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Trends and Opportunities in Fourth-Generation Languages

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TRENDS AND OPPORTUNITIES
IN
FOURTH-GENERATION LANGUAGES



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TRENDS AND OPPORTUNITIES IN FOURTH-GENERATION LANGUAGES

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TRENDS AND OPPORTUNITIES IN FOURTH-GENERATION LANGUAGES

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I INTRODUCTION

A. REASONS FOR PREPARING THIS REPORT

- The purpose of this report is to examine market trends and developments in fourth-generation languages and to provide INPUT's forecast for these products and services.
- Fourth-generation languages (FGLs) appear to be having a significant impact on large Information Systems (IS) organizations and on many end-user departments.
- The emergence of these fourth-generation languages represents a potentially large market that INPUT believes its clients will want to understand and develop strategies for.
- One of the major factors in the growth of personal computers has been the acceptance of fourth-generation languages in large organizations, which underpins the need for clients to understand and plan for these developments.

B. SCOPE AND METHODOLOGY

- This report is part of INPUT's Market Analysis and Planning Service for the Information Services Industry (MAPS) program and addresses the following topics:
 - Definition and characteristics of FGLs (Chapter III).
 - The current FGL environment and products (Chapter IV).
 - Market trends and forecasts (Chapter V).
 - Specific marketing strategy recommendations (Chapter VI).
- The scope of the report will include an examination and analysis of current FGL product offerings as well as emerging significant new developments in the primary hardware categories: mainframes, minicomputers, and micro-computers.
- The research included eight on-site and telephone interviews, over 50 interviews conducted for INPUT's report, The Opportunities of Fourth-Generation Languages, September 1983, and 250 interviews conducted earlier this year as part of INPUT's Information Services Program research.
- These interviews were used to gather primary data, opinions, and plans for the purposes of performing the analysis for this study. In addition, secondary research was conducted using INPUT's Library.
- In addition to the interview program, extensive secondary research was conducted to explore new product development, overall acceptance of these tools, and the relationship between the end user and the Information Center.

C. OTHER RELATED INPUT REPORTS

- Readers are advised to refer to the following earlier INPUT reports:
 - The Opportunities of Fourth-Generation Languages, September 1983.
 - This report examines opportunities for Information Systems organizations to take advantage of these emerging technologies.
 - Organizing the Information Center, August 1983.
 - Since the Information Center and FGLs are so tightly coupled, this report looks at internal strategies and methods for coordinating service and products.
- In addition, INPUT has a series of reports in the 1984 MAPS program that are related and recommended: They are:
 - Micro-Mainframe: Personal Computer Market Opportunities.
 - Market Opportunities for Applications Transfer to Personal Computers.
 - Pricing and Distribution of Personal Computer Software.

II EXECUTIVE SUMMARY

- This Executive Summary is designed in a presentation format in order to:
 - Help the reader quickly review key research findings.
 - Provide a ready-to-go executive presentation, complete with a script, to facilitate group communication.
- The key points of this entire report are summarized in Exhibit II-1 through II-6. On the left-hand page facing each Exhibit is a script explaining the Exhibit's contents.
- Those presenting this Executive Summary are urged to read the entire report in order to add content and to tailor their comments to their specific audience.

A. TRENDS AND OPPORTUNITIES IN FOURTH-GENERATION LANGUAGES

- INPUT believes that fourth-generation languages (FGLs) are gaining acceptance very rapidly with nonprogrammers and programmers. There is continuing market potential for mainframe- and microcomputer-based products. However, there are a number of issues covered in this report that vendors need to analyze and develop strategies for.

- INPUT's research report:
 - Defines FGLs, their uses and economics, current environment, and impacts.

 - Updates the status of FGLs, the current and projected products, and the major strategic and tactical issues.

 - Examines the market trends and the user expectations and provides market forecasts.

 - Summarizes the market and provides recommendations for vendor strategies for fourth-generation language markets.

- The remainder of this report will provide highlights from INPUT's report.

TRENDS AND OPPORTUNITIES IN FOURTH-GENERATION LANGUAGES

- **Impact of FGLs**
 - **Gaining Wider Acceptance and Support**
 - **Microcomputer Acceptance has Helped FGLs**
 - **Vendors Need Strategies to Address Issues**

- **Scope of the Research**
 - **FGL Environment**
 - **User and Vendor Issues and Status**
 - **Market Trends and Forecasts**
 - **Recommendations**

B. CHARACTERISTICS OF FOURTH-GENERATION LANGUAGES

- The characteristics of fourth-generation languages are:
 - They are nonprocedural and focus on results, not on the process of obtaining the result.
 - They use English-like syntax, allowing end users to develop their own applications.
 - They are nontechnical and allow users to specify or even make their own changes.
 - They are flexible, and can be learned quickly and used easily by non-programmers.
 - They reduce the time required to develop and to maintain applications.

CHARACTERISTICS OF FOURTH-GENERATION LANGUAGES

- **Focus on Results**
- **Use English-Like Syntax**
- **Non-Technical Orientation**
- **Highly Flexible**
 - **Easy to Learn**
 - **Easy to Change**
- **Makes Computer Resource Available to Many**

C. USES AND IMPACTS OF FOURTH-GENERATION LANGUAGES

- Most FGLs are being used for secondary analytical applications, not for production data processing applications. However, there is an emerging trend toward users developing their own "pseudo-production" applications for small production-oriented tasks.
- FGLs are gaining acceptance; in fact they are gaining acceptance in both programmer and nonprogrammer communities.
- The success of the corporate Information Center is largely due to FGLs and, of course, to personal computers.
- The benefits most often cited for FGLs are their ability to speed system implementation, their increased productivity, and their contribution to overall system quality through prototyping.
- In addition to users becoming computer literate, there will be other organizational impacts, including users maintaining their own programs and Information Systems becoming more valuable to the overall mission of the business.

USES AND IMPACTS OF FOURTH-GENERATION LANGUAGES

- **Mainline versus Secondary Applications**
- **FGLs Are Gaining Acceptance**
- **Success of the Information Center and FGLs**
- **Benefits of FGLs**
 - **Faster Implementation**
 - **Increased Productivity**
 - **Increased System Quality**
- **Impacts on the Organization**

D. FGLs: STATUS REPORT

- One of the key values of FGLs is their capability to do prototyping. This process receives praise from users and IS, and makes the application more readily acceptable to both.
- Resistance to FGLs for production systems is declining due largely to the appeal of having end users run and maintain these systems on a decentralized basis.
- The most frequently mentioned needs, expressed by IS and end users, are improved human factors and better micro-to-mainframe links.
- One of the negative pressures is that the Information Centers are already overloaded. This is also an opportunity in that in this respect ICs are open to vendors that could provide the training support services.
- INPUT believes that the product evolution of FGLs will position FGL vendors to participate in the huge market for the office of the future. FGLs will be used in application development and as general-purpose tools.

