needs and the qualifications of the service provider.

3. *Access to Capital.*

The Center will aid software firms in obtaining capital through two methods. First, referrals to private capital sources showing interest in software investment opportunities. Second, continued operation and management of the Technology Product Investment Program currently being operated by the Minnesota Energy and Economic Development Authority and the Office of Software Technology Development.

4. *Access to Education and Training.*

The Center will provide access to special training as required by software firms. It will also coordinate access to Minnesota's educational institutions, their research, consulting and training capabilities, for the benefit of the software industry.

5. *Market and Industry Information.*

The Center will maintain a sophisticated data base. Functions will include: identifying appropriate service providers to meet industry needs; providing Minnesota software industry data, providing consumers with software product/service information and sources of educational opportunities. In addition, the Center will provide access to a variety of sources of market information to assist Minnesota software firms in identifying market opportunities.

The Center will require initial funding for the 1987-89 biennium of $730,000. This funding will be augmented by an estimated $193,000 per year contribution by private industry in the form of fees for services and other compensation (See Center plan for details).

In conclusion, the Commission believes the Center for the Development of the Software Industry represents both a strategically sound economic development activity and a fiscally sound investment.

B. The commission recommends that efforts and support be devoted to the establishment of three chairs at the University of Minnesota.

While the Center represents a short-to medium-term strategy, the Minnesota software industry needs a long-term strategy as well. The Commission has reviewed a number of efforts by other technology industries. The Commission's study indicates that a core of basic research forms the long-term base for a successful industry.

Thus, the Commission recommends that Minnesota build a basic research capability in software. Though building this capability is a complex task, a sound first step would be to establish three endowed chairs related to software at the University of Minnesota. These chairs would be:

1. *A Supercomputer Chair.*

Supercomputers are a homegrown Minnesota industry that show great potential. A key to capitalizing on this potential is the development of software for the supercomputer. Among the most significant barriers to the widespread use of supercomputers is the lack of suitable software. By creating a chair focused on supercomputers, Minnesota will not only form a research base for the advancement of the supercomputer industry, but also provide a research foundation for a specific software opportunity.

2. *A Software Engineering Chair.*

To provide general research support to the technological base of the Minnesota software industry, a center for basic research in software technology is essential. A software engineering chair is a strong first step toward establishing this necessary research.

3. *A Knowledge Engineering Chair.*

The key to the further use of computers and software is identifying and developing methods to apply technology. This process is called knowledge engineering. By establishing a knowledge engineering chair, Minnesota will be assuring its software industry of a leading edge position in the development of new applications and innovations.

Establishing a research core not only supports the long-term growth of the Minnesota software industry, it can also be the most attractive feature of Minnesota to software firms looking to establish or expand their operations. Evidence indicates that a strong basic research climate, and the people attracted to such an environment, want to locate near that core. This location activity builds a self-generating force for technological and economic development.

C. The commission recommends that Minnesota adopt appropriate policies and legislation to improve the likelihood of success of entrepreneurial endeavors and encourage technological investment.

The Software Technology Commission is not an expert in the area of taxation or other business climate issues. However, the Commission feels it is essential for Minnesota to create an economic climate conducive to entrepreneurship. And though the Commission expects the software industry to mature over the next decade, it believes small companies will continue to form a key growth component in the software industry for the foreseeable future.

The climate also needs to be competitive with other software development hubs around the country. If Minnesota is to compete long term, it will be essential that the state's tax structure not create barriers for software companies that might otherwise choose to locate here. Though the Commission does not believe our present tax climate will drive companies from Minnesota, it may prevent the state from attracting people and firms that could contribute much to its economic development.

Appendix 1

This summary presents a thumbnail sketch of the software industry, with special attention given to Minnesota's position in the national software marketplace.

I. Inadequacy of Software Industry Statistics

Conducting research on the software industry is complicated by at least four specific factors:

1. *Inadequate Federal Coverage*

The federal government's industrial classification scheme identifies software as a service industry. Consequently, software has suffered along with other service industries in terms of adequate collection and reporting of industry statistics. With the exception of the Census of Service Industries, conducted once every five years, state-level data showing industry characteristics other than employment, number of establishments and payroll, is not available from federal sources. While this inadequacy will partially change with the reclassification of software from a service industry to a manufacturing industry in 1987, updated data will not be available until at least 1989 or as late as 1991.

Because software is among the most dynamic of all industries, with average annual growth of 25 to 30 percent, much of the federal government's data is essentially obsolete by the time it is released. While private information sources have begun to develop a number of important related data bases, they tend to be organized around particular markets as opposed to the position of individual states. Moreover, data from such sources can be quite expensive to obtain.

2. *Crosses Several Industry Definitions*

Much more than other industries, software is created by establishments which produce principally other products or services. Hence, tracking software's primary classification, SIC 737, captures only part of the industry's total contribution to the economy. Under current data collection systems, it is almost impossible to examine software production from multiproduct firms. This problem is further compounded by the growing importance of "imbedded software" and an inability to properly allocate the value of software produced in-house as an intermediate input into another manufactured good or service.

