IMPACT OF TECHNOLOGY ON FIELD SERVICE

INPUT

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INPUT Planning Services for Management

IMPACT OF TECHNOLOGY ON FIELD SERVICE

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CONTENTS

		Page
I	INTRODUCTION	1
II	EXECUTIVE SUMMARY	3
	A. Importance Of The Role Of Technology In Field Service	3
	B. Field Service Participation In Product Development	5
	C. Impact On Field Service Personnel	10
	D. Comparison Of Vendor And User Viewpoints Regarding Maintenance Features	12
	E. Recommendations	15
III	THE ROLE OF FIELD SERVICE IN PRODUCT DESIGN	19
	A. An Overview Of The Product Design Process	19
	B. The Role Of Field Service	24
	C. Initiating New Product Design	26
	D. Introducing Advanced Maintenance Technologies	29
	E. Phase Reviews	35
	F. Sign-Off And Veto Of Product Designs	36
	G. Performance Feedback And Continuation Engineering	39
IV	IMPACTS OF ADVANCED TECHNOLOGIES ON PRODUCTS, DELIVERY METHODS, AND PRICING	41
	A. Technologies Of Importance To Maintenance	41
	B. Impact On Maintenance Design Of Products	43
	1. Vendor Maintenance Objectives	43
	2. Vendor Priorities Of Maintenance Features	49
	C. Impact On Maintenance Delivery Methods	55
	D. Impact On Pricing	58
V	IMPACTS OF ADVANCED MAINTENANCE TECHNOLOGIES ON FIELD SERVICE PERSONNEL	61
	A. Number Of Personnel Required	61
	B. Demand For Interpersonal Skills	62
	C. Skill Requirements	63
	D. Training	65
	E. Other Impacts On Personnel	68
VI	IMPACTS OF ADVANCED MAINTENANCE TECHNOLOGIES ON THE FIELD SERVICE ORGANIZATION	69
	A. Relationship Of Field Service To Sales	69

IMPACT OF TECHNOLOGY ON FIELD SERVICE

EXHIBITS

			Page
II	-1	Changes In Relative Importance Of Field Service Factors Due To Technology	6
	-2	Field Service Activity Levels In New Product Development	8
	-3	Vendor Versus User Ratings Of Maintenance Objectives	13
	-4	Vendor Versus User Priorities Of Maintenance Features	14
III	-1	Generic Steps In The Product Design Process	20
	-2	Activity Level Of Field Service In Initiating New Products	27
	-3	Responses For Field Service Product Initiation That Varies By Product Line	30
	-4	Activity Level Of Field Service In Introducing Advanced Maintenance Technologies In Product Design	31
	-5	Responses That Vary By Product Line For Introduction Of Advanced Maintenance Technologies	33
	-6	Activity Of Other Departments In Introducing Advanced Maintenance Technologies	34
IV	-1	Technologies Important To Maintenance	42
	-2	Advanced Technology: Vendor Maintenance Objectives	44
	-3	Advanced Technology: Vendor Priorities Of Maintenance Features	50
	-4	Maintenance Delivery Methods Supported With Technology	57
	-5	Impact Of Advanced Maintenance Technology On Pricing	59
V	-1	Impact Of Technology On Skills Requirements Of Field Service Personnel	64
VII	-1	Rating Of Benefits By Users Of IBM 4300 Series	78
	-2	Comparison Of Benefit Ratings Among Users Of The IBM 4300, 8100, And 3101	79
	-3	Rating Of Disadvantages Of Maintenance Features By Users Of The IBM 4300, 8100, And 3101	81
	-4	Rating Of Advanced Maintenance Features By Users Relative To Future Purchases	85
D	-1	Profile Of Vendor Respondents	122

1 INTRODUCTION

I INTRODUCTION

- This report is produced by INPUT as part of the 1981 U.S. Field Service Program.

- Data for the report was obtained from three sources:

  - Telephone interviews with 20 users.

  - Telephone interviews with 15 computer equipment vendors.

  - INPUT's library of vendor and market information.

- The objectives of the report are to investigate:

  - The impact of advanced technology on field service.

  - The use of new field service techniques.

  - The need for, and usefulness of, the participation of field service management in the design process of new products.

- Included in the report are the reactions of the user community to recently introduced products, such as the IBM 4300, that offer advanced maintenance features.

- In order to allow the users and vendors interviewed to freely express their views without disclosing data that could be used for competitive purposes, their identity has not been revealed.

- This study addresses the market and user environment in the U.S. only.

- The questionnaires and terms used in this report are provided in the appendices.

- Client comments and queries on this report are welcomed, and clients may contact their nearest INPUT office for this purpose.

II EXECUTIVE SUMMARY

II EXECUTIVE SUMMARY

- Recent reports in the press reflect a new optimism about the development of technology in the United States. After a period of pessimism, particularly with regard to overseas competition, research and development spending by the U.S. is on the increase, having exceeded the 1980 rate of inflation by an estimated 4%.

  - The information processing industry has been largely technology driven from its inception.

  - It is essential that field service management have an appreciation for and participate in the impact of technology on the industry.

- In this study, the focus is on electronics technology with emphasis on those elements of direct interest to field service. The study will deal with product development issues, and also will examine the impact of advanced technology on field service.

A. IMPORTANCE OF THE ROLE OF TECHNOLOGY IN FIELD SERVICE

- It is important to recognize that field service organizations have a primary responsibility to maintain the current installed base of products, and as such the impact of technology on the field service organization is often not

immediate; it awaits the shipment of new products and a buildup of significant density. In field service organizations the bulk of available management time is spent on current or obsolete products and therefore on "old" technology.

- If field service management is to retain and build on the gains in stature won over the past decade, it will have to take an active part in research and development because these functions are a key part of the total industry.

  - In 1980, IBM spent $1.5 billion on R&D, trailing only General Motors and Ford among U.S. companies.

  - In terms of R&D as a percent of sales, computer manufacturers Amdahl (15.8%) and Cray Research (14.5%) led all U.S. companies. Other companies with very high investment in R&D as a percent of sales included Auto-trol (12%), Intel (11.3%), and Floating Point Systems (10.8%).

  - In terms of R&D dollars per employee, the figures are even more impressive, with Amdahl and Cray again leading the list at $15,333 and $11,591 respectively, compared to $2,982 at General Motors and only $864 at an old-line company like Combustion Engineering.

  - The average R&D spending for computer companies in 1980 was $3,979 per employee and for peripherals and services companies it was $3,060 per employee, compared to a $1,834 average for the total of U.S. industry.

- R&D is a major part of the information processing industry and field engineering must play its rightful role in applying technology through participation in the R&D function. As installed bases grow, the contribution of field service to revenue and its impact on profit increases in significance. The only opportunity field service management has of influencing the maintainability of the products they are later called to service is in the R&D stage.

- The technology impact on field services over time is presented conceptually in Exhibit II-1.

  - The impact of new equipment builds in relation to its shipping rate and the replacement rate of old equipment, however, because old equipment needs more relative maintenance and a more complex inventory of spare parts, the old equipment continues to heavily influence manpower and revenues long after it has become a minority member of the installed base.

  - Some field service functions, particularly preventive maintenance (PM), will decline in importance as new products require less (if any) PM.

  - This trend is another side of the shift to more user self-maintenance; even in the face of user resistance, self-maintenance is growing, particularly among terminal users.

  - Technology includes more than hardware - in particular it includes software; software maintenance is a growing factor and ultimately will impact all field service organizations.

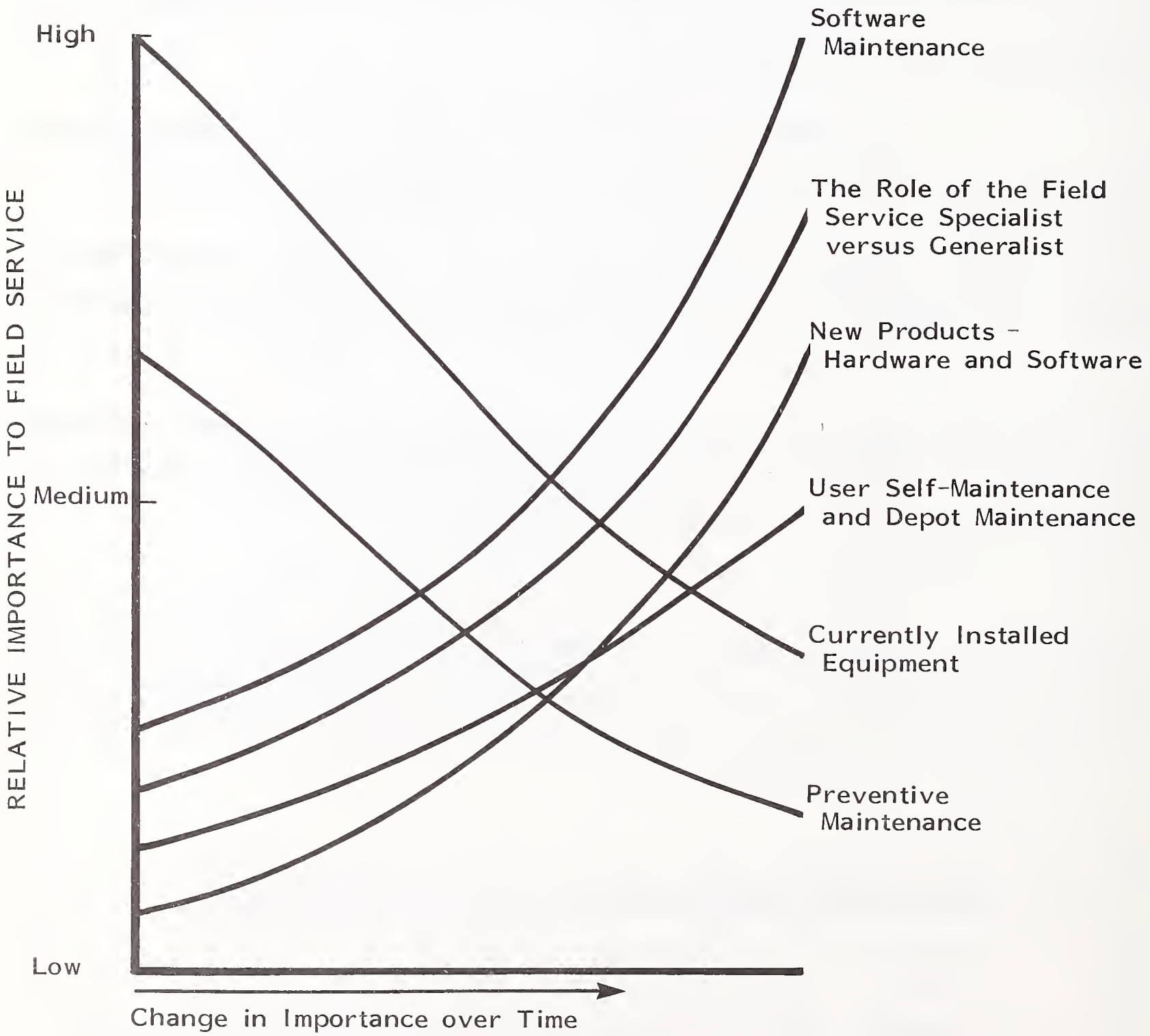
  - Finally, the new technologies will change the makeup of the field service organization. Specialists will increasingly take over such functions as board swapping from the generalist who has been able to service entire systems. Higher level specialists will be concentrated in service center locations.

B. FIELD SERVICE PARTICIPATION IN PRODUCT DEVELOPMENT

- The influence of field service activity in product design remains long range.

EXHIBIT II-1

CHANGES IN RELATIVE IMPORTANCE OF
FIELD SERVICE FACTORS DUE TO TECHNOLOGY



- Field service currently has a low level of activity in new product design, and vendor respondents do not expect a significant increase in this activity level through 1985, as shown in Exhibit II-2.

- Since product development cycles range between one and one-half to two and one-half years, it will be the end of the 1980s before significant impacts can be expected from field service activity in new product design.

- This lull indicates a strategic opportunity for field service organizations to move early into product design.

  - Recent announcements from IBM indicate it may be taking advantage of this opportunity.

  - If this is the case, the vendor community may be forced to increase its activity level sooner than is now planned.

- Short-term impacts from new maintenance techniques will be experienced over the next two years, and can be expected to increase throughout the 1980s.