FGLs: STATUS REPORT

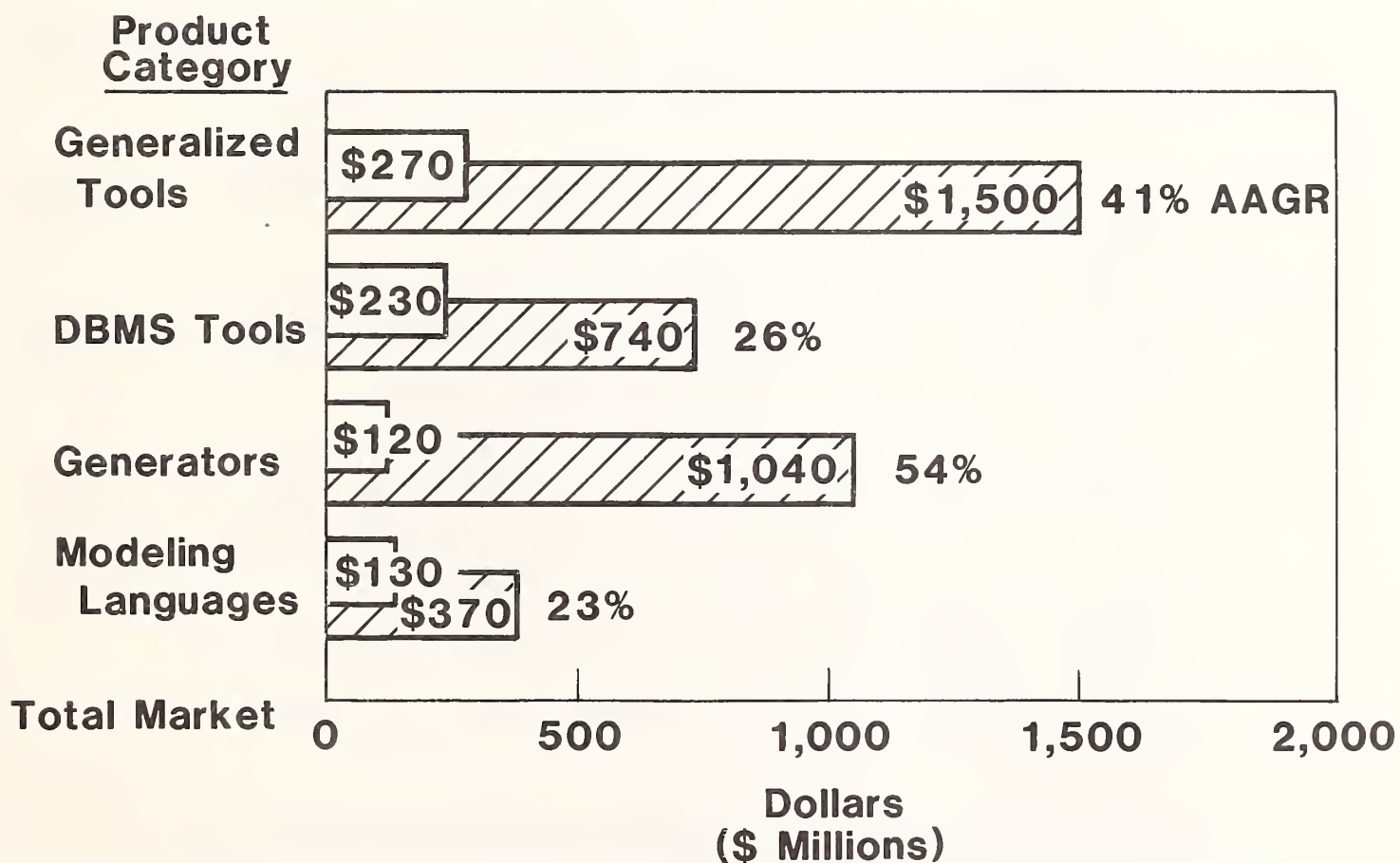
- **Prototyping Has Dual Benefits**
- **Acceptance of FGLs Is Increasing**
- **Most Frequently Mentioned Needs**
 - **Improved Human Factors**
 - **Micro-to-Mainframe Links**
- **The Information Center**
 - **Overloading Creates Pressures**
 - **It Also Creates Opportunity for FGL Vendors**
- **Future Opportunity: Office Automation**

E. FGL MARKET TRENDS AND FORECASTS

- Most mainframe FGL vendors have developed or are developing micro-based versions of their products. These functionality-rich products should enjoy success in the market.
- FGLs will be one of the fastest growing software markets over the next five years. It would be even more dramatic if INPUT considered the application-specific programs developed by systems integrators using these fourth-generation tools.
- Growth is expected to slow toward the end of the forecast period because of the emergence of "expert systems" products.
- While modeling languages will grow most slowly, the tools based on proprietary DBMSs also lag, due to a combination of users' perceptions of being hooked to a new DBMS technology and the high price of the DBMS versus a micro-based generalized tool that adds costs by increments.
- The fastest growing segment will be Generalized Tools, due to their applicability to a wider range of potential applications.

FGL MARKET TRENDS AND FORECASTS

- Vendors Are Migrating Their Products to Micros
- Invisible FGL Market: Application-Specific Software



- 1984 Total \$750 Million
- ▨ 1989 Total \$3,650 Million

F. CONCLUSIONS AND RECOMMENDATIONS

- The proliferation of personal computers as management workstations will fuel the desire for more FGL products.
- INPUT expects to see the product differentiation between micro and mainframe products diminishing.
- Micro-to-mainframe links will support today's needs and are needed for office automation. Improved human factors are needed to compete with microcomputer software.
- Long-range strategies are needed to sell production uses to IS management and to solidify relationships with IS.
- INPUT feels vendors should take advantage of the opportunities in training and support.
- Vendors should develop products or services to address the pending problems of data management, data control, and administration.
- The Development Center is evolving as a concept for application development. If successful the Development Center will be the group developing production applications. INPUT urges vendors to plan for this potential market.

CONCLUSIONS AND RECOMMENDATIONS

- **Many Factors Fuel FGL Market**
- **Market Requires Robust Micro-to-Mainframe Links**
- **Human Factors Will Play an Important Role**
- **Vendors Must Sell Information Systems Organizations**
- **Opportunities Exist in Support and Training**
- **Address Products and Services to Pending Problems of Information Systems**
- **Opportunities Exist in the Evolution of the Development Center**

III FOURTH-GENERATION LANGUAGES: DEFINITION AND ENVIRONMENT

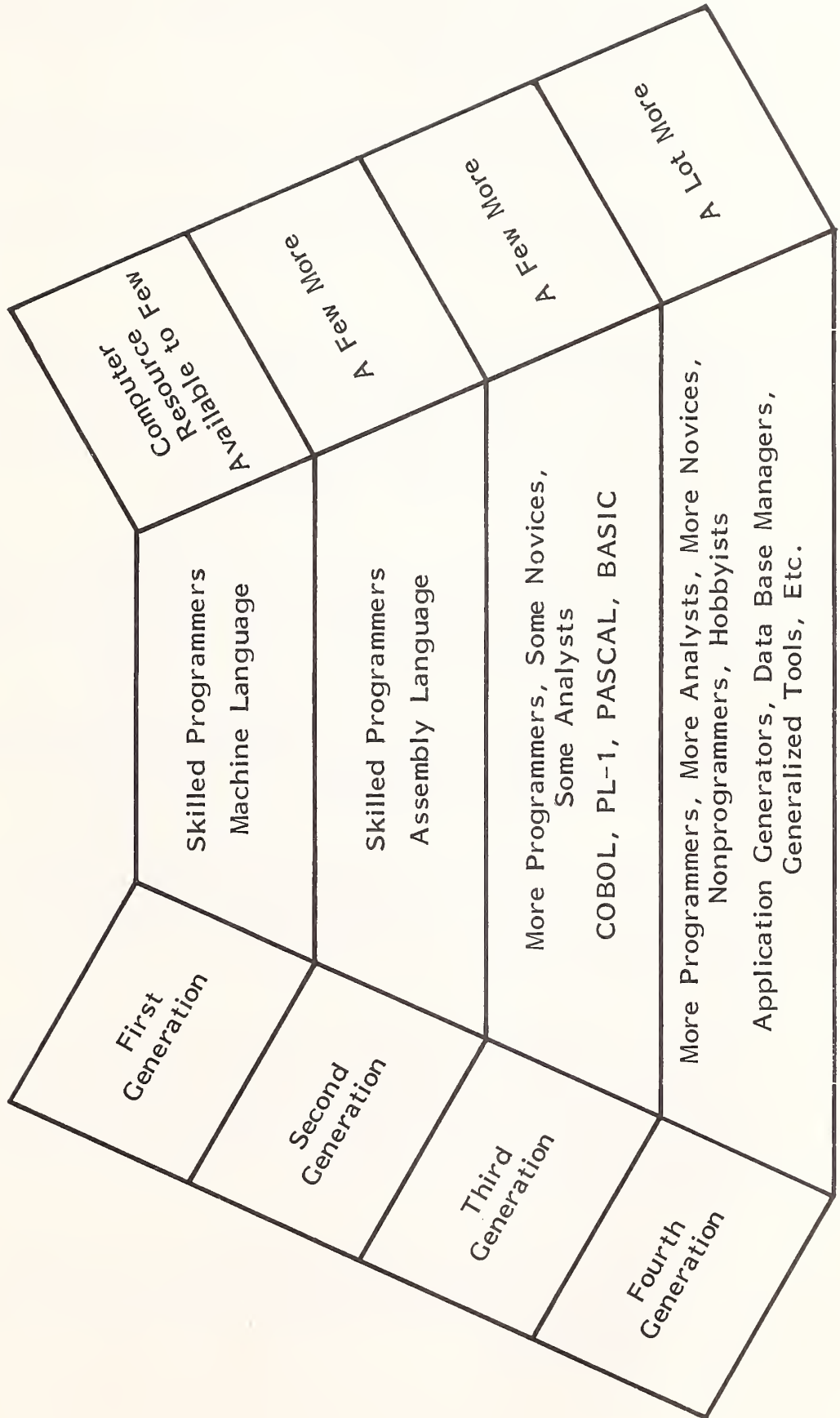
A. DEFINITIONS AND CHARACTERISTICS: A MODEL