However, the small amount of data that does exist on secondary producers of software indicates remarkable growth. Manufacturers of computers, SIC 3573, for example, reported $147 million in software revenues for 1983 and $407 million in 1984. In general, secondary producers of software are concentrated in six industry groups: printing and publishing, non-electrical machinery, electrical equipment and supplies, transportation equipment, scientific instruments and finance and insurance. With the exception of transportation equipment, Minnesota has strong representation in all of these major industry groups.

3. *Underground Economy*

Software represents one of the most vibrant parts of the underground economy. Even where industry statistics are available, they fail to include 20,000 software producers nationwide who work part-time out of their homes or at school or on company time. These underground producers are significant because their services compete in the marketplace along with everyone else. An upcoming survey conducted by the Small Business Administration on home-based employment may help shed some light in this area.

4. *Inadequate Product Definitions*

Unlike the national system of commodity codes which classify virtually all manufactured products, there is no universally accepted system for classifying the vast array of software products. This problem is especially severe because software products serve all industries and cover a broad spectrum of markets and end-uses. In 1985 alone, more than 11,000 new software products were introduced. Consequently, it is extremely difficult to track or assess particular software markets, and a substantial volume of talent is wasted on the development of redundant products. Without good market information, it is difficult, if not impossible to assess the saturation of particular markets and develop more reliable industry forecasts.

As the software industry matures, the availability of better and more current information will no doubt improve. Market and industrial statistics are an important factor contributing to the competitiveness of Minnesota's software industry. Bearing in mind the above-cited problems, this report proceeds with a discussion of the industry in Minnesota.

II. The Importance of Software to Minnesota's Economy

Minnesota currently employs over 13,000 people in the major industry group called Software and Data Processing Services–SIC 737. Based on occupational statistics, however, there are at least 45,000 people employed under the related occupational titles of systems analyst, computer educators, computer programmers and computer operators. These statistics do not include persons involved in the adminstration, distribution, marketing and other support areas does for software products. Nor does it include a large number of professionals in the physical, natural and social sciences who are involved in the upgrading of existing software products or the development of new products. The industry is, therefore, considerably larger than its primary SIC code.

Revenues from the software and data processing service industry during 1985 are estimated at roughly $600 million, which would give the state a 2.7% share of national output. Combined payroll for all software-related occupations exceeds $1 billion and salaries in this industry are roughly 40 percent above the state average.

Since 1976, software and data processing services have been the fifth largest source of new employment for the Twin Cities and the sixth largest source for the state. If Minnesota's current rate of employment growth in software and data processing services continues, the industry could employ close to 80,000 people by 1995.

This outlook is generally confirmed by the Bureau of Labor Statistic's most recent forecast for software and computer-related occupations which are anticipated to grow at 4 to 10 times the rate of total employment. In response to this outlook, Minnesota has begun to position itself to capture a larger share of this industry. Last year, for example, Minnesota's institutions of higher education graduated more than 1,000 computer science majors.

III. Markets For Software

To help identify the relative importance of software to various industries, Table 1 shows total software sales, software sales per employee, and capital expenditures for computers by major industry group. The data, however, is from 1977. Unfortunately, it is the most recent data of its kind available. This data is based on a 537-sector, U.S. Input-Output table, released by the federal government in 1984 with corresponding industry employment data released in 1985.

If the federal government were separated into non-defense and defense-related purposes, non-defense would have ranked as the second largest software market behind the finance and insurance sector, while defense would have ranked as the 12th largest market. Today, defense is probably among the top three markets for software.

Table 2 presents a ranking of the 30 most software-intensive industries for 1977 (measured in terms of software sales per employee). This information is presented at as high a level of detail as the data permits. Of the 30 industries, one-third showed a ratio of sales per employee in excess of $1,000 dollars and another third with sales per employee in excess of $500 dollars. Of the 30 industries, 14 were in manufacturing, 6 in business and professional services, 3 in finance and insurance, 3 in mining and 4 in transportation and utilities. Tables 1 and 2 indicate that software and data processing services cut across all industrial markets.

In 1977, virtually all software output went to industry or government. Households were, at that time, a negligible market. While this has changed with the penetration of personal computers into the household, all evidence suggests that industry demand will continue to dominate the software and data processing services market.

In 1977, manufacturing industries collectively represented the single largest consumer of software and data processing services. As markets for programmable automation software continue to expand, manufacturing is likely to remain among the most important market segments. Since 1977, manufacturer's expenditures for computers and peripherals have increased nearly tenfold.

Applications of software to the manufacturing sector are particularly important given manufacturing's contribution to our export base and software's role in enhancing the productivity and competitiveness of manufacturing processes. In view of the Midwest's move toward factory automation, where flexible manufacturing systems, computer numerical controlled machine tools, computer-aided design and robotics are being adopted at a comparatively faster rate than in other parts of the country, programmable automation software represents a particularly important market segment.