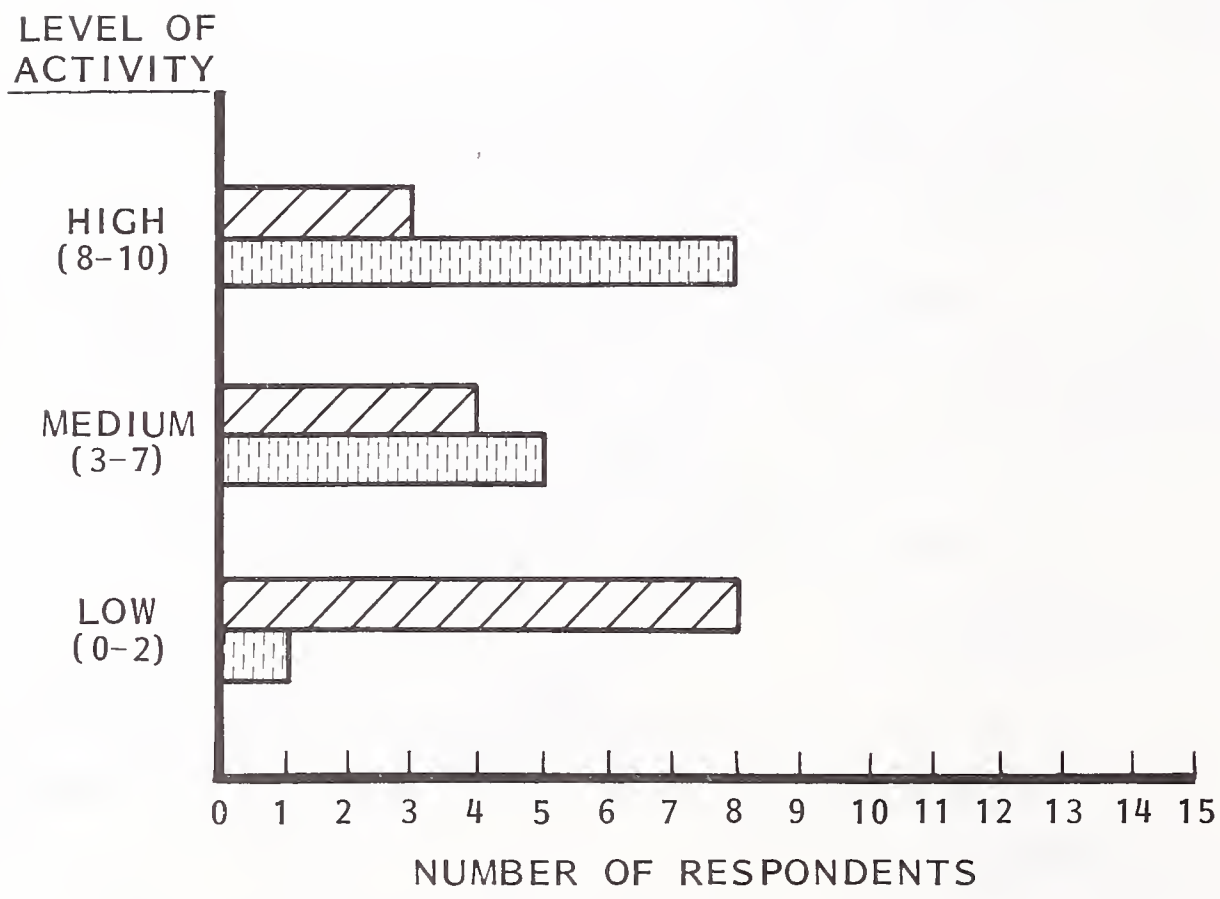
  - Field service organizations are very active in introducing new maintenance techniques now, and expect this activity level to increase through 1985.

  - In the short term, the most dramatic impacts will be in on-site maintenance since this is the area of major focus for new maintenance techniques.

  - User self-maintenance and depot maintenance are receiving less emphasis from field service. This might be because these concepts are currently more closely tied to the lower end of the product line (e.g., terminals).

EXHIBIT II-2

FIELD SERVICE ACTIVITY LEVELS IN
NEW PRODUCT DEVELOPMENT



RATING: 0 = NO ACTIVITY, 10 = HIGH ACTIVITY

- Results of the survey of 15 vendors carried out for this study indicate the non-aggressive stance of field service in new product R&D.

  - As shown on Exhibit II-2, approximately half the respondents had a low level of involvement, and only 20% had a high level.

  - Furthermore, field service usually gets involved in the design process after the product concept is decided.

    . This study indicates an average of eight steps in the product design process. On the average, field service's participation begins almost one-third of the way through the process.

    . Field service is rarely involved in the marketing studies that are conducted at the beginning of the product design process. This is despite the fact that field service as an organization has one of the highest levels of direct customer contact.

    . Engineering typically develops the product specifications, including the maintainability factors.

    . In firms that have a centralized business planning group, field service may be represented by marketing or operations, rather than participating directly.

  - This low activity in new product initiation has at least two adverse effects:

    . First, it means that the extensive knowledge which field engineering develops in day-to-day contact with clients is often wasted - it is not communicated back to where it can be valuable, the point of new product development.

- Second, it means that field engineering management is not taking this opportunity to shape its future. Certainly much of the ultimate profit potential in servicing a product is determined in the early product concept, and field engineering often does not participate in that phase, but will later be expected to take on a significant share of profit responsibility.

- To balance the picture, survey results do indicate a high level of field service participation in the introduction of advanced maintenance techniques in new product development.

  - However, marketing and engineering also have an active role in introducing maintenance techniques according to this survey.

  - Of the vendors interviewed, 40% indicated that two or more departments other than field service are consistently involved in introducing advanced maintenance techniques.

  - It is logical that field service should play a dominant role in the maintenance aspect of new product development.

  - Input from field service in product design could reasonably be increased to parallel the involvement of other departments in service aspects.

C. IMPACT ON FIELD SERVICE PERSONNEL

- Most vendors project fewer field service managers and field engineers will be required due to advanced technologies.

- A shift in skills requirements is also anticipated.

- For field service managers, business orientation becomes more important. Other areas of increased importance for management are depot management and total systems service responsibility.

- Depot maintenance with its implications of multiple skill level requirements is expected to have the biggest impact at the field engineer level.

- Requirements for interpersonal skills are expected to be somewhat more in demand due to increased technology, but there is not a consensus as to whether this will occur at the management or field engineer level.

- Due to the use of advanced technology, requirements for hardware skills are expected to decline, while requirements for software and communications skills are expected to increase. This applies to both field service management and field engineers.

- Longer range personnel considerations are as follows:

  - Increased engineering requirements for higher level field service personnel, who require a more advanced educational level and hence a higher salary scale.

  - Redefinition of field service career paths, as demand for hardware expertise becomes more a thing of the past and software and communications skills become more critical.

D. COMPARISON OF VENDOR AND USER VIEWPOINTS REGARDING MAINTENANCE FEATURES

- Vendors and users surveyed for this study are in close agreement regarding the objectives of the application of advanced technology to products as it relates to maintenance.

  - As shown in Exhibit II-3, the profile of ratings by vendors and users tracks well, with both groups rating product reliability highest.

  - The vendor understandably rates ease of installation, repair, and maintenance slightly higher than the user does.

  - Just as understandably, the user rates ease of upgrade/expansion a bit higher than the vendor; the user has to live with the problem of adapting the equipment to an expanding applications mix.

  - Both vendors and users rated ease of user training lowest. This indicates the continuing attitude that maintenance is not part of ongoing operations.

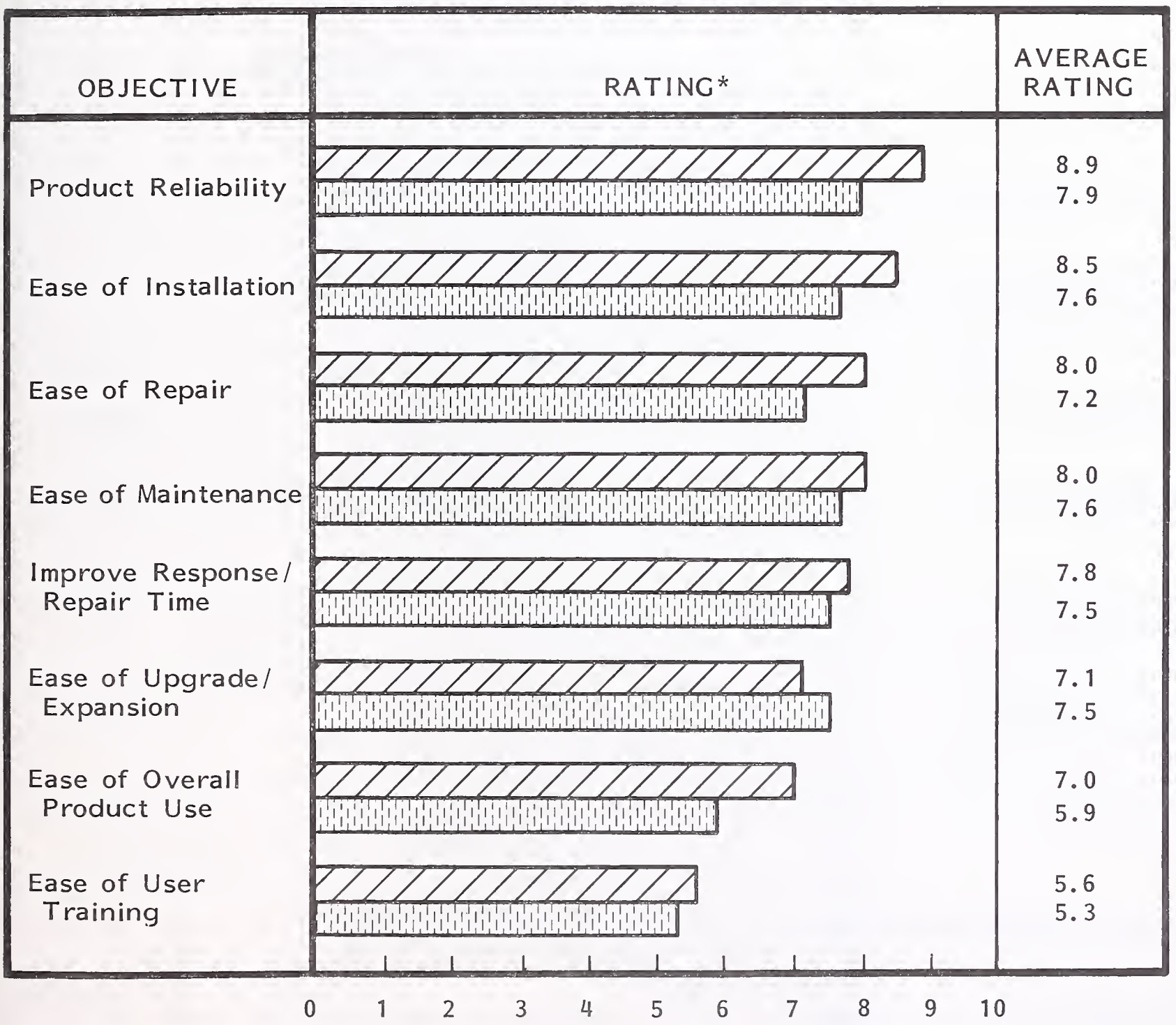
  - The close agreement between the vendor and user response adds substance to the value of a field service viewpoint in the initiation phase of new product development.

- In setting priorities for a list of maintenance features, vendors and users do not respond with similar priorities. As shown in Exhibit II-4, vendors rate those features higher which tend to reduce maintenance costs, while users rate those features higher which tend to increase uptime.

  - Features designed to reduce repair time - field replaceable units, modularity, and microprocessor controlled self-test - were rated highest by vendors.

EXHIBIT II-3

VENDOR VERSUS USER RATINGS OF MAINTENANCE OBJECTIVES

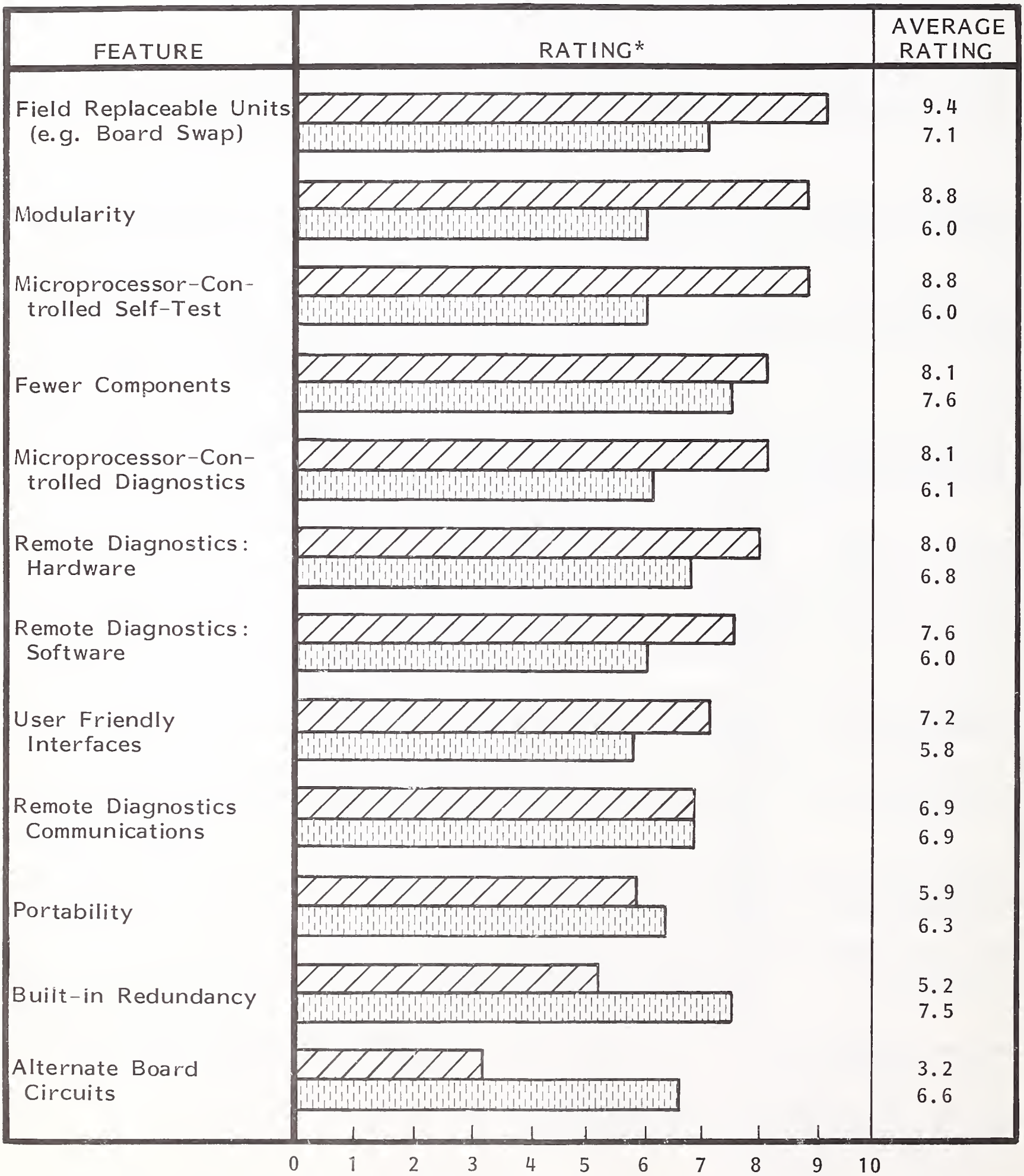


* SCALE 0 - 10 (0 = NO IMPORTANCE, 10 = HIGH IMPORTANCE)
BASED ON 15 VENDOR RESPONSES AND 20 USER RESPONSES

VENDOR USER

EXHIBIT II-4

VENDOR VERSUS USER PRIORITIES OF MAINTENANCE FEATURES



* SCALE 0 - 10 (0 = NO IMPORTANCE, 10 = HIGH IMPORTANCE
BASED ON 15 VENDOR RESPONSES AND 20 USER RESPONSES

VENDOR USER

- Both rated "fewer components" high, a recognition that this feature carries the image of both lower maintenance cost and higher reliability. However, field service organizations usually attribute component responsibility to engineering, not to field service.