- A fourth-generation language has the following general characteristics:
 - It is nonprocedural, i.e., the language focuses on the result rather than the process of obtaining the result.
 - It uses English-like syntax and interfaces, allowing end users to actually develop their own applications.
 - It is nontechnical and provides facilities for users to specify or even make their own changes.
 - It is flexible, has a fast initial learning period, and allows for frequent changes without creating difficult maintenance problems.
 - It has built-in functions such as a DBMS, statistics, text editor, and graphics.
 - It reduces the time required to develop applications and, through end-user involvement, can improve the quality of the result.

- COBOL is a leading example of a third-generation language. Exhibit III-1 demonstrates the evolution of fourth-generation languages. Exhibit III-1 also demonstrates how these fourth-generation languages have dramatically increased end-user involvement in corporate information processing.
- Although suited to the hardware available, first-generation languages were very restrictive and only usable by a few skilled programmers. Second-generation products were some improvement but it wasn't until the third generation that the power of the computer wasn't severely limited. The excitement of fourth-generation languages is that they really unlocked the power of the computer to a wide audience.
- Fourth-generation languages are pervasive and many products are viewed by users and promoted by vendors as fourth-generation languages. In addition to the definition provided, the fact is that these tools are making the computer resources available to many more users.
- It appears that fourth-generation languages are, by and large, discrete products. INPUT believes vendors should examine these products to develop product lines containing several discrete products or even fourth-generation environments consisting of a set of tools that fully shelter the user from the complexities of the operating system.
- While many fourth-generation languages are designed for programmers, there are many that are targeted for the end user. INPUT's research shows that in 1984 over 60% of the users of these products are nonprogrammers and that this will grow to 75% by 1985.
- INPUT has identified at least four major types of fourth-generation languages:
 - Generalized tools, including self-contained proprietary DBMSs.
 - Tools linked to a separate proprietary DBMS.

EXHIBIT III-1

CHARACTERISTICS OF THE LANGUAGE GENERATIONS



- Application and program generators that generate higher level language object code.
 - Modeling languages that have "programming" facilities.
 - Exhibit III-2 gives examples of leading products in each of these categories.
- INPUT's definition allows for including some micro products like Lotus and VisiOn that are questionably called fourth-generation languages but are of such high interest and referred to so frequently as FGLs that the definition has been loosened to conform to industry usage.
 - Exhibit III-2 displays some existing product categories. INPUT believes that new products will emerge that are hybrids of these categories or fourth-generation environments.
 - Exhibit III-3 shows another view of fourth-generation languages: who uses them and for what type of activity.
 - Exhibit III-3 further demonstrates the degree to which fourth-generation languages are making computing resources available to more and more people in the business world.
 - Further consideration of Exhibit III-2 and III-3 shows that vendors need to plan for multiple hardware products to support, since users will want their applications to migrate to higher capacity machines as they develop larger and more complex systems.
- Users also want product integration or the ability to link the same product to different hardware products and to move back and forth between them.

EXHIBIT III-2

TYPICAL FOURTH-GENERATION PRODUCTS

MAJOR TYPES	MICRO-BASED	MINI-BASED	MAINFRAME-BASED
Generalized Tools	Framework, Symphony, Focus PC	GRS	Culprit, Easytrieve
Tools Linked to DBMSs	dBase III, RBase, Salvo	MDBS III	RAMIS II, Focus, Inquire, Ideal, Natural
Application Generators	Quickcode, Next Step, Magix	Appgen, RDM, Black	Mark V, Mantis, UFO
Modeling Languages	Micro W	Express	IFPS, Express

EXHIBIT III-3

TYPICAL USER ACTIVITY

TYPICAL APPLICATIONS					
USER TYPES	REPORTING	QUERY	ANALYTICAL	PRODUCTION	TRANSACTIONAL
Programmers	Generalized Tools			Application Generators DBMS Tools	
			Modeling		
Technical Staff			Modeling		
		Generalized Tools			
	DBMS Tools		Application Generators		
Managers			Modeling		
		Generalized Tools		DBMS Tools	
			Application Generators		
Clerical	Generalized Tools				
	DBMS Tools				

B. FOURTH-GENERATION LANGUAGES: USES AND ECONOMICS

- Most current fourth-generation language products are typically being used for secondary, nonmainline data processing applications.
 - "Mainline" uses are those that introduce or modify a production system that is usually both large and transaction oriented.
 - Secondary applications are generally using already "processed" data, at least in the minds of IS management. These are applications like modeling and decision support systems.
 - Other secondary applications that are large but less visible than the normal analytical applications are the development, by users, of their own "pseudo" production systems. The management of one very large Information Center estimates that 10% of their resources are being used to support end-user-programmed-and-operated production systems.
- Most of these applications are developed by end users to address the invisible backlog that has built up due to the users' frustration with corporate IS response. However, fourth-generation languages are contributing to a shift in these user attitudes. More important, users are developing computer literacy and awareness.
 - The shift in user attitude is one of independence and feeling of control, since they know they can solve their own problem rather than worry about the backlog.
- Both vendors and users surveyed agreed that the application backlog still remains about the same, but that the mix has shifted to more new applications, with users taking on more small tasks and more reporting and query applications.

- The acceptance of fourth-generation languages appears to be gaining. Exhibit III-4 shows vendor and user responses to issues or objections they are encountering. The responses reflect whether the user or vendor has a high, medium, or low concern for a particular issue.
- The highest concern expressed by vendors was competitive products and features. The other issues, common objections appearing in the literature, were not even moderate concerns.
- Users attribute much of the acceptance shown in Exhibit III-4 to the establishment of Information Centers and planned support and training.
 - Training is a major concern.
 - More users and more IS and IC departments are interested in getting vendors to step forward to take over training so they can use the resources of the Information Center for support and internal consulting.
- The use of fourth-generation languages has been strongest in analytical or ad hoc applications; this satisfies a current, often short-term, need. With growing acceptance, INPUT believes that vendors will find more users growing into "pseudo" production applications, resulting in further increases of the demand for these tools.
 - However, some of this growth may be delayed by the lack of hardware resources, since large organizations plan capacity 12 to 18 months in advance and IS expressed concern about being able to adequately forecast and justify the capacity needed to meet the insatiable demand.