In 1985, the U.S. Department of Commerce released data which for the first time showed a distribution of computer sales by price class. This data is presented in Figure 1. In total, 41 million units and $15 billion worth of computers were sold in 1984. There were additional sales of $30 billion for peripheral equipment.

Despite the attention that microcomputers have received, computers priced over $50,000 still account for more than 60% of total industry revenues. Moreover, it is well recognized that markets for the personal computer, at least temporarily, have become fairly saturated. In contrast, market opportunities offered by very large computers, particularly supercomputers, are just beginning to emerge. Minnesota's comparative advantage for producing supercomputers, therefore, represents another significant market opportunity for locally based software producers.

More generally, Minnesota's software industry is likely to excell in areas that relate closely to the skill base of its own population and its existing mix of economic activities. Minnesota has demonstrated a comparative advantage in a number of industries, including health, scientific instruments, industrial machinery and agriculture, to name a few. For several reasons, it may be most appropriate to look within our own backyard for market opportunities and the development of new products.

IV. Minnesota's Position Within the National Software Industry

In 1984, Minnesota employed 10,745 people in SIC 737, with 95.5% of that total located in the seven-county Twin Cities metropolitan area. In the same year, the U.S. employed 473,000 persons in SIC 737, giving Minnesota a 2.3% share of U.S. employment in this industry. To help put this share into perspective, Minnesota accounted for 1.87% of the U.S. population in 1984 and commanded roughly 2.7% of U.S. software and data processing service industry revenues.

While Minnesota's share of national software employment is well above its population share, our share of national production in computers, roughly 9%, would suggest an even stronger position in the national software market. Census data and the data presented in Table 1 both suggest that Minnesota is probably a net importer of software.

Table 3 shows 1982 revenues for software and related service industries and the net change in programming-related revenues between 1977 and 1982 for 34 metropolitan areas. When these 34 areas are ranked in declining order for net changes in software programming-related revenues, the Twin Cities comes in 22nd. When these 34 areas are ranked for percent growth in programming-related revenue, shown in Table 4, the Twin Cities again ranked 22nd. In terms of total software and data processing service revenues, the Twin Cities ranked 14th in 1982.

In contrast to Minnesota's position, Washington, D.C. had the largest net increase in programming revenues, nearly 27 times larger than the Twin Cities net increase, due, no doubt, to federal contracts. In percent terms, Boston had the largest increase, nearly 37 times larger than that of the Twin Cities. Boston is generally perceived to offer a number of comparative advantages over other producing regions in the so-called high technology arena.

Figure 2 presents a distribution of software and related service industry revenues by source for the Twin Cities and Boston. Revenue sources are broken out into 10 major categories. In a hierarchy of activities, the first two, prepackaged and custom software, are the most export intensive and command the greatest income premium. They are followed closely by research and development for equipment and turnkey sales and licensing. In contrast, rental/leasing, maintenance, facility management, data processing and general consulting are considered more common and oriented toward local markets.

Boston's distribution of revenues shows a strong export orientation with income shares from prepackaged and custom software services almost twice as large as that of the Twin Cities. In contrast, the Twin Cities' revenue shares are considerably larger than Boston's in the areas of product maintenance, rental and leasing of products and data processing and preparation.

This data begins to suggest that, at least in 1982, Minnesota was not in as desirable a position in the national software market as many people might have expected. Using data from several sources, it has been estimated that in 1982, Minnesota probably imported in excess of $1 billion worth of software and related services. More importantly, the question as to where Minnesota's position has gone since 1982 remains unanswered. It should be clear, however, that simply looking at employment and employment changes is insufficient to assess our position.

In view of the software industry's job generation capability and its potential for enhancing the productivity of other sectors, it is clearly a key sector in Minnesota's economic future. The direction of the sector and optimal use of its resources, however, need to be more clearly understood and better channeled. Unfortunately, the existing body of information insufficiently identifies Minnesota's producers, their capabilities or the most promising market opportunities.