- Built-in redundancy and alternate board circuits were rated much higher by users, a reflection of the high up-time associated with redundancy; the success of Tandem computers is an example of a vendor capitalizing on the high user receptivity to the concept of redundancy.

- Users and vendors rated remote diagnostics on communications at exactly the same level, with the vendors rating remote diagnostics on hardware and software higher than did users. This follows from the likelihood that the user is receptive to more help on communications, where he feels more a part of the problem, while he views hardware and software maintenance as primarily the vendor's problem.

E. RECOMMENDATIONS

- To promote field service participation in new product initiation, field service management should assign this function to an individual within field service.

  - Survey results show that field service executives have a low level of interest in including the impact of technology in their planning and product thinking.

  - The identification of responsibility for technology will allow field service to be a full participating partner in a company's exploitation of technology.

- Field service management must review personnel plans to ensure that the impact of technology has been fully considered.

  - Lower component counts, fewer mechanical devices, and better pre-testing techniques will reduce repair time in the field which will require less skilled manpower in the field.

  - The reduction in the amount of preventive maintenance will further reduce in-field manpower requirements.

  - Shipment of more equipment, and the wider distribution of this equipment will increase field manpower requirements.

  - Management must balance these forces. One alternative is to develop area support centers where field engineers can be employed during slack times, and still be available for on-site calls when required.

- Also with regard to personnel, management must develop a clear understanding of its plan regarding "generalist" versus "specialist" field engineers.

  - The traditional generalist who can maintain an entire system is giving way to specialists in defined areas of hardware and software. Specialists may be resident in support centers rather than in the field.

  - The specialist's knowledge is being leveraged through remote diagnostics, and centralized software maintenance, reducing the dependency on on-site techniques.

  - As vendors press for greater efficiency through specialization, they must take care not to overlook the user who is looking for the total solution provided by the generalist.

- The trend toward smaller, more distributed equipment has pressed forward the development of depot maintenance and user self-maintenance.

- Traditional EDP users resist the trend.

- Newer, non-EDP users, tend to be less resistant.

- Vendors must design their depot maintenance and user self-maintenance strategies with a clear idea of the uniqueness of their product line and their user base; a misreading on this issue can lead to expensive and unprofitable maintenance on the one hand, or an angry user base on the other.

- Management must consider software as an increasingly important field service consideration. Virtually every piece of equipment has a software aspect, even previously hard-wired devices such as disk drives and modems. Much of the force shaping products in the 1980s will come from software rather than hardware technology.

- Management must begin thinking in terms of a multilevel service which optimizes available manpower.

  - Technology is making diagnostics available in several forms - remote, customer activated built-in diagnostics, and built-in self-test. Combined with equipment which "degrades gracefully" through redundant circuitry, the user will often have time to more clearly define the problem before releasing the equipment for repair.

  - The better diagnostics and potentially longer time available for response will allow vendors to understand the problem more clearly before dispatching a field engineer.

  - In this environment, the speciclist with exactly the required talents can be dispatched, rather than the first person available, which is the traditional method.

- Technology will impact virtually every aspect of field service, and management must organize to capitalize on it.

III THE ROLE OF FIELD SERVICE IN PRODUCT DESIGN

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- A major objective of INPUT's Field Service Program is to consider field service relative to overall corporate strategies. Understanding the role of field service in the product design process may be of particular significance in determining the position of field service in the corporation.

  - An overview of the product design process in corporations is necessary to put field service's role into context.

  - It should be noted that significant variations were found in the firms interviewed for this study.

  - In examining the specific elements of the product design process, and the departmental responsibilities for these elements, field service organizations can find methods for improving their profitability.

A. AN OVERVIEW OF THE PRODUCT DESIGN PROCESS

- Although the specific steps for product design vary with individual companies, some generic steps in this process are shown in Exhibit III-1.

EXHIBIT III-1

GENERIC STEPS IN THE PRODUCT DESIGN PROCESS

• Conceptual Stage
Step 1. Product Request Step 2. Product/Cost Analysis and Specifications Step 3. Financial Analysis and Authorization
• Design and Testing Stage
Step 4. Engineering Prototype Step 5. Quality Testing Step 6. Pre-Production Run Step 7. Internal (Alpha) Testing Step 8. Manufacturing Pilots Step 9. Field (Beta) Testing Step 10. Full Production
• Post-Introduction Stage
Step 11. Performance Feedback Step 12. Continuation Engineering

- The general process can be divided into three stages: a conceptual stage, a design and testing stage, and a post-introduction stage.

- The conceptual stage is often characterized by the following:

  . The conceptual stage begins with some form of product request, which is typically drawn up by a marketing or product design department. Many companies allow products to originate with any variety of specific departments or individuals, but the official first step is a product request document.

  . The conceptual stage also includes development of the product specifications. This is typically done by the engineering department, and includes the specifications for the maintainability factors of the product.

  . The conceptual stage usually ends with a financial analysis and authorization. This is frequently done by a centralized business planning group within the vendor organization. The group providing final authorization is comprised of representatives from the various departments in the company, such as engineering, marketing, finance, manufacturing, quality control, and individual product lines. Field service is sometimes represented at this level, although marketing or operations departments often represent field service. Items that are typically part of the final authorization are as follows:

    - Financial feasibility, including return on investment requirements and costing.

    - Market feasibility and projections.

    - Priorities for the release of funds.

- Financial controls.

- Production benchmarks or milestones.

- Detailed engineering specifications.

. Engineering specifications are done in either one or two phases. Some firms have a two-step process that provides first for a set of preliminary and then for final engineering specifications.

. After final authorization is obtained, implementation responsibility is diffused to different departments within the corporation. This includes engineering, which then proceeds to develop a prototype.

- The design and testing stage has the following characteristics:

. Design and testing takes a product from an engineering prototype through full production. This stage often includes a number of prototypes. Typically these will be an engineering prototype, a pre-production prototype, and a manufacturing pilot.

. Phase reviews are scheduled throughout this stage.

. The early production prototypes are frequently internally (Alpha) tested within the vendor organization. This means that some department or division within the company will use the new product.

. Field (Beta) testing usually occurs with a late prototype, or even the initial full production run. Beta test sites are frequently "friendly" customers.

- The post-introduction stage has the following characteristics:

- This stage monitors new installations, isolates problems, and corrects them.

- It is an interactive process in which field service is commonly responsible for performance feedback, and engineering is responsible for continuation engineering.

- Occasionally, the quality assurance department is involved at this stage.

- The average length of the product design process was found to be 17.3 months in those companies interviewed.

  - This figure varied considerably by the type of product being offered by the vendor. The length of time spent on product design is heavily dependent on the complexity of the product, even within a specific product type.

  - This average length figure applies to the product design cycle for a whole system, or for the most complex product offered by the firm in the case of a peripheral or terminal manufacturer.

  - A total of 12 vendors responded to this question, with seven vendors giving a range for an answer. In calculating the overall average, the midpoint was used for those companies giving a range.

  - The lowest response given to this question is six months, and the highest response is 30 months.

- Based on 14 vendor responses, the average number of steps in the design process is as follows:

  - An average of 8.1 steps for the entire process, with a low response of six steps and a high response of 10 steps.

- An average of 3.3 steps before the first prototype is developed, with a low response of two steps and a high response of five steps.

- An average of 2.6 for the step level at which field service becomes involved, with one step as the low response and seven steps as the high response.

- Getting involved in product design a third of the way through the process is too late for field service to be most effective. Involvement should be much earlier.

B. THE ROLE OF FIELD SERVICE

- As can be seen from the above average, field service is typically involved in the later steps of the conceptual stage of the product design process. General characteristics of the role of field service in the product design process are as follows:

  - Field service is not involved in initial product requests.

  - In initial product/cost analysis and specifications, field service's role is one of advising when requested, rather than being given responsibility.

  - Some form of concurrence or sign-off is provided by field service before final authorization at the end of the conceptual stage. This includes specification of the maintainability and serviceability requirements for the product. These are incorporated into the final product specifications, and then into the various prototypes.

- In describing their companies' product design process, a number of respondents referred to the specific role of field service. Some of these responses are as follows:

- "The first step is a marketing survey of what fits into our company's data communications strategy. I wish field engineering were involved here. The second step is a product/cost analysis to judge if the product can be a revenue maker for a minimum of five years. First we see if our company can do it, or we'll see if we can purchase it OEM. It's at this step that field engineering has input."

- "Field service comes in after the concept stage. We are part of the design and manufacturing pilot reviews."

- "Field service is involved with the product development plan. It's a conceptual plan that deals with costs, and establishes such things as MTBF and MTTR, required tools, and so forth. From this, engineering develops the engineering documents that are the true product specs."

- "After the prototypes and the internal testing, field service is given the product design for total review. This is when the product goes from an engineering environment to the 'real world' environment. It could be in field engineering for a couple of days to a month, depending on the sophistication of the product. Then we report back to engineering. Here field service can have a veto, if there's serious problems. For new systems, we haven't had a veto yet. However, field service sign-off is required at this level. From here it goes to user sites for testing."

- "For peripherals, engineering qualifies vendors for us to buy from OEM. Then field service has the final say on which firm to pick based on serviceability."

- "In our company, an idea for a business plan (for a new product) can come from any division."

- "For software, field service is responsible for writing the user requirements document. Those are like the engineering specs for software. Primarily, they deal with diagnostics. Field service funds the diagnostics and maintenance documentation for software."

- "Our company has different strategic business segments. There is a product planning committee for each segment. Members of the committee include all groups, like manufacturing, marketing, quality control, and test engineering. Field service is an outsider that sits in."

- "We have a 'design-to-life cycle' criteria so field engineering is involved from the beginning. Typically, we use a five-year life cycle. This cost is getting to be about 50% of the manufacturing cost. Field engineering is getting more and more involved in the research now, because our involvement is reflected in the financials."

C. INITIATING NEW PRODUCT DESIGN

- Respondents were asked to rate the current activity level of field service in initiating new products, using a scale of 0 to 10 (0=low, 10=high). The average of the 15 responses to this question was a moderately low 3.2.