EXHIBIT III-4

STATUS OF COMMON ISSUES

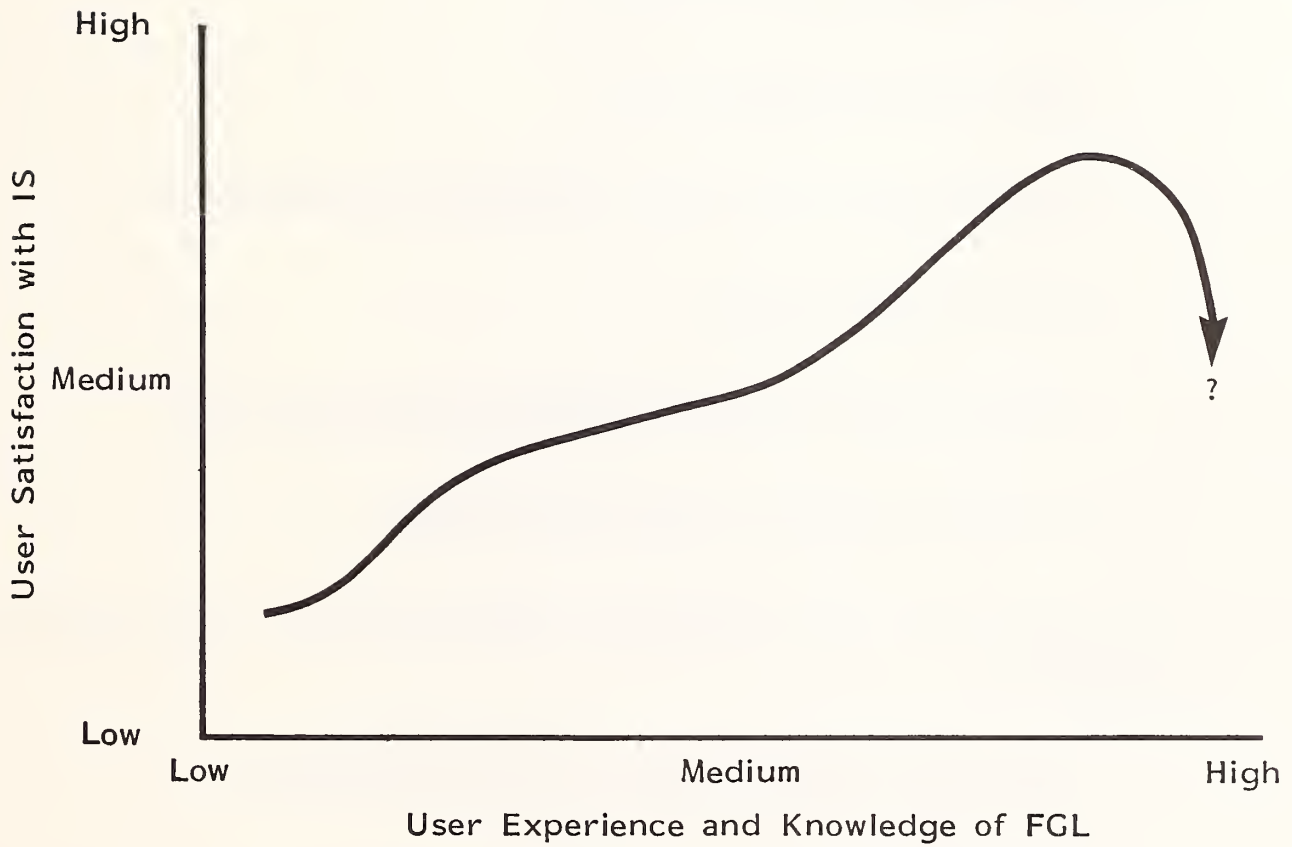
	CONCERN BY:	
	VENDORS	USERS
Increased Hardware Resources	Medium	Low
Increased Staff and Support Costs	Low	Medium
Programmer Opposition	Low	Low
Commitment to Traditional Methods	Low	Low
Lack of Structured Methodology	Low	Medium
Loss of Control of Data, Systems, etc.	Low	Low
Competitors' Features	High	N/A

C. IMPACTS OF FOURTH-GENERATION LANGUAGES

- Fourth-generation languages are establishing a strong presence and high utility to the IS and IC organizations. These organizations report that their end users are very satisfied and are demanding more products, more services, and more training.
- Fourth-generation languages have been a major factor in the success of the Information Center. INPUT believes a similar opportunity exists in the emerging Development Center, which is intended to do for programmers what the IC has done for end users.
- Within the organization the strength of fourth-generation languages depends heavily on how they are used by end users or by the Information Systems department.
 - When fourth-generation languages are used by the end users, the overall result is positive but there is little perceived impact on the organization.
 - The exception occurs as these users begin to really understand how to use these tools and extol their virtues to senior management. The more management understands how end users are profiting from these tools, the more management will be encouraged and the easier it will be to fund projects and services.
 - There is a danger of conflict in that the users may then tell Information Systems how to design and implement corporate systems, as Exhibit III-5 illustrates.

EXHIBIT III-5

FGL USER SATISFACTION WITH INFORMATION SYSTEMS
(WHERE INFORMATION SYSTEMS DO NOT USE FGLs)



- The impact of fourth-generation languages can be much greater when they are used by Information Systems for mainline or production systems.
- In the early stages of experience with an FGL, users' satisfaction with IS increases due to more appreciation for data processing, etc. However, as users become highly skilled the satisfaction may go down due to feelings that they know how to solve a problem better and faster.
- Information Systems and Information Center departments expect to enjoy the benefits of fourth-generation languages:
 - Faster systems implementation.
 - Increased productivity in both development and maintenance.
 - Increased system quality.
 - Allow IS to shift costs to the department incurring the cost.
 - Reduction in the visible and invisible backlog.
- Fourth-generation languages will have a significant impact on personnel, both IS and non-IS.
 - User skills in computer tools will increase dramatically.
 - IS skills will change in response to fourth-generation languages, since FGLs will obsolete traditional languages.
- There will be organizational impacts to deal with as well.
 - For many applications, routine maintenance will be handled by user departments.

- Information Systems will expand their quality assurance activities to include user-developed systems as well as their own.

- Generally IS will improve as a corporate resource, becoming more consultive and better advisors on how to benefit from the corporate information resource. This type of a role will also be more valuable to contributing to the success of the corporation.

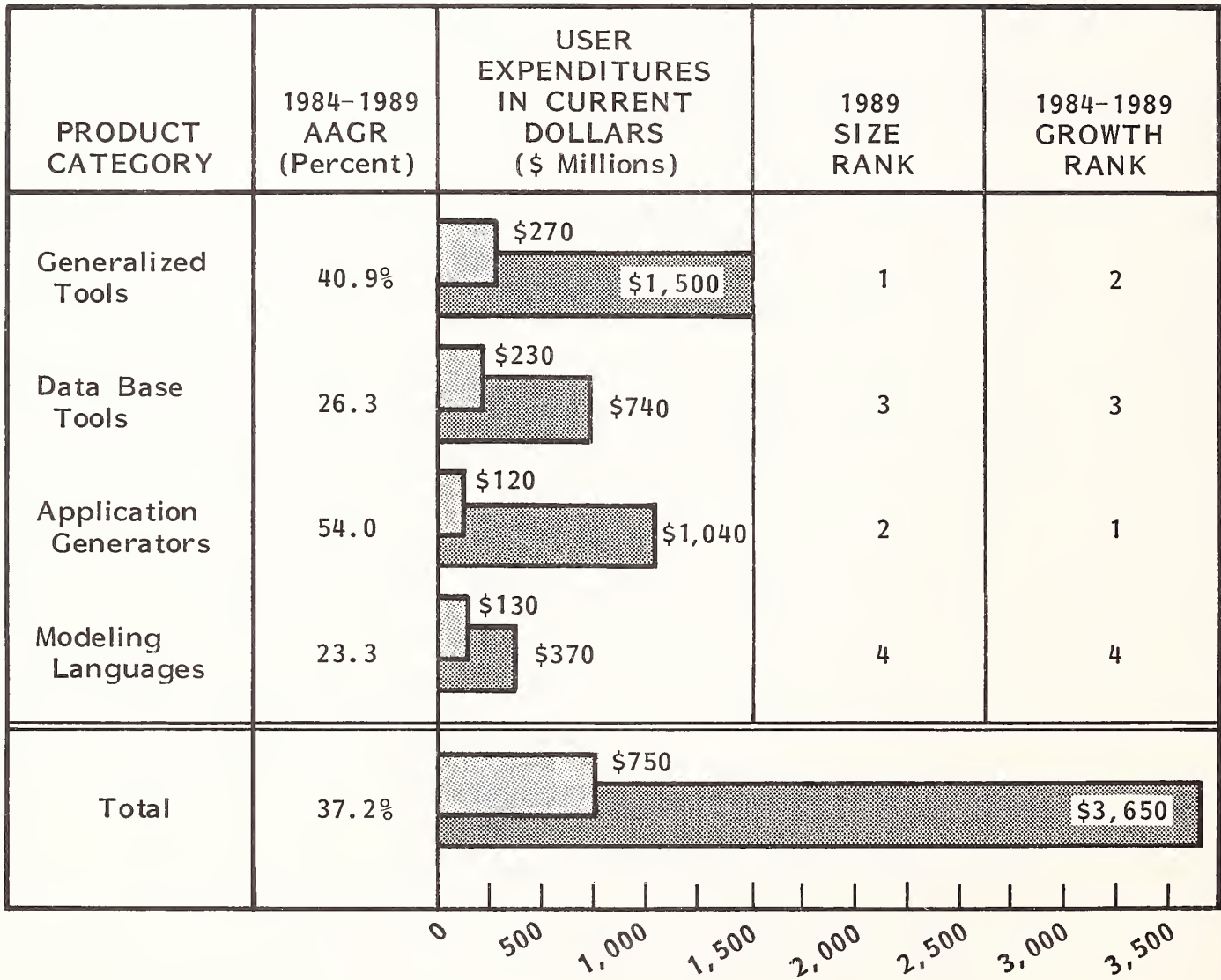
IV UPDATE ON FOURTH-GENERATION LANGUAGES