Table 1

Software Industry Markets: 1977
By Major Industry

Industry	Software Expend. (in mils.)	Employ-ment (in thous.)	Software Exp./ Employee	Computer Exp. (in mils.)
Farms	0.1	1337.0	0.1	5.9
Ag Svc, Forestry, & Fisheri	23.2	453.6	51.1	12.2
Metal Mining	26.0	79.8	325.8	5.2
Coal Mining	18.8	240.7	78.1	3.7
Oil & Gas	177.5	144.3	1230.1	50.0
Nonmetallic Minerals	27.9	115.7	241.1	7.9
Construction	385.9	5754.9	67.1	102.9
Food & Kindred	193.3	1605.8	120.4	117.1
Tobacco	13.9	67.0	207.5	9.8
Textiles	84.3	922.3	91.4	30.9
Apparel	69.1	1357.8	50.9	49.5
Lumber & Wood product	23.5	711.5	33.0	21.9
Furniture & fixtures	65.7	465.5	141.1	22.7
Paper	79.4	653.5	121.5	177.4
Printing & publishing	425.6	1114.5	381.9	203.1
Chemicals	225.8	1012.3	223.1	356.6
Petroleum refining	146.7	201.2	729.1	94.0
Rubber & plastic	64.7	730.4	88.6	44.8
Leather	24.7	256.7	96.2	5.9
Stone Clay & Glass	78.5	647.0	121.3	69.0
Primary metals	152.7	1144.5	133.4	170.3
Fabricated metals	174.2	1559.9	111.7	112.4
Non-electrical machinery	484.9	2134.8	227.1	465.7
Electrical equipment	473.0	1840.5	257.0	261.6
Transportation Equipment	427.9	1863.4	229.6	204.4
Instruments	114.6	571.1	200.7	62.8
Miscellaneous Manufacturing	48.3	455.2	106.1	29.7
Transport & warehousing	279.8	2099.6	133.3	144.4
Telecommunications	217.9	896.9	242.9	139.5
Radio & TV broadcasting	17.3	168.8	102.5	12.5
Utilities	278.9	591.3	471.7	214.2
Wholesale & Retail	1324.7	19013.8	69.7	1467.3
Finance & Insurance	2997.5	3643.2	822.8	1358.7
Real Estate	29.2	761.2	38.4	40.8
Hotels, Personnel Svc & Rep	144.2	2407.9	59.9	56.4
Business Services	2006.8	3887.0	516.3	949.8
Auto Repair services	8.7	680.2	12.8	29.6
Amusements	37.5	674.7	55.6	89.5
Health, Ed, and social svcs	1276.0	8236.6	154.9	231.2
Federal Government	1396.0	2727.0	511.9	1217.3

Source: Detailed Input/Output Structure of the U.S. Economy, 1977, U.S. Department of Commerce.
Survey of Current Business, November, 1985, U.S. Department of Commerce.

Table 2

Top 30 Software-Intensive Industries

Industry	Total Software Expenditures (in $1,000,000)	Software Expenditures Per Employee
Computer Data Processing	$ 708.0	$1838
Accounting, etc.	451.6	1658
Banking	2154.3	1586
Security & Commodity Broker	281.6	1492
Equipment Rental & Leasing	217.0	1362
Crude Petro & Natural Gas	177.5	1230
Manifold Business Forms	54.9	1228
Periodicals	74.2	978
New Petro & Gas Drilling	121.2	969
Petroleum	137.0	869
Electrical Computing Equipment	161.9	753
Pipe Lines Exc. Gas	10.2	708
Typewriters & Office Equipment	29.8	652
Management Cons. Testing Labs	230.7	640
Engineer/Architecture	261.6	628
Electric Utilities	197.4	587
Guided Missiles & Space	56.3	581
Insurance Agents and Brokers	212.0	537
Polishes & Sanitation	11.2	498
Aircraft	106.8	470
S&L Electric Utilities	21.6	456
Newspapers	157.0	444
Radio and TV Receiving Sets	35.2	429
Aircraft & Missile Equipment	47.1	427
Aircraft & Missile Engines	52.2	424
Book Publishing	25.9	424
Telephone & Telegraph Appra	52.4	373
Copper Ore Mining	11.8	363
Doctors & Dentists	353.2	361

Source: Detailed Input/Output Structure of the U.S. Economy, 1977, U.S. Department of Commerce.

Survey of Current Business, November, 1985, U.S. Department of Commerce.

Table 3

Net Change in Software Revenues: 1977-1982

City	Total Revenues	Programming-Related Revenues
United States	9665902	4617073
MD, Washington D.C.	1591614	518150
CA, Los Angeles-Long Beach	947521	296669
NY, New York	840932	274948
MA, Boston	677624	200628
IL, Chicago	532133	168656
GA, Atlanta	430167	139143
CA, San Francisco-Oakland	289602	130347
PA, Philadelphia	484092	127507
TX, Dallas-Fort Worth	505968	119926
TX, Houston	324833	114455
CO, Denver-Boulder	314309	105198
FL, Tampa-St. Pete	123367	75353
WA, Seattle-Everett	196429	71704
MI, Detroit	142067	62019
NJ, Newark	229174	56899
AR, Phoenix	120066	34777
NC, Raleigh	65560	30164
MD, Baltimore	124108	28130
NY, Nassau-Suffolk	155282	21852
FL, Jacksonville	71377	21385
FL, Orlando	137515	20785
MN, Mpls-St. Paul	163323	19476
OH, Cleveland	94556	19022
CN, Hartford	72869	16348
IN, Indianapolis	63462	13230
NE, Omaha	86644	12613
CA, Sacramento	98516	11229
KS, Kansas City	55956	9528
NJ, Paterson-Clifton-Passaic	81286	8896
MO, St. Louis	483998	7429
AL, Birmingham	69300	7039
FL, Miami	63895	5591
OR, Portland	28357	5079

Source: 1982 Census of Service Industries, Miscellaneous Subject Reports, U.S. Department of Commerce, Bureau of the Census.