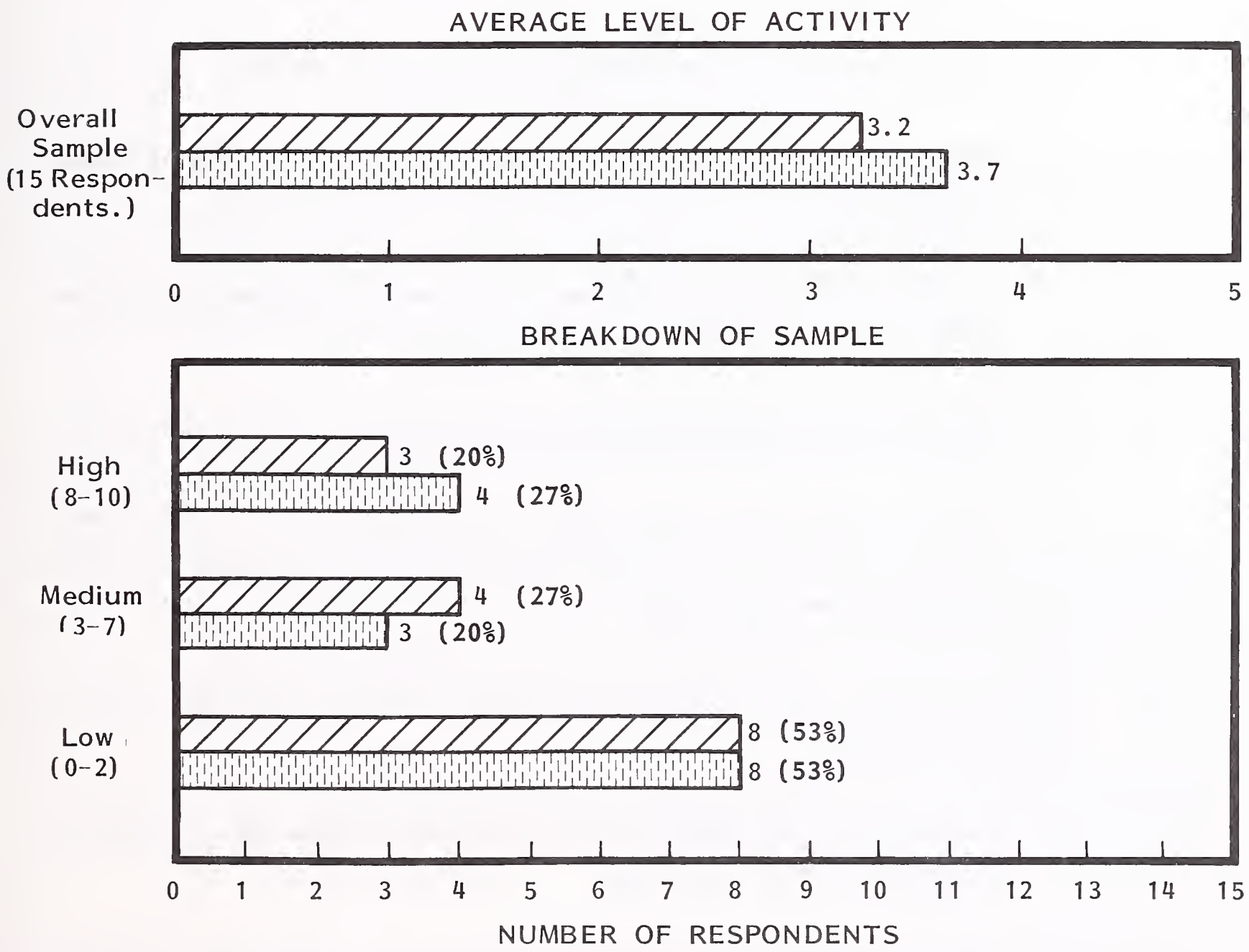
- As shown in Exhibit III-2, field service's level of activity in initiating new products is not expected to rise dramatically by 1985.

  - The average activity level for 1985 was projected to be 3.7 on the scale of 0 to 10.

  - Over half the respondents interviewed felt that field service's activity level was low (between 0 and 2), and projected that it would stay at this level through 1985.

EXHIBIT III-2

ACTIVITY LEVEL OF FIELD SERVICE
IN INITIATING NEW PRODUCTS



- The departments identified as being most active in initiating new products are marketing and product development. Engineering was also mentioned occasionally.

- The role of field service in initiating new product design is reflected in some of the comments made by the individuals during the interviews:

  - "Input from field service is after the product is designed to meet market needs."

  - "Our involvement is low, and it will stay low through 1985."

  - "Field service gets involved on enhancements only as far as initiating the product."

  - "Occasionally something happens there for field service, but it's not phenomenal. And I don't see that changing for 1985."

  - "That's a marketing function."

  - "Field service gets involved 100% in all products, and we get in fairly early. But we don't necessarily get in on the conceptual side with marketing and engineering."

- Three respondents rated field service activity level as very high (9 or 10) in a new product design.

  - These firms ranged greatly in size, having $30 million, $700 million, and $3 billion in gross annual sales.

  - All three firms are mainframe manufacturers, with two of the firms having extensive product lines that include terminals, communications equipment, and word processing.

- The following comments were made by these firms relative to field service's role in new product development:

  . "Field engineering is 20% of the company. We are about 30% of the revenues and have 12,000 men. We have staffs of people that look at new products."

  . "Our activity level is 10 now, and if possible it will go even higher for 1985."

  . "Field service is part of the team that initiates new products."

- Field service's activity level is found to vary by product line in 40% of the firms interviewed. Exhibit III-3 indicates the responses of those areas in which field service is most active and least active in product initiation for firms that vary by product line.

D. INTRODUCING ADVANCED MAINTENANCE TECHNOLOGIES

- Field service's activity level in introducing advanced maintenance technologies in product design is 7.2 on a scale of 0 to 10 for the 14 vendor respondents who answered this question. As shown in Exhibit III-4, this relatively high level of activity is expected to increase by 1985.

  - The general activity level of field service in introducing advanced maintenance technologies is expected to rise from its current level of 7.2 to 8.2 by 1985.

  - Over half (57%) of the vendors interviewed reported a high level of activity (between 8 and 10) in this area currently; 79% of the vendors responding projected a high level of activity for field service by 1985.

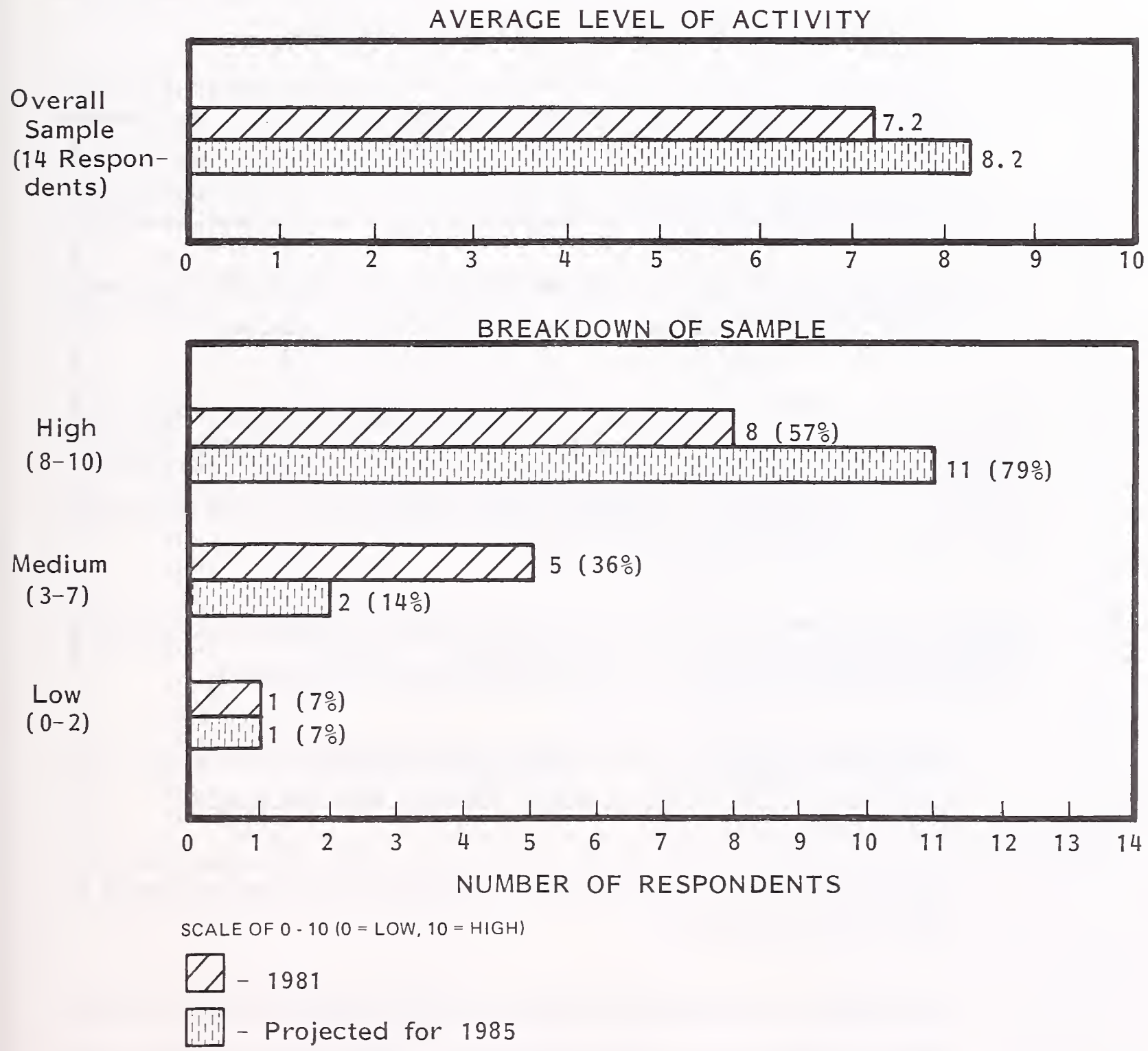
EXHIBIT III-3

RESPONSES FOR FIELD SERVICE PRODUCT INITIATION
THAT VARIES BY PRODUCT LINE

RESPONDENT	PRODUCT LINE IN WHICH FIELD SERVICE IS:	
	MOST ACTIVE	LEAST ACTIVE
A	In-House Test Equipment, Remote Interface Adaptors	New Products To Be Marketed Outside
B	DP Equipment, Peripherals	Data Communication, Telephone Equipment
C	Terminals	Modems
D	Logic Analyzers	-
E	Plug-Compatible Mainframes	Single Board Equipment
F	Large End User Products, Such As Terminals	Special System Or Low Volume Products

EXHIBIT III-4

ACTIVITY LEVEL OF FIELD SERVICE IN INTRODUCING
ADVANCED MAINTENANCE TECHNOLOGIES IN PRODUCT DESIGN



- Comments on field service's role in introducing advanced maintenance technologies in product design are as follows:

  - "If it could go up for 1985, it would."

  - "Field service has upmost authority in dictating to engineering relative to serviceability."

  - "It's kind of a joint thing between the technical design group, the technical support group, and the product design group."

  - "At least as far as field service requesting (advanced maintenance technologies), it's 100%. But what is accepted is another thing. Most of our limitations are customer-driven."

  - "Field service works with engineering to have it (advanced maintenance technologies) optimized. We go outside for instrumentation."

- Fifty percent (50%) of the 14 companies responding indicated that field service's activity in introducing advanced maintenance technologies varies by product line. The responses for those areas in which field service is most and least active are indicated in Exhibit III-5.

- Exhibit III-6 indicates the activities of departments other than field service in introducing advanced maintenance technologies into product design.

  - Engineering is the most active department outside of field service. It is mentioned by 50% of the 14 vendors responding to this question.

  - Marketing is the second most active department, being mentioned by 36% of the respondents.

  - Departments categorized as "other" include financial, product design, technical design, and test engineering. They were mentioned once each.

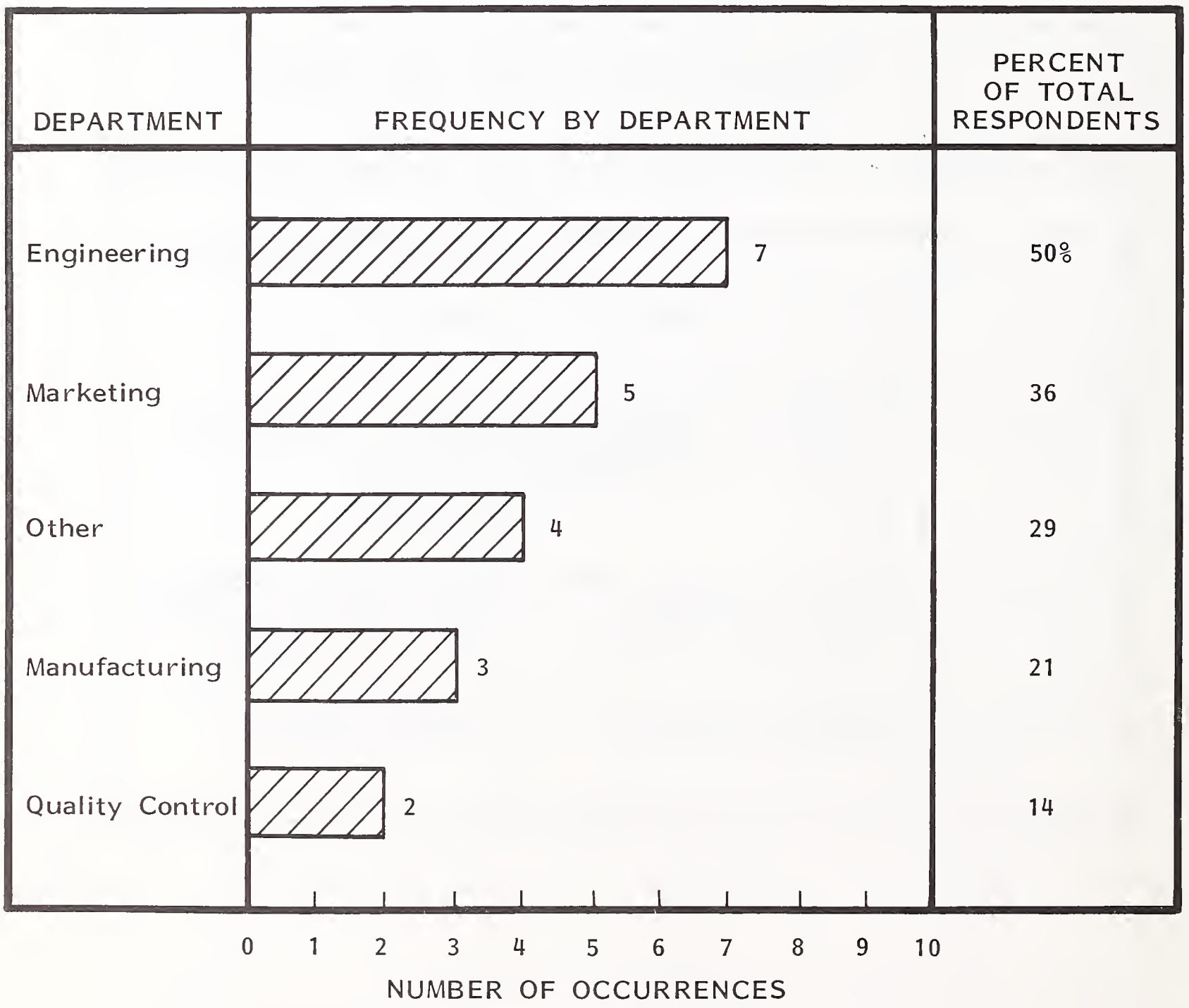
EXHIBIT III-5

RESPONSES THAT VARY BY PRODUCT LINE FOR
INTRODUCTION OF ADVANCED MAINTENANCE TECHNOLOGIES

RESPONDENT	PRODUCT LINE IN WHICH FIELD SERVICE IS:	
	MOST ACTIVE	LEAST ACTIVE
A	DP Equipment, Peripherals	Data Communications and Telephone Equipment
B	Multiplexor Systems	Modems
C	Terminals Only	-
D	Information Displays, Microprocessor Design Systems	Test and Measurement Equipment
E	Systems	Chip Level
F	Those Requiring On-Site Service, Terminals, Front-End Processors	Those Requiring Whole Unit Swapping, Modems And Low-End MUX's
G	Large End User Products, Such as Terminals	Special System or Low Volume Products