A. CURRENT USER ENVIRONMENTS

- One of the most important issues for vendors to understand is the degree to which Information Systems management is using FGLs and what applications they are addressing.
- One way to view the current use of fourth-generation languages is displayed in Exhibit IV-1. In summary, what appears to be occurring is:
 - Fourth-generation languages are less likely to be used when the systems are large or when they are transaction oriented.
 - Although INPUT does not agree that fourth-generation languages are limited in this way, it is important in planning sales programs to realize this is the way IS management is thinking.
 - INPUT believes that the shift to higher level languages will be pervasive and that FGLs will be used for large applications and transaction-oriented applications as well. Regardless of what IS is thinking, end users will lead the way.
 - In the case of these larger systems, the end user is much more likely to get IS involved. In either case, vendors will need to have sales programs directed at IS management.

EXHIBIT IV-1

FOURTH-GENERATION LANGUAGES'
MAJOR PRODUCT CATEGORIES



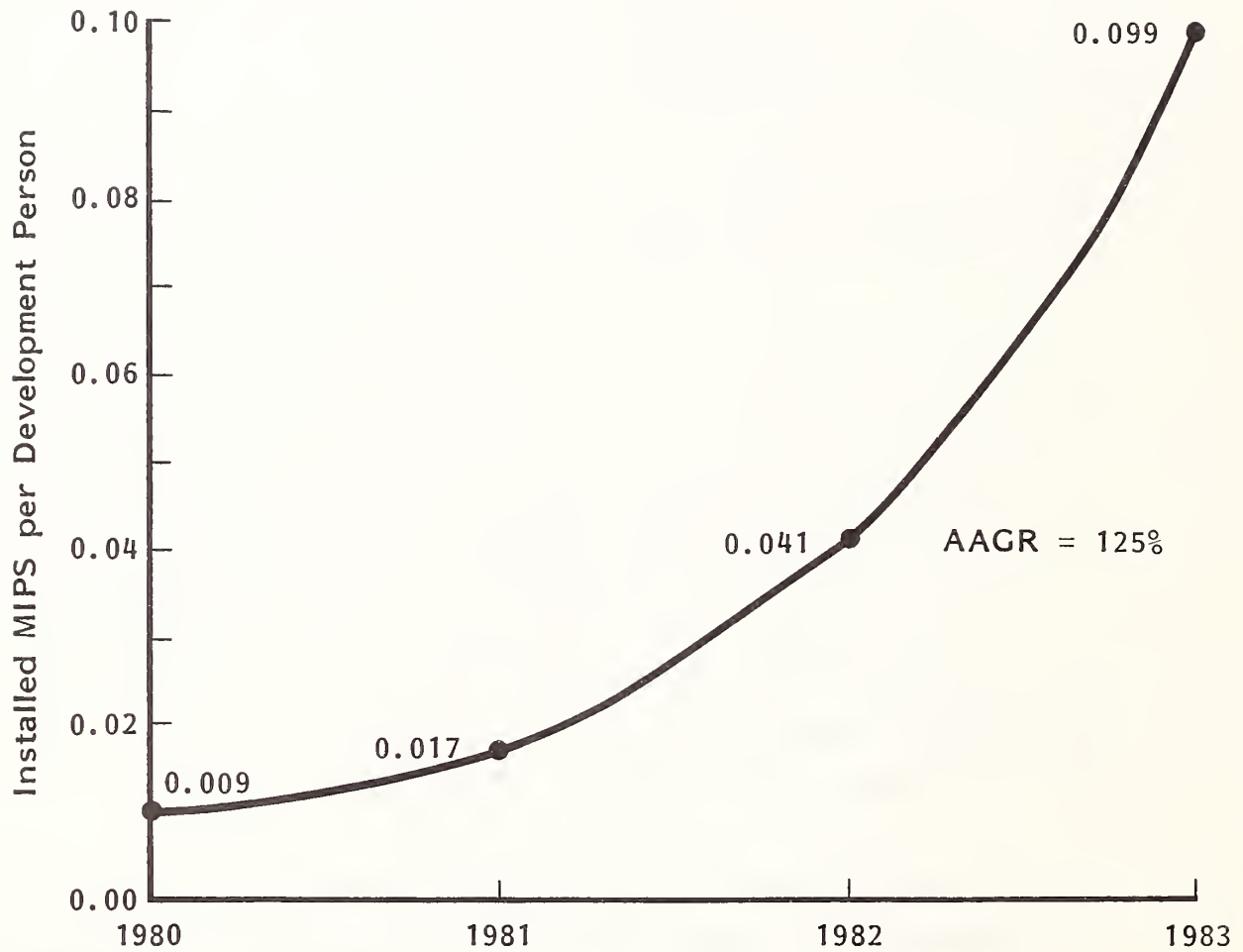
- As fourth-generation languages have found their way into user environments, they have evolved around four primary developments or issues, usually stemming from the involvement of the Information Systems organization or the Information Center in large organizations.
 - Prototyping with FGLs. Users feel that the value of prototyping is very high and that this allows them to improve their ability to respond to changing end-user requirements.
 - FGLs for production systems. Although there has been resistance to FGLs for production systems, resistance appears to be weakening as production and pseudo-production systems evolve.
 - One of the biggest benefits cited by IS is that with a FGL production system it becomes feasible for the user to run the system and to maintain it on a decentralized basis.
 - IS also cites the ability of FGLs to satisfy changing user needs and to make users feel that the system is their own. Apparently IS management is thinking these systems will remain small since they did not express concern over control of the systems or the data.
 - Micro-to-Mainframe FGL Links. Users rate the current products as unsatisfactory, regardless of the initiative taken by vendors in this area. While it is not totally clear what the relationships between micro and mainframe links should be, the following points seemed to emerge:
 - A complete or comprehensive subset of the FGL has to be on the micro so that uploading and downloading are transparent to the user.

- The linking is needed on an application basis, with the micro "using" the mainframe as a data base "backend" machine. The implication here is that users don't want to transfer files, they want to access data.
- System Quality and FGLs. IS departments are becoming increasingly concerned about quality. They see quality as the foundation for productivity, for user satisfaction, and for controlling the life cycle costs of application software.
 - IS acknowledgement of this is a plus for fourth-generation languages since the real key to robust growth is FGLs' use in production systems, both for capturing more applications and for significantly enhancing users' ability to access data for Decision Support Systems.
 - The most important attributes of quality systems can be directly addressed by FGLs. What IS sees is the ability of FGLs to improve system robustness, system flexibility, and data integrity.
 - In contrast IS is concerned that users will get carried away with these new-found tools and fail to effectively manage data and information.
 - Another concern is users adding more features and functions and actually increasing development and operating costs.
- There are also factors really fueling the acceptance and growth of FGLs in the user community, especially:
 - FGLs are the biggest single reason for the success of the Information Center, a real success story for many IS departments.