Table 4

Percent Change in Software Revenues: 1977-1982

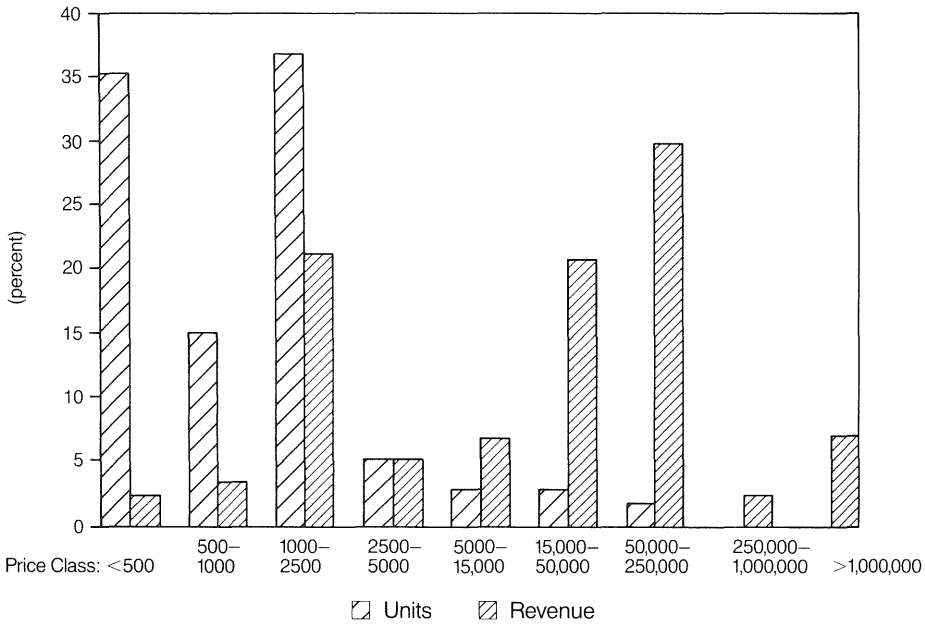
City	*Total Revenues	*Programming-Related Revenues
CA, Sacramento	6.08	8.46
FL, Orlando	4.65	1.48
WA, Seattle-Everett	3.64	8.00
NE, Omaha	3.37	2.25
NC, Raleigh	3.29	4.20
CO, Denver-Boulder	3.04	11.51
GA, Atlanta	2.91	3.03
CN, Hartford	2.51	3.75
MD, Washington, D.C.	2.49	1.43
MA, Boston	2.48	22.72
IN, Indianapolis	2.25	4.12
MO, St. Louis	2.23	0.34
MD, Baltimore	2.18	7.12
FL, Tampa-St. Pete	2.10	9.60
TX, Dallas-Fort Worth	2.10	2.68
NJ, Newark	2.07	1.99
PA, Philadelphia	2.07	1.95
AL, Birmingham	2.04	1.44
NJ, Paterson-Clifton-Passaic	2.01	3.24
FL, Jacksonville	1.95	5.08
U.S. Average	1.82	3.27
CA, Los Angeles-Long Beach	1.75	1.39
MN, Mpls-St. Paul	1.49	0.62
AR, Phoenix	1.44	5.17
OH, Cleveland	1.42	1.60
IL, Chicago	1.40	2.18
TX, Houston	1.33	1.56
FL, Miami	1.31	1.24
NY, New York	1.17	2.02
CA, San Francisco-Oakland	1.15	3.09
MI, Detroit	1.14	2.75
KS, Kansas City	0.94	2.42
NY, Nassau-Suffolk	0.78	0.49
OR, Portland	0.34	0.81

*All figures are in 100% increments (i.e., total revenues for Sacramento = 608%).

Source: 1982 Census of Service Industries, Miscellaneous Subject Reports, U.S. Department of Commerce, Bureau of the Census.

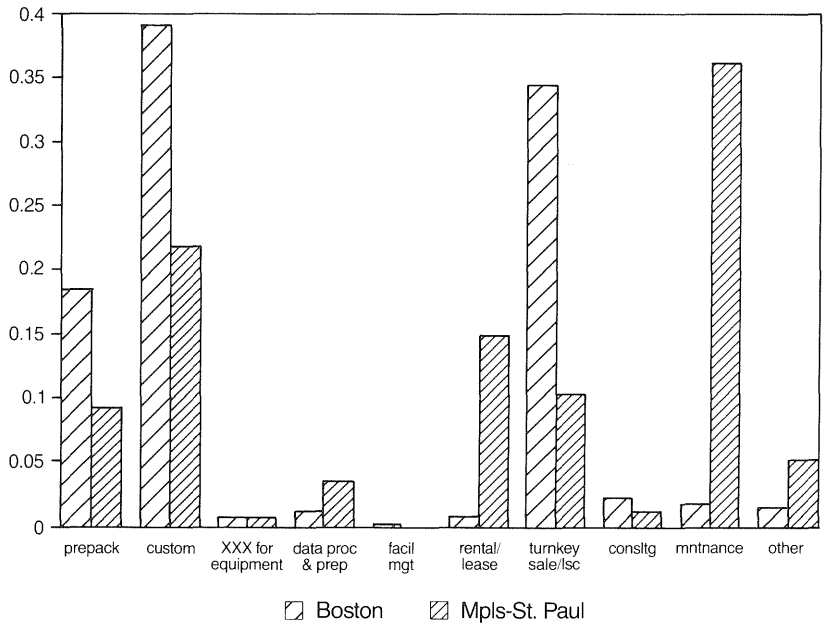
Figures 1 and 2

Figure 1
Distribution of digital computers sold by price class, 1984



Source: U.S. Department of Commerce, Current Industrial Reports, 1985.