EXHIBIT III-6

ACTIVITY OF OTHER DEPARTMENTS IN
INTRODUCING ADVANCED MAINTENANCE TECHNOLOGIES



TOTAL NUMBER OF RESPONDENTS - 14

- The number of departments other than field service that are involved in introducing new maintenance technologies is distributed as follows:

  . Two respondents (14%) have no other departments involved.

  . Five respondents (36%) have one other department involved.

  . Four respondents (29%) have two other departments involved.

  . One respondent (7%) has three other departments involved.

  . Two respondents (14%) have four or more other departments involved.

E. PHASE REVIEWS

- Two basic approaches were found for phase reviews in the companies interviewed. One approach has a time-related basis, where phase reviews are periodic. The other approach is based on a set number of phase reviews, which parallels the steps in the product design process.

  - Of the 15 vendors interviewed, seven indicated that their firm's phase reviews are on a time-related basis. Weekly phase reviews were cited by four of these seven respondents.

  - Seven of the 15 also indicated a set number of phase reviews. The average number of phase reviews in these firms is six, with the low response being four and the high eight.

  - One of the 15 vendors responding to this question indicated a combination of time-related and set reviews. This respondent identified three design phase reviews, plus weekly phase reviews.

- Field service is very active in phase reviews. On a scale of 0 to 10 (0 = low, 10 = high), the firms interviewed rated field services activity in this area as a 9.1, with a low response of 3 and a high response of 10.

- Comments of those individuals interviewed about phase reviews in their company are as follows:

  - "We have independent product reviews, which are done by other organizations in the company that are not involved in that specific product. They are set up to be sure the product meets the business objectives."

  - "Phase reviews are done each week with each department, including field service, manufacturing, marketing, software, engineering, and financial. They're a pain in the neck."

  - "They are done perpetually by each department. They may be weekly, daily, or even hourly."

  - "There are lots of them; I don't know the exact number. Each director that is respondible for a product calls reviews to meet his own objectives."

  - "We have hundreds. Officially we have weekly product reviews, but there's always lots of sub-meetings."

F. SIGN-OFF AND VETO OF PRODUCT DESIGNS

- An activity level of 6.7 on a scale of 0 to 10 is indicated for field service relative to final sign-off authority on new product designs.

- Of the 15 individuals responding to this question, four gave a rating of 0, which indicates that field service never has a sign-off authority. Nine of the 15 respondents gave a rating of a 10, which indicates field service always has a final sign-off authority.

- For those firms rating field service sign-off authority as a 0, a review and documentation process was common. The following comment by one respondent indicates this:

  . "Field service can review and document its findings to the appropriate general manager or vice president of the systems division. We can recommend, but the Vice President doesn't have to accommodate all of our recommendations. It's the same for all departments. In the event of a severe disagreement, the president of the company is the final arbitrator."

- Firms rating field service sign-off activity as a 10 made the following comments:

  . "Field service has to sign-off after the product definition, the quality test plan, and after the final design review."

  . "No product leaves the company without acceptance by field engineering."

  . "All departments have final sign-off authority. Field service gets one vote like everyone else."

• All the vendors interviewed have some provision for veto in the product design process.

  - A common justification for veto is a product design that does not meet the design review specifications or milestones.

- Vetoes are most frequent early in the design process, although some companies have a final review late in the process that may result in a product veto.

- Many times a veto is affected by withholding a sign-off. In other words, nonconcurrence is an effective veto.

- Some comments from individuals interviewed that indicate the nature of the veto in the product design process are as follows:

  . "In a sense we have a veto. If the signatories don't agree, it's either resolved or moved on to the next higher management level. It's a nonconcurrence procedure which escalates it. It isn't a function of majority rules."

  . "We have a modified provision for veto. It's not exercised lightly. We can't unilaterally stop a product from being shipped, but we can raise enough hell."

  . "As we near the end of the development cycle, costs can be measured by manufacturing. If the margins are found to be 'out to lunch' the product can be stopped. Inadequate manpower resource can also stop it."

- Field service's activity level in exercising a veto in the product design process averages 6.6 on a scale of 0 to 10.

  - This average is based on 15 vendor responses, with three respondents rating the activity level as 0, and seven respondents giving a high rating of 10.

  - Comments made by respondents indicating that field service is never given a veto option are as follows:

. "None of the departments are. Only the vice president of the appropriate division can do that, with the company president acting as final arbiter."

. "It's all political, with a lot of 'wheeling dealing.' "

- Vendors that indicate field service always has the option of vetoing a new product design made the following comments:

. "I can pull the plug at any time. I have done it at the end of the product design process a couple of times because the product missed reliability specs. Most often, though, it's a matter of modification, and a compromise is obtained."

. "The option for veto occurs at the manufacturing prototype stage. Here field engineering can stop the product. It's not optional. It's required that each product meets the equipment reliability and safety feature requirements."

G. PERFORMANCE FEEDBACK AND CONTINUATION ENGINEERING

- Field service's level of activity rating in continuation engineering is an average of 9.2 on a scale of 0 to 10.

  - Eleven of the 15 respondents to this question rated their field service department's level of activity as a 10.

  - Performance feedback is a key responsibility for monitoring new products in the Beta test phase, or in the early production phase.

  - The call reports from the field service engineers are key in the performance feedback mechanism.

- While field service is responsible for gathering performance feedback data, it is almost always reported to the engineering department. In most cases, this involves formal weekly and/or monthly reports.

- Computerized tracking systems are indicated by 47% of the 15 vendors interviewed. Frequently, these automated systems are a computerized method for recording and analyzing the manual field service reports.

- Comments on performance feedback in the vendor companies interviewed are as follows:

  . "For field service, performance feedback is 'like sending in your timecard to get your paycheck.' We use an on-line dispatch system to monitor FEs and failures. This information goes into our performance feedback system, and then goes to engineering. I have an on-line report of customer complaints, and I monitor it daily."

  . "It is field service's engineering group that monitors the product after it's installed. Field service is the first line to see the problem, and offer a solution if it can. If not, it goes to engineering."

  . "Continuation engineering and performance feedback are large problems for field service. We don't have an automated system, and we are 'dying for it.' We can isolate a problem, but we cannot communicate enough to engineering for them to fix it."

- Continuation engineering after the product is first installed is generally the responsibility of the engineering department.

  - Field service may offer solutions to a problem, but the problem remains the responsibility of the engineering department.

  - Of the 15 vendors interviewed, 93% mentioned engineering as the responsible department for continuation engineering.

IV IMPACTS OF ADVANCED TECHNOLOGIES ON PRODUCTS, DELIVERY METHODS, AND PRICING

IV IMPACTS OF ADVANCED TECHNOLOGIES ON PRODUCTS, DELIVERY METHODS, AND PRICING

A. TECHNOLOGIES OF IMPORTANCE TO MAINTENANCE

- Based on the vendors interviewed, maintenance is not technology driven.

  - When asked to cite the advanced technologies that are important to maintenance, many of the respondents did not express any strong opinion on the matter.

  - Even when such technologies as VLSI, lasers, fiber optics, satellites, or bubble memories were suggested, a response was not always forthcoming. In fact, in some cases the respondent indicated that the technology was irrelevant to maintenance design currently. In other words, there is no need perceived by vendors to pioneer technologies. The technologies to be used by maintenance are already there, and it is application that is needed.

- Taken in this context, Exhibit IV-1 indicates the vendor perceptions of technologies that are important to maintenance.

  - The application of existing technologies was cited as being important by 43% of the 14 vendors responding.

EXHIBIT IV-1

TECHNOLOGIES IMPORTANT TO MAINTENANCE

TECHNOLOGY	NUMBER OF RESPONDENTS	PERCENT OF RESPONDENTS
Application of Existing Technologies	6	43%
VLSI or LSI	6	43
Microprocessor Technology	4	29
Fiber Optics	2	14

BASED ON A TOTAL OF 14 VENDOR RESPONSES

- VLSI or LSI is also cited by 43% of the vendors as a technology important to maintenance today.

- In addition to microprocessor technology and fiber optics, other technologies that were mentioned include the following:

  . The key technology is cheapness of "hardware relative to software." "Soft" technologies such as programming efforts are what are important.

  . Machine structure, partitioning, and other advanced "processes" are more important than technology.

  . On the mechanical side, the use of plastics in such things as motors is important. Processing changes such as laser welding are also important to the ease of building structural parts on a small scale.

B. IMPACT ON MAINTENANCE DESIGN OF PRODUCTS

1. VENDOR MAINTENANCE OBJECTIVES

- Vendors were asked to rate the general maintenance objectives being implemented with advanced technology. The responses to this question are shown in Exhibit IV-2.

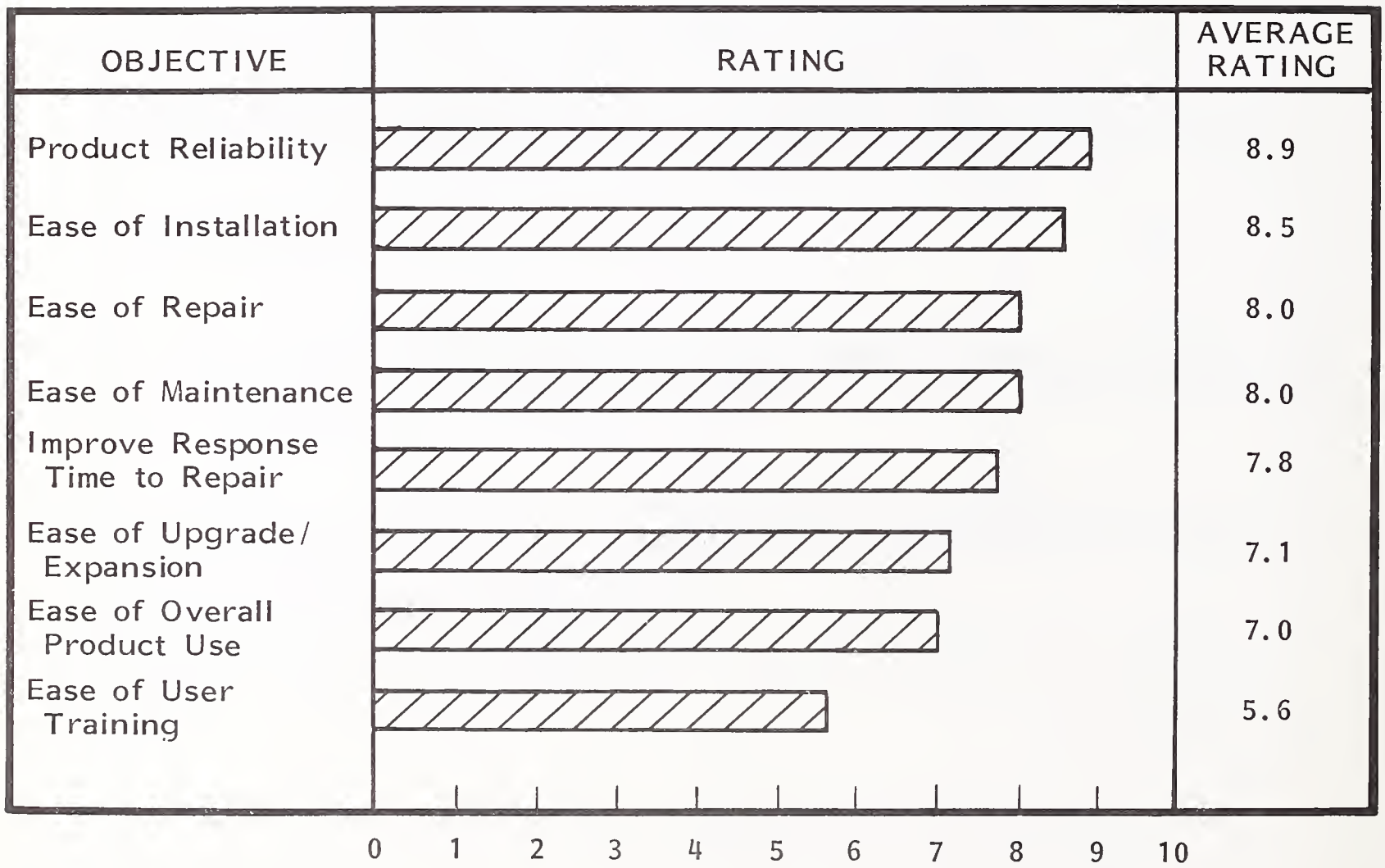
  - The eight maintenance objectives each vendor was asked to rate include the following:

    . Increased product reliability.