- The explosive growth of microcomputers and FGLs or FGL-like systems.
- Even with the high acceptance of FGLs, users did cite the need for improved performance by generating higher level code or other means.
- Users also felt the need for continuing improvements in human factors was very important. For example, they felt fourth-generation languages must be built on DBMS technology to hide the complexity of the data and to present the data the way the user thinks.
- FGL growth is expected to remain strong and to increase at the rate resources are made available, which may be the constraining factor.
 - FGL support and training is expected to lag behind the growth in users.
 - Within organizations with Information Centers the expectation is that the growth of FGL use by nonprogrammer users will be 50% greater than the growth in use by programmers. However, use by programmers will increase dramatically (over 500%) over the next five years.
- Although the acceptance of FGLs is currently high, IS is aware that the FGL environment does require more hardware resources.
 - Exhibit IV-2 shows the need for substantially more horsepower for each development person after the installation of a fourth-generation language.
 - As fourth-generation languages are installed and really used by programmers, the hardware resource requirement increases an average of 125% per year.

EXHIBIT IV-2

INSTALLED MIPS PER DEVELOPMENT PERSON
AFTER FOURTH-GENERATION LANGUAGE INSTALLATION



- . Exhibit IV-2 shows this build-up; it also demonstrates that growth appears to further accelerate with user experience.
- In fairness to the fourth-generation languages, it should be noted that these economics are at a particular point in time and that they should become more favorable to FGLs as vendors plan to provide ongoing enhancements to improve performance.
- Also in favor of FGLs are falling hardware prices and rising personnel costs that translate into IS management having increased interest in improving labor productivity.
- It wasn't too long ago that assembly language was being touted over COBOL; now it is COBOL being touted over FGLs. The significance is that the importance of hardware efficiency is diminishing and is not a deterrent to fourth-generation language growth. In fact it is the impetus for continued success.

B. CURRENT VENDOR ENVIRONMENTS

- FGL vendors are very active in product development and promotion. The last year has seen more developments in FGL products than the previous five years combined. INPUT attributes this to several factors:
 - As stated in the previous section, user acceptance has been very high and most FGL vendors have had strong performances, allowing them to put more resources into Research and Development.
 - Competition within their own markets and the market opportunities resulting from the personal computer explosion have put pressure on FGL vendors to assure their participation in broader markets in the future.

- From the user point of view this activity has produced mixed results. For example, while many micro-to-mainframe links have been introduced, the users were, by and large, unimpressed. However, this does not mean vendors should be discouraged, since users are also relatively pleased in that they see competition and keen interest from vendors as signs that products meeting their expectations will emerge.
- Nearly all vendors cited the reduced cost of development as a key factor in promoting their products. This was corroborated by users in their evaluations of product advantages. Exhibit IV-3 shows the balance between the product advantages perceived by vendors and those perceived by end users.
- This type of analysis is important in deriving strategy since it points out that many vendors are missing the mark by not taking advantage of their products' perceived strengths.
- Another perceived advantage cited by users is use of the FGL as a tool for the Information Center. INPUT feels this is a real advantage for vendors and one they should aggressively promote.
- Vendors feel their highest development priority is to improve product performance, either by developing post processors that generate more efficient run time modules, or by generating higher level code that is similar to the application generator products.
 - Also, micro-to-mainframe links are high in the development priority scheme.
 - Exhibit IV-4 shows the users' requirements and the vendors' market perceptions and development plans.

EXHIBIT IV-3

FGL ADVANTAGES: PROMOTED AND PERCEIVED

ADVANTAGE	USER	VENDOR
Improved Development Capability	High	High
Prototyping	High	Medium
Reduced Cost		
In Development	High	Very High
In Production	Medium	Low
In Maintenance	High	Medium
Greater Productivity	Medium	Very High
Better End-User Participation	Medium	High
Micro-to-Mainframe Links	Low	High

EXHIBIT IV-4

PRODUCT REQUIREMENTS:
USER NEEDS AND VENDOR PLANS

REQUIREMENT	USER NEED	VENDOR PLANS (Year)
Performance; Generate Higher Code	Medium-High	1984-1985
Micro-to-Mainframe Application Linkage	High	1985
Transportability	Medium	1984-1985
Enhanced Data Structures	Low	1986
Enhanced I/O Support	Low	1986
Analytical Tools	Medium	1984-1985
Improved Human Factors	High	1985
Security	High	1984-1985

- Vendors and users alike were mixed on the need for analytical tools as part of the FGL. The ability to provide "connectivity" to other tools appears to be satisfactory.
- Only one vendor felt improved human factors was a very high priority item; users, on the other hand, ranked human factors as critical requirements.
 - This is important to understand because this response may stem from users' frustration with being unable to provide adequate training rather than from a real product shortfall.
 - The main issue in the users' minds is that the syntax offered by the personal computer software vendors is superior and that vendors should create products equal to or better than their fourth-generation language products.
 - Other issues such as documentation and user interfaces appear to be secondary. However, INPUT believes these issues will begin to surface as more new users are introduced to FGL products.
- On the training issue all mainframe FGL vendors consider training to be critical to success. In contrast, micro vendors don't consider training a high priority (other than training for their dealer and distributor organizations).
 - IS and end users consider training critical and nearly all IS and IC organizations reported that they provide training through internal classes, video instruction, computer-based courses, and vendor classes (both on-site and at the vendor's office). Although most users currently do their own training, they are interested in contracting this activity to qualified vendors.
- The training issue points out only one of the many contrasts between mainframe and micro software vendors. INPUT believes that from the users' point

of view, the lines between these vendor classes will blur and the huge current disparity in price and capability will also blur.

- The above is important because it will make the selling job more complex and will open questions about alternate forms of product distribution.
- Vendors that offer versions running on both micro and mainframe will benefit in all respects. Reduced training costs will be one more sales advantage.

C. STRATEGIC AND TACTICAL ISSUES

- One of the big tasks for vendors will be tracking technology as it changes at ever-increasing rates. Tracking changes will be important because it will affect product differentiation more than it has in the past. For example, the blurring of product lines referred to in Section B is probably favoring the mainframe vendor, especially after recent announcements of larger micro-computers.
 - For example the IBM PC AT, with three million bytes of main memory and full 16-bit data transfer, is a reasonable target machine for vendors to move full mainframe FGL implementations to.
 - In fact, one of the toughest product decisions for vendors may be choosing which new architecture makes sense. It may make sense to rethink whole product lines from a standpoint of distributing more to the micro.

- FGL vendors will also face the issue of where to keep the data. Already 40-to-160-megabyte disk systems are available on micros; developments like optical storage aren't far behind.
- Alongside these technology issues is the issue of pricing--users are not accustomed to paying under \$1,000 for microcomputer software. INPUT believes a hybrid of the current mainframe software and services industry pricing is needed--i.e., an upfront license fee plus an incremental amount per workstation.
- Vendors and users believe that software technology is at hand to develop a fourth-generation environment, i.e., a fully self-contained application environment that is its own operating system, application generator, and transaction processor.
 - However, vendors and users also agree that such a system would be very difficult to get accepted.
 - From the user point of view the system would be highly desirable in that it would be operating system independent. The objections--too much hardware resource, lack of transportability, etc.--are similar to those raised about fourth-generation languages a few years ago.
 - INPUT believes this technology will emerge within the next one to two years and will be targeted toward smaller companies by vertical-industry turnkey vendors as they move to microcomputer-based solutions.
- Given FGLs' success in the Information Center, vendors should closely track the emergence of the Development Center (DC) concept. Although the Development Center is modeled after the IC, the audience for DC tools and services is professional programmers.