Figure 2
Distribution and Revenue Sources Boston and the Twin Cities: 1982



Source: 1982 Census of Service Industries, Misc. Subject Reports, U.S. Department of Commerce, Bureau of the Census.

Appendix 2

Description of Software Industry Impact Model (SIIM)

Introduction

The Software Industry Impact Model (SIIM), was developed to help assess what impact the proposed Center for the Development of the Software Industry would have on Minnesota's marginal software companies, particularly in terms of new employment.

In large part, the structure of this model parallels the various functions of the proposed Center. The structure was developed from the initial Center concept, extensive interviewing with software industry personnel concerning their needs in the industry, the U.S. Small Business Administration's United States Establishment Longitudinal Microdata (USELM) file, a comprehensive literature search on why businesses fail and obstacles faced by newly created businesses, as well as data from an on-going survey of newly created businesses conducted by the University of Minnesota.

Summary of Major Impacts

Using SIIM, it is estimated that the proposed Center for the Development of the Software Industry will retain or create 5,700 jobs in 239 firms between 1987 and 1995. Over the eight-year simulation period, it is estimated that the total number of software and data processing service companies in Minnesota will increase from 600 to nearly 1,000. During this same period, the Center would provide assistance to more than 1,300 firms. Because of the great volitility of this industry, however, it is estimated that roughly half of the more than 150 new entrants each year will fail within a six-year period.

While the results given by SIIM were obtained using fairly conservative assumptions, it cannot be overemphasized that the SIIM is a learning tool, based only in part on empirical data. As interactions between the Center and establishments of the software industry occur, a body of data will develop, which will permit more reliable forecasts of the Center's long-term impact. More importantly, SIIM offers a structure for monitoring the Center's performance and incorporating industry feedback on an on-going basis.

For the interested reader, a copy of SIIM and alternative simulation runs based on different assumptions is available upon request from DEED's policy division.

Model Components

The following section presents a summary of SIIM's major components. These components are presented in the order that they appear in the sample output presented on pages 24-25.

Column 1 Stage of company development

Companies are grouped into one of four stages, according to their level of development, access to resources and position in the marketplace. The idea of company stages is adopted in large part from a body of economic literature referred to as the "product cycle." The product cycle seeks to analyze a firm's location and market as a function of a product's level of development. With each iteration of the model, a given company either moves to the next stage of development or goes out of business.

The four stages of development are:

Stage 1

Seed/concept development–Earliest stage of company development, focus is on concept development, early stages of product development, establishing company objectives and basic personnel. At this stage, companies are internally financed and substantially under capitalized.

Gestation period–Amount of time a given company will remain in any one stage is 12 to 18 months.

Attrition rate–The probability of company failing during a given stage of development. Thirty % fail between Stage 1 and Stage 2 and 62% fail between Stage 1 and Stage 4.

Stage 2

Product development–Company still immature, focus is on refinement of prototype, development of market plan, identification of subcontractors, increased access to capital, still undercapitalized.

Gestation period–12 months.

Attrition rate–21.5% fail between Stage 2 and Stage 3 and 41.5% fail between Stage 2 and Stage 4.

Stage 3

Market development–Company is substantially more developed, focus is on production, market development/market penetration and distribution, greater access to capital, potentially over capitalized, potential high growth/high risk stage.

Gestation period–12 months to 24 months.

Attrition rate–28% fail between Stage 3 and Stage 4.

Stage 4

Market maintenance–Focus is on maintenance or expansion of existing market share, minimized production costs, new production/market development, public offerings, relatively stable and potentially less dynamic.

Gestation period–not specified.

Attrition rate–10% fail in Stage 4 in any given year.

Column 2 Number of companies

Represents total number of establishments in a given stage presumed to exist in Minnesota. Number of companies is a function of the industry birth rate, gestation periods and attrition rates. The initial total number given corresponds closely with federal estimates for Minnesota.

Column 3 Company request rate

Represents the percent of all companies within a given stage that are anticipated to call the Center seeking some type of assistance. Request rates are assumed to be a function of direct contact with companies through the Center's surveying activities, press releases and other media exposure.

Contacts are also generated through developed reputation and referral. It is assumed that a company's likelihood of calling the Center decreases with its age and stability.

Column 4 Number of calls

Represents the number of companies calling the Center annually. The number of calls is arrived at by multiplying the company request rate (column 3) by the number of companies within each stage (column 2).