    . Ease of installation.

EXHIBIT IV-2

ADVANCED TECHNOLOGY:
VENDOR MAINTENANCE OBJECTIVES



BASED ON 15 VENDOR RESPONSES

* SCALE 0 - 10 (0 = NO IMPORTANCE, 10 = HIGH IMPORTANCE)

. Ease of repair.

. Ease of maintenance.

. Improved response time to repair.

. Ease of upgrade/expansion.

. Ease of use.

. Ease of user training.

- The average rating given for all of these maintenance objectives is 7.6 on a scale of 0 to 10 (0=low, 10=high).

  . The maintenance objective given the highest rating by vendors is product reliability, which has an average rating of 8.9

  . The maintenance objective receiving the lowest rating is ease of user training, which received an average of 5.6.

  . With products emphasizing user maintenance, primarily terminals, the importance of ease of user training can be expected to increase.

- An additional maintenance objective that was mentioned by one vendor is customer uptime, to which he gave an importance rating of 10. This, of course, is another vote for the importance of product reliability.

- Three of the vendors interviewed did not differentiate their maintenance objectives. Comments made by these vendors are as follows:

  - "All of these (the eight objectives mentioned above) are part of the bottom line. What we need to provide are the intangibles to make the

customer happy. Long-term profitability is the key to using advanced technology."

- "All of these are equal. You can't have one without the others."

- Twenty-nine percent of 14 vendors differentiated their maintenance objectives by product type. In each of these cases, terminals were mentioned as the product category being most suited to a high degree of advanced maintenance technology.

- Many of the comments made by the vendors interviewed are useful in reflecting the attitudes toward these various maintenance objectives. Some of these comments, categorized by objectives, are as follows:

  - Increased product reliability.

    . "I hate to keep saying 10, but that's also very high."

    . "There's a whole group formed for this. It's a trade-off with response time."

  - Ease of installation.

    . "We have an emphasis on that, and the emphasis for each generation of product probably gets to be more."

    . "Relative to terminals, we've developed a maintenance strategy to do precisely this."

  - Ease of repair.

    . "We will trade off ease of repair for reliability. By opting for reliability we save money because we don't have to send the field engineer on site."

- "For us, it's more a matter of problem determination. We feel there is a need to isolate our equipment as the one having the problem in a multivendor environment."

- Ease of maintenance.

  - "This is particularly important so we can get the customers to do it."

  - "This is particularly important for printers. The competitive situation requires that we design our printers so that they basically require no ongoing maintenance activities such as PMs."

  - "We don't use high technology for this, because our equipment is already designed to eliminate PMs."

  - "That's very high on our priorities. If we could eliminate maintenance, that would be a success."

  - "We are particularly interested in using technology to develop user diagnostics."

  - "The focus here is to remove the need for preventive maintenance."

- Improved response time to repair.

  - "Product design doesn't affect this."

  - "Centralized dispatch is a major technique we use to meet this objective."

- Ease of upgrade/expansion.

- "Our company is known for this."

- "That's very high."

- Ease of use.

  - "I don't see that this is an area affected by maintenance technology. It's picked up by other departments in the company."

  - "Human engineering is absolutely vital."

  - "Product use and maintenance are separate items."

  - "In an interactive environment, this is more important. We probably don't do as well here as we believe we should."

- Ease of user training.

  - "It's very important, otherwise users are calling service all the time."

  - "For printers, it's not important. Manual training is enough. But that's probably due to the nature of the equipment."

  - "We are not applying technology to this area. We have regional training centers as the first level, and then the field engineering (force) trains on site."

  - "It doesn't relate to maintainability."

  - "Software technology is doing this."

2. VENDOR PRIORITIES OF MAINTENANCE FEATURES

- Vendors were asked to rate the importance of applying technology to implement a range of specific maintenance features. These features, and the average ratings given to them by the vendors, are shown in Exhibit IV-3.

  - The overall average rating for all the maintenance features listed in Exhibit IV-3 is 7.1. The highest rating is 9.4, which is given to using technology for designing field replaceable units, such as board swapping. The lowest rating is 3.2, which is given to the use of technology to design alternate board circuits.

  - Of the 15 vendors that provided these ratings, two did not significantly differentiate among the priorities given to the various maintenance features in design of their products.

- A number of respondents gave additional maintenance features that their firms are implementing with advanced technology. These are as follows:

  - Automated technical data bases, which are tied into remote diagnostics. Primarily these are used to keep files of known problems.

  - Automatic error logging for disk systems, which allows the field engineer to rapidly check out a system when he calls on-site.

  - Disposable subassemblies.

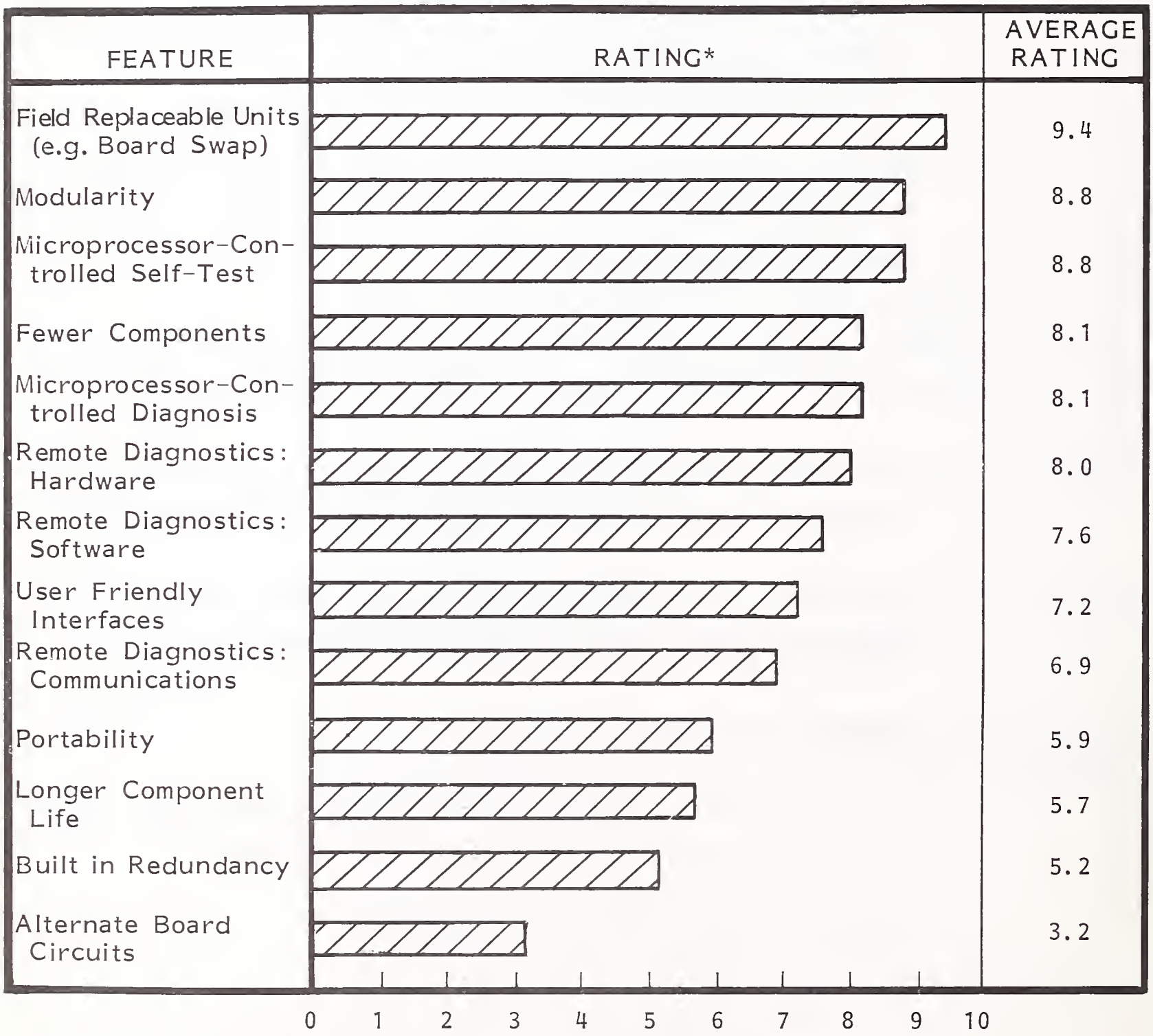
    . "Our firm is looking at it, and its prospects look good. Within one to two years we should see a shift toward it."

  - Signature analysis, especially for terminals.

    . "This is a diagnostic tool that allows the unit to cycle in a microprocessor loop that stimulates most of the logic. It's a kind

EXHIBIT IV-3

ADVANCED TECHNOLOGY: VENDOR PRIORITIES OF MAINTENANCE FEATURES



* SCALE 0 - 10 (0 = NO IMPORTANCE, 10 = HIGH IMPORTANCE)

of microprocessor self-test, but it doesn't depend on the rest of the device working."

- Many of the comments made by the vendors during the interviews are useful in reflecting attitudes toward the maintenance features being designed into products. Some of these comments categorized by maintenance feature are as follows:

  - Field replaceable units (e.g., board swap).

    . "There is very little of anything left that doesn't use this concept."

    . "We try to have a few dissimilar parts as possible."

    . "That's engineering's responsibility, not field service's."

    . "This is a particularly high priority for our systems products."

  - Modularity.

    . "Extremely high."

    . "The degree of modularity we design into a product depends on the sophistication level of the product."

    . "That has become a key part of any product. We have a very high focus on it."

  - Microprocessor-controlled self-test and/or diagnosis.

    . "That, along with remote diagnostics, is a top priority item for us. A major source of our customer calls is trying to decide whether the problem is hardware, software, or communications.

We'd look to this kind of thing to reduce our number of customer calls by 15%-20% eventually."

. "All of our products have microprocessor self-test and diagnosis."

. "These are under the 'very active' category for us."

- Fewer components. A number of the vendors interviewed indicate that the components are engineering's responsibility rather than field service's.

. "It's engineering's job to build it cheaper."

. "That is a trade-off. You can put everything on one board and then if something fails, everything goes at once."

. "Since we sell a good deal OEM, we go with what our customer base wants."

. "That's vital."

. "That is a coming focus. It's something we're working on because cost is related to the number of components."

- Remote diagnostics.

. "Remote diagnostics are absolutely vital. You gain two things. First, you don't have to dispatch an FE to a site that doesn't have a failure. In data communications, this is especially vital. Secondly, with the manpower shortage we have, you can make the best use of your top FEs."

- "For hardware and software diagnostics, our machines are designed with the capabilities, but we don't have a center yet. We'll start one probably late in 1981. We have no plans for remote communications diagnostics."

- "Although we are doing it more and more, we're really just getting started."

- "I don't see that remote diagnostics are offering us a great deal at this time. You can diagnose remotely, and that's a benefit, but you can't repair it locally with remote diagnostics. With software, remote diagnostics get more attention from us, because you can ship a patch down line."

- "We think of remote diagnostics in terms of our large mainframes only."

- User-friendly interfaces.

  - "The emphasis in our products is on flexibility instead of ease of use. We don't like to admit it, but it is probably true."

  - "I'd have to rate that as a seven, because it helps the FE as much as the customer."

- Portability.

  - "That's a low priority for us since CPUs and peripherals are the bulk of our business."

  - "We design for portability within units, not for the whole unit."

  - "That's not a critical issue for us because we don't have small systems."

- "The Japanese competitive impact on printers is forcing us to this. As a result, we have designed some UPS-size printers."

- Longer component life.

  - Once again, many of the vendors cited that component life is engineering's responsibility, not field service's.

  - "We do try to select components that are good, particularly the ICs that we purchase OEM. It's not a key issue, but we're not going to throw them away."

  - "It's a very high priority for us."

  - "It's a high priority because it goes along with eliminating PMs."

  - "I have no feel for this. It's an engineering concern."

  - "That's harder to pin down, because we're often at the mercy of our vendors."

- Built-in redundancy.

  - "The only redundancy we have is the power supply."

  - "This is especially important for our systems products."

  - "Redundancy is an engineering concern, not a field service concern."

  - "We try to put in higher quality instead. Redundancy is too expensive."

  - We really don't design for redundancy at all."

. "That's a tough one. You have to trade off costs. Redundancy severely reduces the actual reliability of a product. It allows the equipment to bypass a failure, but a failure has still occurred. I've known users to get paranoid because they're already using the backup, so they have nothing left to fall back on."