- The apparent acceptance of DCs by more and more programmers should be a good sign for FGL vendors.
- However, INPUT expects that the higher level of sophistication means that FGLs will compete with many good development tools and that the penetration of the DC will not be as easy.
- IC management expects a lag in its ability to get sufficient budgets to meet end-user demand for FGLs and to provide other end-user computing support.
 - Since the end users themselves feel these tools are valuable, end users should be the source for budgets, either through charge-back schemes to the IC or through direct purchases of services like training.
 - Vendors should find opportunities by looking to the end users, identifying product and service needs, and proposing product and service solutions to IC management.
 - However, vendors should still nurture their relationship with IS departments since INPUT believes that most IS departments see FGLs as an opportunity to improve their image and get closer to the mainstream organization.
- Another organizational impact that INPUT feels FGL vendors should track is the increase in mobility between IS and user departments. As end users become proficient in FGL technology, they will become more mobile and can move between IS and other operational functions of the company.
 - This also implies another possible scenario--that is, a potential shift of information power from IS to the user. INPUT believes this is a concern of IS and one that vendors need to watch for.

- Product differentiation will be increasingly difficult to achieve, not only between established large-scale products, but also between those products and micro-based ones. This will occur for two reasons: most current products are already feature rich, and the performance differential between micros and mainframes will diminish.
 - There are several major vendors with over 1,000 installations of their product. In order to be successful, smaller vendors need to find ways to differentiate their products and services from those of other, established vendors.
 - Conversely, the established vendors are expected to aggressively support their account base through service and product enhancement.
- The key product issues appear to be in communications, both micro-to-mainframe and micro-to-micro. INPUT believes vendors can find in these product trade-offs differentiation that users will perceive as real and important.
 - The IS department and end users believe that the personal computer is very beneficial in the progress of the information resource. They are also very anxious to see more and better micro-to-mainframe links.
 - The need for micro-to-micro links is driven by the number of workstations and by the growth of the available data residing on them.
 - Although the need for these micro-to-micro linkages has not surfaced in a big way, INPUT believes that it will be a major need within the next two years and that vendors should begin planning for product offerings now.
- The next major market opportunity will be driven by the development of micro-to-micro and micro-to-mainframe networks. The most visible potential is for office automation systems.

- Combined with the power of the 16- and 32-bit microcomputers, these office networks will evolve, as will a new architecture to support them.
 - On the hardware side the mainframe will become even bigger, however, and the layers of smaller mainframes will vanish from these systems, leaving only two hardware layers.
 - The software layers will include FGL-like products and much more highly developed applications links. Some of these links will be hardware assisted, both by firmware and in some instances by special dedicated processors.
- One of the keys to the successful development of office systems is simplicity to the end user—that is, simple and intuitive responses to system actions.

V MARKET TRENDS, DEVELOPMENTS, AND FORECASTS

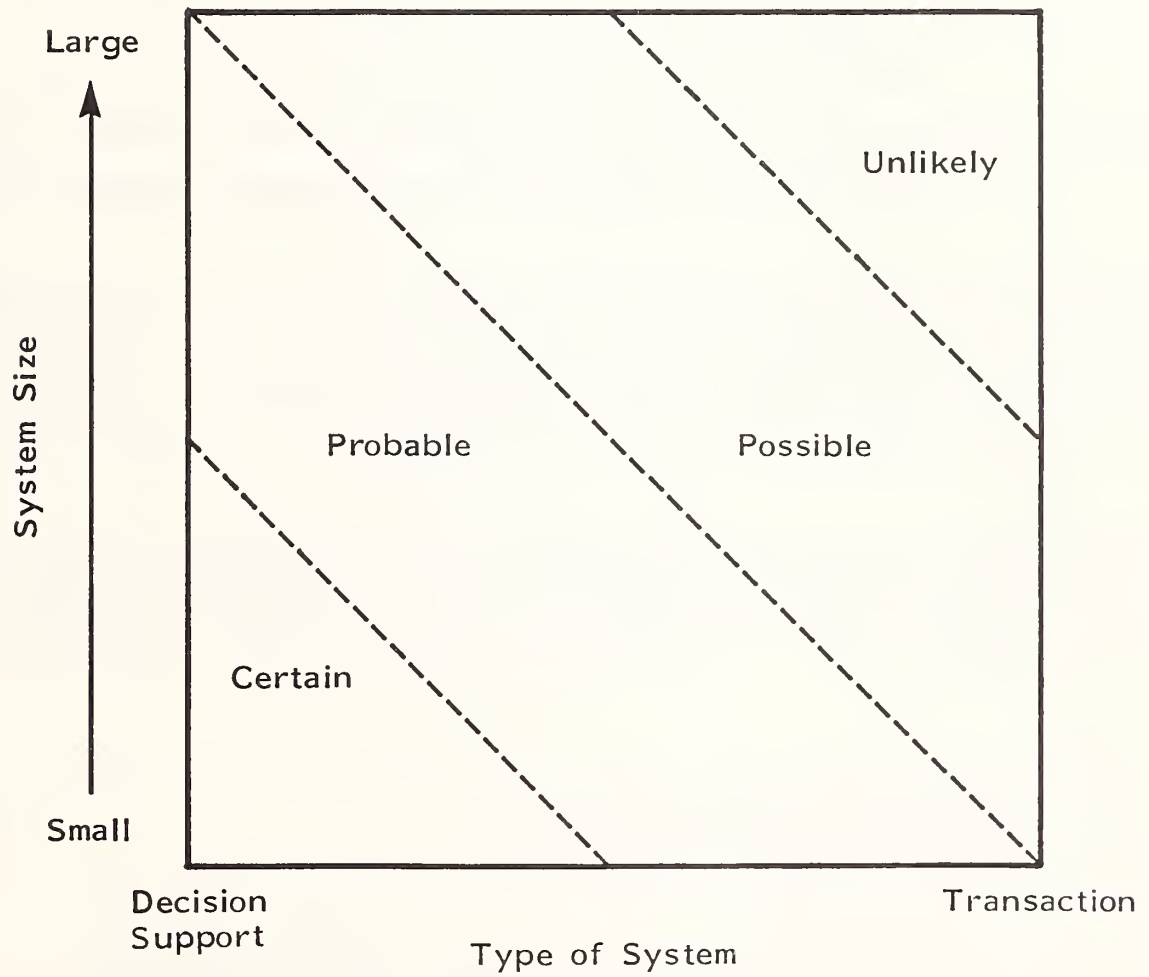
A. USER EXPECTATIONS

- In the large organizations there are two distinct sets of "users": the end users and the Information Systems organization. The fact that fourth-generation languages have improved the cooperation between these two groups doesn't change the need to:
 - Understand the needs of both groups in planning products and product enhancements.
 - Develop selling strategies for both groups. The success of FGLs is based on two steps: getting in the door, generally through IS and secondly being utilized by end users in a way they perceive as productive and in a way that contributes to the accomplishment of their mission.
 - Understand each individual company and plan the support strategy on a "tailored" basis.
- The IS and IC organizations view their role as the information consultant as one that is critically important, one that enhances their image and their value to the corporation. This presents two opportunities for vendors:

- The resources these organizations put into training and hand holding they perceive as "stolen" from their consulting. This creates an opportunity for vendors to serve these needs and strengthen their relationship with IS and IC groups, as well as to establish a new revenue stream.
- The other opportunity is to further strengthen account presence by promoting the success of the IS and IC groups in improving end-user computing through the use of powerful tools like FGLs.
- For FGLs to make real inroads into production applications, IS believes that more structured methodologies need to be made available. For the smaller applications these are not required; however, for large applications more structure is needed.
- The highest priority requirements expressed by IS and IC management were:
 - Improved human factors, primarily in simplifying the syntax and "protecting" the end user from complexities of the data or data organization.
 - Better micro-mainframe application linkage. In over half the responses the need was expressed as a micro version of the FGL. INPUT believes this is a very high priority because the IS organization wants personal computers linked in order to increase user dependency on their organizations.
- Exhibit V-I summarizes IS views on FGL use.
- The user departments strongly believe the vendor community will respond and respond quickly to these and other market requirements.