Column 5 Most Critical Needs

Represents specific areas of assistance which are assumed to be most crucial to the short- and long-term success of individual companies. The services listed have been grouped by stage of development and correspond to empirical data from several sources including 1) a sample of 300 calls to the Office of Software Technology Development from firms seeking assistance in 1985/86; 2) a sample of 520 newly formed Minnesota companies participating in a survey on factors influencing their formation and development in 1984/85; 3) a sample of 50 Minnesota firms that failed in 1985 and participated in a survey on reasons for failure; and 4) data published by Dun and Bradstreet on business failures for the years 1981, 1982 and 1983.

Definitions of assistance codes used in column 5 are as follows:

- C - Capital formation, direct financing and financing referral
- BP - Business Plan development via referral and direct assistance
- L - Legal assistance referral
- A - Accounting assistance referral
- SL - Skilled Labor via direct training and referral
- MA - Market Analysis via research support and publication
- LMI - Labor Market Information via research support and referral
- EA - Equipment Access via referral and contract
- M - Marketing assistance via referral and Marketing assistance
- QA - Quality Assurance via standards development and referral
- D - Distribution via referral and publication
- AP - Application seminars and conferences

Column 6 Needs Assessment factor ID rate

Represents the percent of all companies seeking assistance whose needs correspond to services available through the Center. The comparatively high rate of 80% reflects both the Center's ability to identify individual company needs and the broad scope of services to be provided by the Center. Needs assessments will be routinely conducted by the Center for individual companies seeking assistance. Examples of company needs that will not be addressed include provisions for motivation, disaster, fraud and restricted trade.

Column 7 Total referral

Represents the total number of companies that have received assistance from the Center, either in-house or through referral using the Center's data base of software industry support services.

Total referrals are arrived at by multiplying the needs assessment factor id rate (column 6) and the number of calls (column 4).

Column 8
Effectiveness rate

Represents the likelihood that in-house or outside contracted services will be of sufficient quality to effectively address the particular need(s) identified. It is recognized that some service needs can be more effectively addressed than others. For example, accounting services generally reflect a more straightforward problem than the development of a marketing strategy. Outside contractors who provide services will be monitored on an on-going basis for quality assurance and continued referral. For this reason, it is assumed that effectiveness rates will be reasonably high for all services. Finally, it is assumed that effectiveness rates will rise as the industry matures and market information becomes more readily available and service providers become more experienced.

Column 9
Implementation rate

Represents the likelihood that a given service, provided in-house or by an outside contractor, will be adopted and implemented by the company. Occasionally a company will choose to ignore the advice it has received or may be unable to fully implement the recommendations because of resource constraints. It is assumed that older, more established firms will be in a better position to articulate their needs, have more specific/structured needs, pay for higher quality services and have more resources for implementation. Effectiveness rates and implementation rates are, therefore, assumed to increase with each stage of a firm's development. Because virtually no services will be provided without cost and because quality standards will be maintained, it is assumed that implementation rates will be reasonably high (greater than 60%).

Column 10
Companies assisted

Represents the number of companies that receive and implement effective services identified and provided by the Center or through outside contractors through Center referral.

The "companies assisted" ranking is arrived at by multiplying total referrals (column 7) by the effectiveness rate (column 8), and multiplying that solution by the implementation rate (column 9).

Column 11
High reliance rate

Represents the likelihood that any given company's survival within a particular stage of development, will have critically depended upon access to services provided directly or indirectly through the Center. High reliance rates are based on Minnesota and U.S. establishment death rates for software and data processing services, as reported by the Small Business Administration's USELM database. Death rates represent the percent of firms in any given stage that will fail by the time they reach Stage 4.

Using death rates as a surrogate for high reliance rates assumes that firms with a high probability of failing will critically depend on the Center's services and that a firm's likelihood of seeking assistance from the Center is equal to the proportion of firms expected to fail within each stage of development.

Column 12
Marginal firm impact rate

Represents the likelihood that provision of services through the Center will save a marginal firm from failure. Marginal impact rates are based on the same sources cited in column 5. The provision of a marginal

impact rate reflects an understanding that the provision of services may still be insufficient to save a company because of such factors as bad timing, foreign competition, depressed markets, lack of motivation, etc.

Empirical evidence indicates that on average, the critical factors identified in column 5 will collectively account for more than 80% of all reasons why business fail. Marginal company impact rates of 10% to 65% are, therefore, conservative. These conservative rates have been adopted to reflect greater volatility in the software industry.

Column 13 Marginal companies saved

Represents the number of companies saved that would not otherwise have survived without Center assistance.

Marginal companies saved is arrived at by multiplying the number of companies assisted (column 10) by the high reliance rate (column 11) and the marginal impact rate (column 12).

Under the structure of this model, it is assumed that once a marginal company within a given stage of development is saved, it moves into the next stage of development but is not included thereafter as a "marginal company." By doing this, no company is "saved" by the Center more than once. This adjustment is made by reducing the high reliance rate (column 11) with each iteration of the model.

Column 14 Average number of employees

Represents the average number of employees per company in a given stage of development. The average number of employees is based on the Small Business Administration's USELM database, using average number of employees per establishment by size class for newly created companies and average change in employment by establishment size class for companies that have expanded for various paired-year intervals of time.