. "It's an area we're exploring."

- Alternate board circuits.

. "We don't have alternate circuits that are brought in automatically, but it is built into the board, and the FE can do it."

. "That is mainly a mainframe feature."

. "We use an alternate circuit approach on our more complex products."

C. IMPACT ON MAINTENANCE DELIVERY METHODS

- Vendors were asked to rate maintenance delivery methods that advanced technology is being used to support. The delivery methods that are rated include on-site repair, user self-maintenance, and depot maintenance.

  - User self-maintenance is further categorized by the following activities:

    . Installation.

    . Diagnosis.

    . Repair.

- Depot maintenance generally includes both mail-in and walk-in activities. Except in two instances, the vendors interviewed did not differentiate between these two methods of depot service.

- Exhibit IV-4 shows the vendors' ratings of these various maintenance delivery methods.

- On-site repair is cited as the primary delivery method supported by the use of advanced technology.

- While user self-maintenance is given an overall average rating of 5.5, there is significant variation within the category by the type of activity.

  - Diagnostic activity has the highest rating (7.7) for self-maintenance.

  - Installation has the second highest rating (5.7) for self-maintenance.

  - Repair is by far the lowest priority activity (3.1) for self-maintenance.

- On depot maintenance, the 15 vendors interviewed indicated the following:

  - Six of the vendors indicated that they are doing no depot maintenance at all.

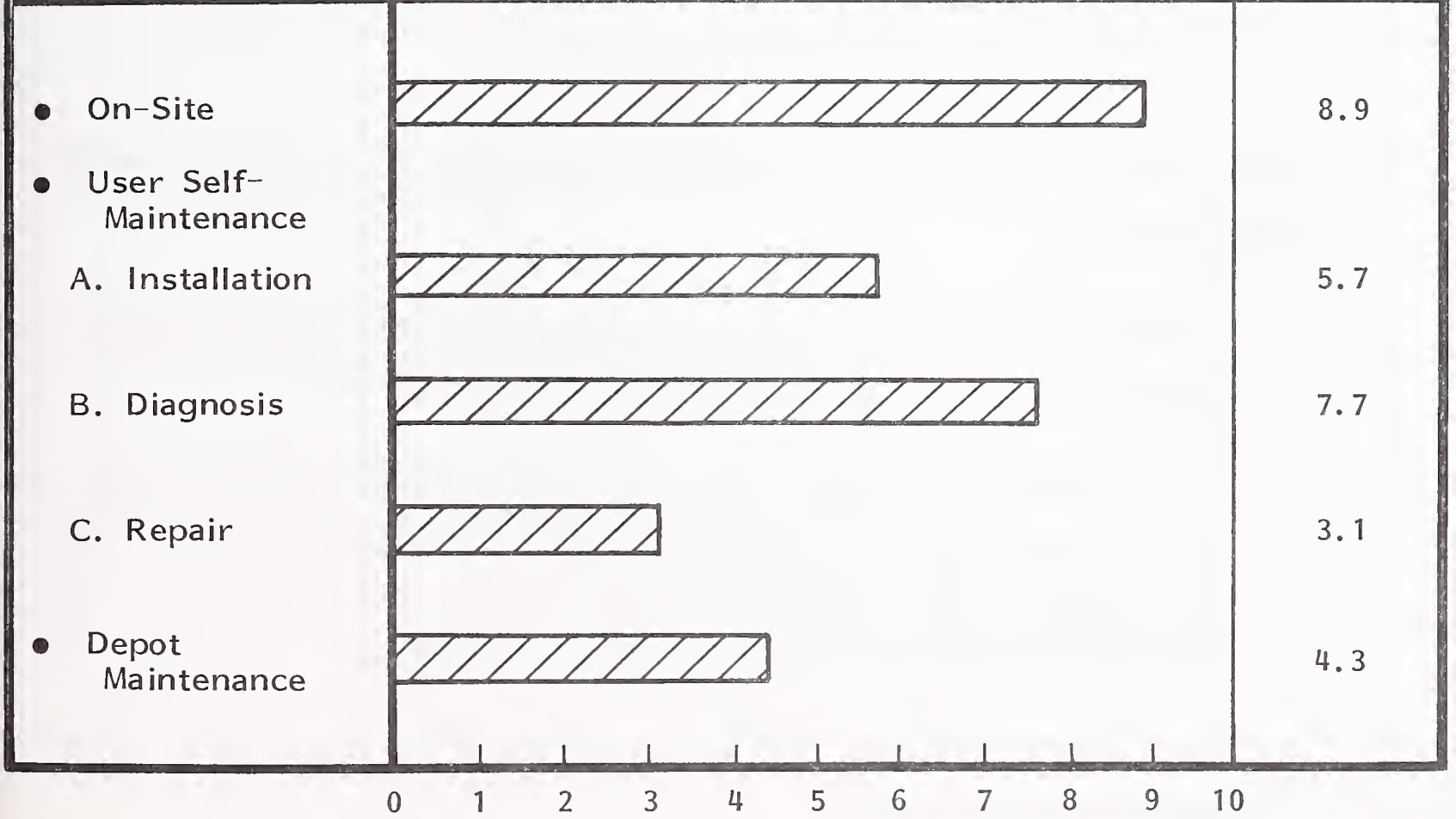
  - Of the vendors that indicated they are doing some form of depot maintenance a rating of 6.9 was the average.

  - Three of the vendors differentiated the priority their firm places on depot service by product type. In each case, terminals were given the high rating, while systems and mainframes were given a low rating.

EXHIBIT IV-4

MAINTENANCE DELIVERY METHODS SUPPORTED WITH TECHNOLOGY

METHOD	AVERAGE RATING
• On-Site	8.9
• User Self-Maintenance	
A. Installation	5.7
B. Diagnosis	7.7
C. Repair	3.1
• Depot Maintenance	4.3



*SCALE OF 0 - 10 (0 = LOW, 10 = HIGH)

D. IMPACT ON PRICING

- Vendors were asked to assess the impact of advanced maintenance technologies on prices of maintenance and products. These results are shown in Exhibit IV-5.

- Approximately one third of the vendors interviewed believe that advanced maintenance technology has no impact on the pricing of either maintenance or products.

  - A number of respondents indicated that pricing is based on what the competition does, not on technology.

  - Another common response was that the impact of technology could not be segregated from its impact on pricing.

- Regarding the impact on the price of maintenance, the following results were found:

  - None of the vendor companies interviewed believe advanced maintenance technology will increase the price of maintenance.

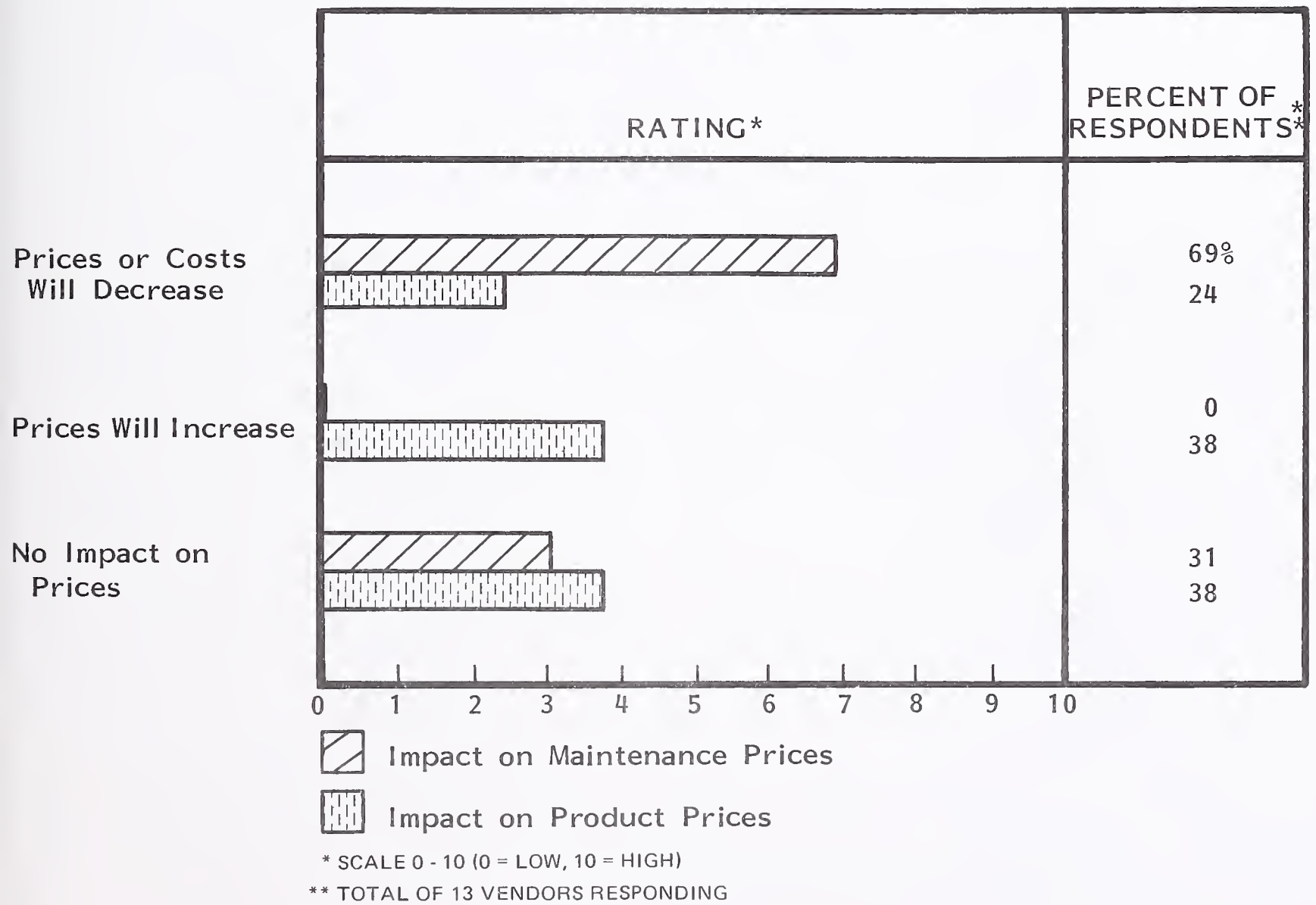
  - The majority of vendors (69%) interviewed believe advanced maintenance technology will decrease the price for maintenance, or at least will reduce costs. Whether the full amount of the decrease would be passed on as lower prices is uncertain to many vendors.

- On the impact of advanced maintenance technology on product pricing, the following results were found:

  - There is less consensus regarding the impact on product pricing than there is on the impact on maintenance pricing.

EXHIBIT IV-5

IMPACT OF ADVANCED MAINTENANCE TECHNOLOGY ON PRICING



* SCALE 0 - 10 (0 = LOW, 10 = HIGH)

** TOTAL OF 13 VENDORS RESPONDING

- Thirty-eight percent of the vendors interviewed indicate that prices will increase for those products that are designed with advanced maintenance technologies.

- A slightly lower percentage of the vendors interviewed (24%) indicate that prices or costs will decrease for those products designed with advanced maintenance technologies.

V IMPACTS OF ADVANCED MAINTENANCE TECHNOLOGIES ON FIELD SERVICE PERSONNEL

V IMPACTS OF ADVANCED MAINTENANCE TECHNOLOGIES ON FIELD SERVICE PERSONNEL

A. NUMBER OF PERSONNEL REQUIRED

- Most of the vendors interviewed believe that fewer field engineering managers and technicians will be required for products designed with advanced maintenance technologies.
  - Of the vendors interviewed, 75% believe fewer field service managers will be required.
  - Eighty-four percent feel that fewer field service technicians will be required.
- Some of the respondents indicated that there will be a shift in the types of personnel, both management and technician, that will be required.
  - For management, this shift is seen to be as follows:
    - There will be a different type of manager required. They will be required to manage depots, and sell more services. Business management will become much more important, and will have to concentrate on customer satisfaction.

  - A different management structure will be required as the skill structure of the technician is shifted. Managers in field engineering will have to have more of a business orientation and take on more profit-and-loss responsibility.

- For technicians, the following comments were made:

  - "Overall, fewer will be required, although the numbers in a depot environment will increase."

  - "I think there will be a shift toward depot maintenance. As a result, I think we'll see the general industry that will have a lower cost person in the field, and the highly qualified people in a depot. In our individual case, however, we will increase our depot support, but we are going to have to continue to have very high qualified technicians in the field."

B. DEMAND FOR INTERPERSONAL SKILLS

- The vendors interviewed anticipate a relatively mild impact on the requirement for interpersonal skills based on increased maintenance technologies.

- On a scale of 0-10, the impact on management is expected to be 4.5, and the impact on technicians 4.8. Of the 13 vendors responding to this question, two indicated that the requirement for interpersonal skill is not affected by technology.

- The majority of the vendors felt that the impact would be to increase interpersonal requirements at both the management and technician level. In some instances a relatively low rating was given by the respondent because he felt that the requirements are already very high in this area, and that technology would not be especially significant in impacting this already high level.

- In a couple of instances, a decrease in interpersonal requirements is expected at one level with a compensating increase in interpersonal requirements at another level. In one instance, a respondent anticipated reduced requirements at the management level, and increased requirements at the technician level. Other vendors felt that it will happen just the other way around.