EXHIBIT V-1

IS VIEWS ON THE USE OF FOURTH-GENERATION LANGUAGES



- INPUT believes one of the major concerns of IS organizations resulting from personal computing and fourth-generation languages is the potential of a shift of information power from IS to the end user. It should be pointed out that this particular research did not support the premise. In fact, users rated loss of control, loss of data, etc. as issues of low concern.
- IS is also concerned that the personal computer software firms and their selling approaches, (primarily their overselling of the capabilities of some products) are creating potential conflict between end users and IS.
 - INPUT believes this conflict provides opportunities for information services firms to use their selling and support skills to penetrate this market, either through acquisition or through distribution agreements.
 - Not only is there a competitive advantage resulting from service orientation, there is also a real advantage from experience in end-user computing and the resulting knowledge of support, pricing, and training.
- Users expect to benefit from the highly competitive market, the quality products already available, and products anticipated over the next several years.

B. PROJECTED VENDOR ACTIVITIES

- Vendor plans appear to be consistent with user requirements in that their highest priority is micro-mainframe products.
 - However, vendors did not perceive as high a need for improving human factors in their products. INPUT agrees with users that human factors should be high priority in order to compete with personal computer

products whose strength (or, in some cases, perceived strength) is user interfaces.

- Over half the vendors reported they are working on producing transportable systems, both for new target mainframes and for microcomputers.
- The main objections INPUT anticipated were increased hardware requirements and programmer opposition.
 - Vendors reported these were not major objections.
 - Instead they cited features of competitive products as the toughest objection they were facing.
- Although it was not high on the list of how vendors promoted their products, INPUT found prototyping was a hot button with users. Users extolled the virtues of prototyping in improving development and in contributing to overall system quality.
- The market target for most vendors is the so-called "power user" or the user experienced in data base or decision support systems. Vendors should keep in mind this may not be consistent with IS plans.
 - The user community that IS is trying to satisfy is the first-time user.
 - For vendors who have been concentrating on programmer targets this is reasonable since there are many more potential users. However, there are also a number of entrenched vendors with quality products.
 - One of the reasons for improving user interfaces is to address a wider market than the "power user." The largest target is neither the programmer nor the power user, but the novice or first-time user.

- One of the major trends identified is that vendors of FGLs are expanding their products in many directions in an apparent attempt to be everything to everyone. INPUT believes this is a poor product strategy.
 - From all indications there is plenty of room for products in this marketplace and vendors have little to gain by providing the ultimate all-encompassing product. Instead, what is called for is searching out a niche and developing an all-encompassing strategy to serve and build that market.
 - In the power-user market, for example, many users are already dedicated to a particular product and would be very reluctant to change anyway. They may, however, be very open to a new product that would operate in complement with their existing products.
- While nearly all FGL mainframe product vendors are releasing or planning micro-based products, INPUT knows of no micro-based products being transported up to the mainframe environment.

C. MARKET FORECASTS

- INPUT forecasts the market for fourth-generation languages to be one of the fastest growing markets in the software industry over the next five years. This growth would be even greater if one considered the applications software developed with these tools as part of value-added systems sold to end users.
- The market for modeling languages will grow at a rate of 23%, the lowest rate of any of the FGL categories due to its focused nature and the propensity of users to develop more tailored data-base-oriented applications.

- The overall rate of growth will slow during the last two years of the forecast period, primarily due to the emergence of "fifth-generation" software products resulting from expert systems and artificial intelligence research and development.

VI CONCLUSIONS AND RECOMMENDATIONS

A. MARKET SUMMARY

- FGL products will continue to be predominantly built around proprietary data base systems with more availability of application tools and application templates.
- INPUT also expects to see diminished product differentiation between products and between micro products and mainframe products.
- INPUT expects fourth-generation languages to continue to evolve and for product hybrids or "fourth-generation environments" to be available within the year.
 - Like the current fourth-generation languages, INPUT expects these to be built around proprietary data base systems.
 - However, this does not mean vendors will curtail product enhancement activity. On the contrary, INPUT expects even more aggressive enhancement programs.
- The market for FGLs will continue to be strong and new competitors should be anticipated.

- FGLs should be important participants in the automation of the office, which will in turn attract major vendors to participate with their own products. INPUT expects the majority of these participants to enter by way of acquisition.
- While the office automation market will attract the industry giants, there will be room for Information Services Industry vendors to carve out significant niches.
- The proliferation of personal computers as management workstations will continue, further fueling the fire for more and more software and specifically fourth-generation languages and tools.
- Between the hardware and software developments and the sheer number of new users there have to be new problems to solve. One of those will surely concern how organizations manage and control all the data and educate users to respect the data as a corporate resource.
 - FGLs can add to this confusion since their ease of use can lead to more end users getting at corporate data. While this is desirable on one hand, it can be disastrous if, for example, these users start tying up mainframes with data base queries.
- IS management is generally aware of these types of issues and will be looking to vendors for support and solutions.
- INPUT urges clients to track activities in Artificial Intelligence (AI). Large firms are investing heavily in R&D and one of the market opportunities is competitive with developments in fourth-generation languages.

B. RECOMMENDATIONS

- Vendors are urged to develop full-function micro-mainframe linkages, as these will be important in the traditional markets and critical in the office automation markets.
- INPUT believes the information network systems of the future will consist of large-scale mainframes and microcomputers. Therefore vendors will need products that span these hardware classes.
 - Mainframe FGL vendors will see increasing competitive pressure from the micro software vendors and should have competitive plans and products to counter this competitive threat.
 - Mainframe FGL vendors should increase their emphasis on human factors to counter the micro competitors and to meet what seems to be a current user requirement.
 - These human factors or user interfaces will increase in importance and vendors should plan to be better than today's "best" user interfaces.
 - The emphasis in human factors should reflect an attitude that the user interface should work the way the user works. In other words, the interface should be as intuitive as possible.
- The use of fourth-generation languages in production applications will be one of the key factors for sustained growth. Vendors will need the support of IS management to ensure this growth.
 - Vendors, therefore, should develop long-range sales strategies to sell to IS management and to solidify relationships.

- One of the elements that could help is promoting the success of IS and IC organizations in supporting end-user computing. Another is aligning promotional efforts with a perception of the power of FGLs for prototyping.
- In product promotion plans vendors will increasingly need to be aware of the need to approach the end user and the IS audiences with appropriate messages.
 - For example, reduced maintenance costs may be important to the IS group, whereas to the end user the only thing that is important might be improved customer service.
 - Both groups should be responsive to promotional plans that emphasize FGLs as tools for the IC and as prototyping tools to rapidly develop quality applications.
- INPUT recommends that vendors develop strategies, better yet strategic business units, devoted to the areas of training and support. These will serve two purposes: one, training and support appear to be business opportunities, and two, there are customer needs for training and support services, a revenue opportunity that also will provide leverage for vendors in getting new business and maintaining existing accounts.
- Given the success of fourth-generation languages in the Information Center, INPUT believes vendors should plan sales programs targeted at the Development Center. Specifically these programs should be targeted at the features used by programmers.
 - Contrary to what is being published today, INPUT believes that professional programmers will support advanced tools like fourth-generation languages and that programmers represent an opportunity and a potential ally within the organization.

- As FGL vendors continue to enhance system performance and the use of FGLs for production systems increases, there are additional opportunities:
 - INPUT believes well-tuned FGLs are excellent development tools for the thousands of independent application software companies. This is because of FGLs' inherent power as development tools and their low cost due to ease of maintenance through the applications life cycle.
 - Less important are the large OEMs, which will become more vertical industry specific and will need to get more and more into the application software business to maintain and enlarge their customer bases.
- INPUT believes the rapid-growth stage of end-user computing will be hastened to the maturity stage by problems of managing corporate data and mainframe capacity.
 - Vendors need to develop strategies to address major emerging issues in data control, security, and data administration.
 - By being proactive, vendors will avoid becoming "part of the problem." Another benefit to a proactive strategy is that vendors will learn the full details of the problem, thereby getting a head start on software solutions, another market opportunity.
 - INPUT anticipates that all this emerging power in the hands of end users will surely result in at least a few potential catastrophes. Therefore, planning for disaster should give vendors the ability to be proactive.
 - INPUT also recommends that vendors work as closely as possible with IS and have the objective of being an insider, both to provide solutions and to strengthen the vendor's relationship with the organization.