Column 15 Long-term number of jobs retained

Represents the total number of jobs accounted for by marginal companies saved in column 14.

Long-term jobs retained is arrived at by multiplying the marginal companies saved (column 13) by the average number of employees (column 14) and an adjusted death rate (column 11), which reduces an assisted company's likelihood of failing by 50%.

The adjusted failure rate is based on the assumption that establishments which have used the Center in the past will continue to use the Center in the future. Consequently, continued access to the Center's services is expected to reduce a company's likelihood of failure by 50%.

Columns 16-23 Growth trajectory

Represents total new employment resulting from marginal companies saved (column 13). Growth trajectories are based on observed patterns of average annual employment growth as reported by the Small Business Administrations USELM database. Firms that have been saved expand according to their stage of development. Total employment is the product of the number of firms saved between 1987 and 1995 and the expected employment growth of those firms during that period. Growth trajectories are adjusted to allow for possible company failure by multiplying average annual employment growth by adjusted attrition rates.

Software Industry Impact Model (SIIM)

Initial Assumptions

A. Stage of Company Development:

Stage	Gestation Period (Years)	Attrition Rate
1	1.5	30.0%
2	1.0	21.4%
3	2.0	27.3%
4	—	10.0%

B. Starting number of total establishments (est.) 590
C. Initial birth rate 27.5%
D. Assumed annual births through 1992 162
E. Assumed annual births after 1992 132

1987 Scenario

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Stage of Development	Number of Companies	Company Request Rate	Number of Calls	Most Critical Need(s)	Needs Assessment Factor id Rate	Total Referrals	Effectiveness Rate	Implementation Rate	Companies Assisted	High Reliance Rate	Marginal Impa Rate
1	200	75.0%	150	C,BP,L,A SL,MA,LMI,EA	80.0%	120	70.0%	65.0%	55	63.0%	65.0%
2	93	50.0%	47	C,N,BP,L,A,QA SL,MA,LMI,EA	80.0%	37	70.0%	70.0%	18	43.0%	55.0%
3	147	40.0%	59	M,BP,O SL,MA,LMI	80.0%	47	65.0%	80.0%	24	27.3%	50.0%
4	150	20.0%	30	AP,SL,MA,LMI	80.0%	24	80.0%	85.0%	16	10.0%	15.0%

Birth rate 27.5%

1988 Scenario

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Stage of Development	Number of Companies	Company Request Rate	Number of Calls	Most Critical Need(s)	Needs Assessment Factor id Rate	Total Referrals	Effectiveness Rate	Implementation Rate	Companies Assisted	High Reliance Rate	Marginal Impa Rate
1	209	75.0%	156	C,BP,L,A SL,MA,LMI,EA	80.0%	125	70.0%	65.0%	57	63.0%	65.0%
2	116	50.0%	58	C,W,BP,L,A,QA SL,MA,LIM,EA	80.0%	46	70.0%	70.0%	23	34.7%	55.0%
3	151	40.0%	60	N,BP,D SL,MA,LIM	80.0%	48	65.0%	80.0%	25	26.5%	50.0%
4	192	20.0%	38	AP,SL,MA,LMI	80.0%	31	80.0%	85.0%	21	9.8%	15.0%

Birth rate 24.3%

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Definitions of Assistance Co (as used in Co

- C - Capital form financing an referral
- BP - Business Pl development and direct as
- L - Legal assist
- A - Accounting referral

Quality Assurance via standards development and referral
Distribution via referral and publication
Application seminars and conferences

(13)	(14)							(21)	(22)	(23)	(24)
Marginal Firms Saved	Average Number of Employees	To Jo						Jobs Created in 1993	Jobs Created in 1994	Jobs Created in 1995	1995 Total Employment Impact from 1987
22	6 per est.*	10						85 25	85 29	85 33	620
4	9 per est.*	3						16 29	16 33	16 37	142
3	15 per est.*	4						13 40	13 44	13 48	141
			21	24	28	32	36				
0	24 per est.*	6 per est.*	1	1	1	1	1	1	1	1	13
			28	32	36	40	44	48	52	56	
		192	55	57	65	88	115	115	115	115	915

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
Marginal Firms Saved	Average Number of Employees	Total Long-Run Job Retention	Jobs Created in 1989	Jobs Created in 1990	Jobs Created in 1991	Jobs Created in 1992	Jobs Created in 1993	Jobs Created in 1994	Jobs Created in 1995	1995 Total Employment Impact from 1988
23	6 per est.*	116 per est.*	40	42	42	60	89	89	89	565
			10	12	14	17	21	25	29	
4	9 per est.*	34 per est.*	7	7	11	16	16	16	16	125
			12	14	17	21	25	29	33	
3	15 per est.*	47 per est.*	9	9	13	13	13	13	13	128
			21	24	28	32	36	40	44	
0	24 per est.*	7 per est.*	1	1	1	1	1	1	1	15
			28	32	36	40	44	48	52	
		204	57	59	67	91	119	119	119	833

est. = establishment