C. SKILL REQUIREMENTS

- Vendors were asked to assess the impact advanced maintenance technology has on the skill requirements for field service management and technicians relative to hardware, software, and communications. These results are shown in Exhibit V-1.

  - Lower skills requirements are expected for hardware, while higher skills requirements are expected for both software and communications.

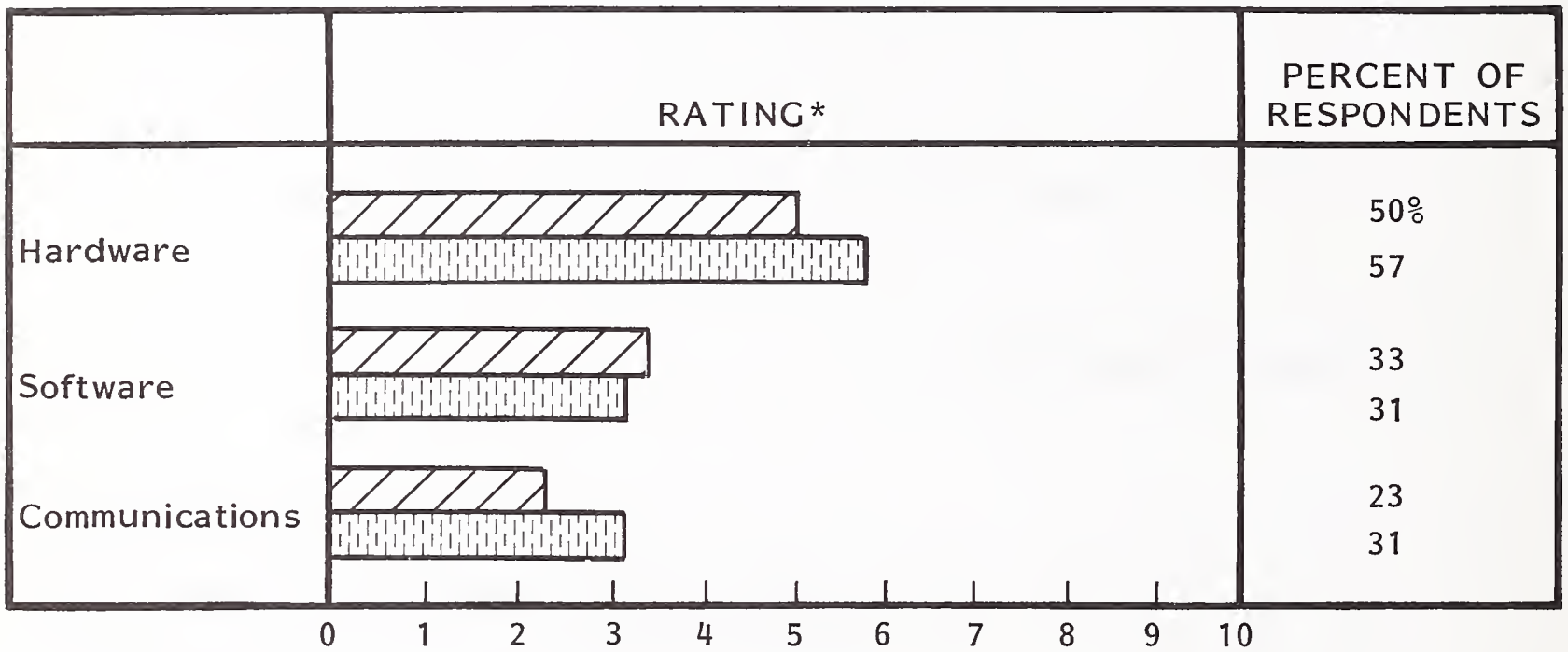
  - There is not a great difference between the skills expectations for management versus technicians.

- While most vendors expect a change in field service skills requirements at both the management and technician level due to advanced technology, there is not a consensus as to whether higher or lower skills levels will be required.

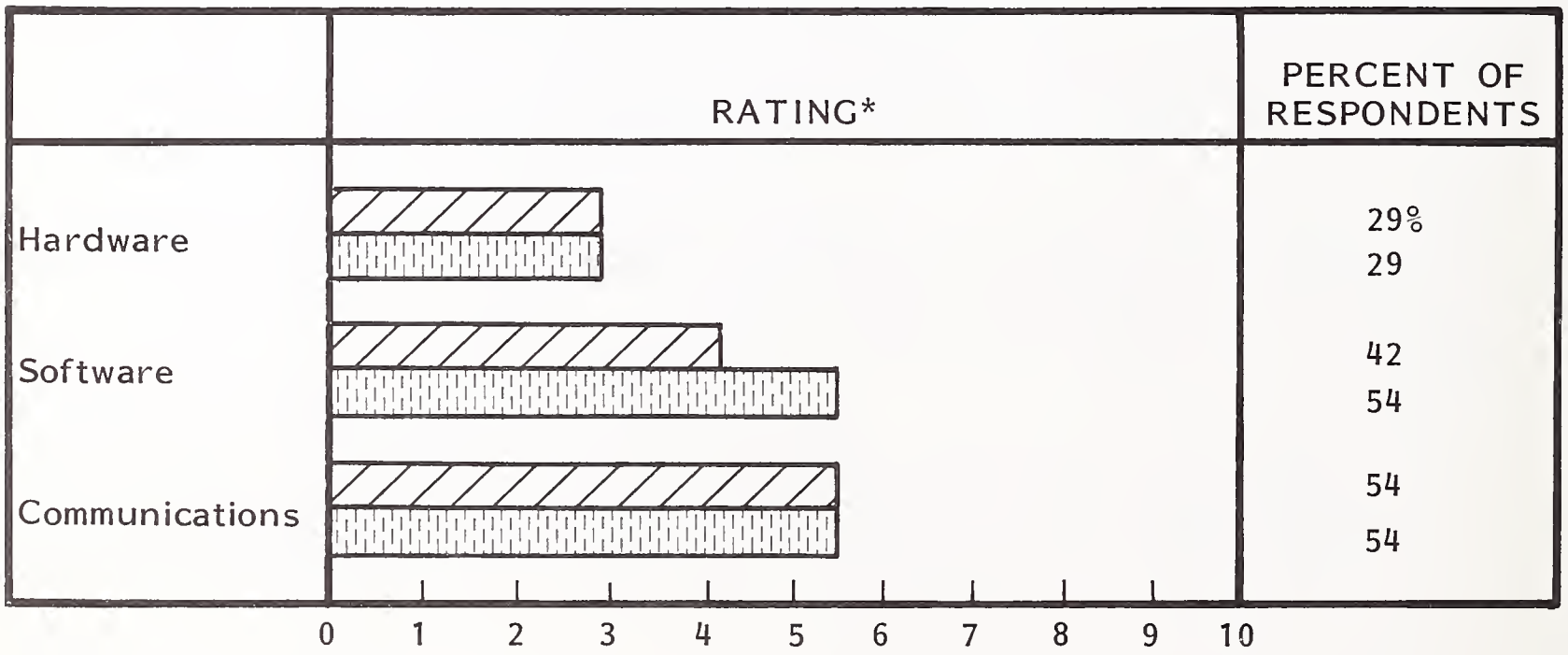
EXHIBIT V-1

IMPACT OF TECHNOLOGY ON SKILLS REQUIREMENTS OF FIELD SERVICE PERSONNEL

PERCENT OF RESPONDENTS EXPECTING LOWER SKILLS REQUIREMENTS



PERCENT OF RESPONDENTS EXPECTING HIGHER SKILLS REQUIREMENTS



AVERAGE NUMBER OF VENDORS RESPONDING = 13

* SCALE OF 0 - 10 (0 = LOW, 10 = HIGH)

- By combining and averaging the data in Exhibit V-1, an indication can be obtained relative to the expected impact on overall field service skills requirements.

- At the management level, 42% of the vendors responding expect increased overall skills to be required, while 35% expect a lower requirement.

- At the technician level, 46% of the vendors responding expect an increase in overall skills requirements, while 40% of the respondents expect lower skills requirements.

- At the management level, 23% of the vendors responding expected no impact on skills requirements due to advanced maintenance technology. At the technician level, 15% of the respondents felt there would be no impact from advanced technology.

D. TRAINING

- A moderate impact on the training of field service management and technicians is expected as a result of advanced maintenance technologies.

  - At the management level, the impact of technology on training is rated at 5.0 on a scale of 0 to 10 (0=low, 10=high).

  - At the technician level, the impact of technology on training is rated at 6.4.

- At the management level, the changes in training are expected to have the following characteristics:

  - A general increase in the amount of training required is expected.

- The following types of training are expected to receive increased attention:

  . Business aspects.

  . Management of depots.

  . Total systems service.

- Some of the comments on the impact on training at the management level are as follows:

  . "Training will be less detailed. The need to think in minute detail goes away with increased technology."

  . "Increased training will be required for field service managers as we go to a system concept as opposed to discrete boxes. This is especially true in communications."

  . "As the state-of-the-art changes, increased training is required."

  . "Field service managers will spend an increasing amount of time managing costs. In our company, this means they will become more manufacturing oriented than field oriented. Therefore, managers will not need as intensive training for the field, but will require more intensive training with a depot and systems emphasis."

- At the technician level, the changes in training are expected to have the following characteristics:

  - Advanced maintenance technology is expected to have somewhat of a greater impact at the technician level than the management level. Whether this impact will be to increase the amount of training required

or to decrease it seems less certain. The vendors interviewed are fairly evenly split between these two positions.

- The following comments were made by vendors expecting a decrease in the amount of training required at the technician level:

  . "Technology reduces the amount of training required. When I started in the business, I was in training for six months. Now the technicians go for six to seven weeks, and learn levels of magnitude more. It should decrease the training requirements because the rules will be simpler. Anyone should be able to push the buttons."

  . "Reducing the amount of training required for technicians is a clear cut goal of technology."

- Comments made by vendors expecting an increase in the amount of training required at the technician level are as follows:

  . "There will be a split between low-level and high-level technicians. The higher level person will be better than the average person is today, and will need to be trained to be a problem solver."

  . "Increased specialization will mean increased training."

  . "We will have to increase software and communications training for technicians."

  . "Technicians will have to be trained in the customer service and problem determination aspects."

E. OTHER IMPACTS ON PERSONNEL

- Two other impacts that were cited by the vendors interviewed involved technology's effect on the education level of field service personnel, and the impact on career paths within field service.

- One vendor speculated that wages and costs will go up as the trend toward increasingly sophisticated maintenance technology increases. As a result, more engineering will become involved in field service. Even equipment such as printers now require such things as software and fiber optics. Therefore a higher education level will be required for individuals entering field service.

- Another vendor expects a major impact from technology to be the redefinition of career paths for field service. He believes this will occur at both the management and technician level. Formerly, technical expertise was the way to advance within the field service organization. However, if technical requirements are reduced, the criteria will need to be redefined.

VI IMPACTS OF ADVANCED MAINTENANCE TECHNOLOGIES ON THE FIELD SERVICE ORGANIZATION

VI IMPACTS OF ADVANCED MAINTENANCE TECHNOLOGIES ON THE FIELD SERVICE ORGANIZATION

A. RELATIONSHIP OF FIELD SERVICE TO SALES

- In the vendor companies interviewed, the equipment sales force is still most frequently responsible for selling maintenance products and services.

  - Six (43%) of the respondents have maintenance products and services sold by the equipment sales force.

  - Five (36%) of the respondent companies have maintenance sold by a field service sales force.

  - Two (21%) of the vendor companies have maintenance products and services sold by both an equipment sales force and a field service sales force.

- Most of the vendors interviewed expect an increased use of advanced maintenance technologies to support a separate field service sales force, if it has any impact one way or the other. When asked how increasingly advanced maintenance technology impacts maintenance sales responsibility in their companies, the following responses were given:

  - Sixteen percent of the respondents believe it supports equipment and equipment sales force having the responsibility.

- Forty-two percent of the respondents believe it supports a separate field service sales force having responsibility.

- Forty-two percent of the respondents believe that advanced maintenance technologies have no impact on the maintenance sales responsibility in their companies.

- In general, the vendors interviewed expect a moderate impact on the working relationship between field service and sales as a result of increasingly advanced maintenance technologies.

  - The extent of this impact is given an average rating of 5.3 on a scale of 0-10 (0=low, 10=high).

  - The nature of this expected impact is indicated by some of the comments made during the vendor interviews. Some of these are as follows:

    . "There will be an increased involvement of service in selling products. Product sales will no longer be driven solely by technology."

    . "There could be increased tension between the two departments. When strictly maintenance technology is involved, it's harder to get equipment sales interested. The maintenance technology must enhance the sales position."

    . "I expect it to be a major impact. Sales and service have to work together as a team. With more sophistication in technology, the requirements on field service will be greater."

    . "There will be an increased amount of direct contact between field service and a customer, without a sales interface."

- "Maintenance will become more important in the user's eyes, so sales and service are becoming more team members. It's a very dramatic change, mostly due to our company philosophy that service is important."

- "I think there will be a change. It may be somewhat subtle. Field service will function in more of a post-sales capacity. We will become more involved in the account, primarily due to networks. As a result, field service will become more dominant than it is now."

- "We are becoming much closer. Sales is seeing that field service is a more salient point in winning sales. Maintenance has become key in product differentiation."

- "There has to be a closer relationship between field service marketing and product marketing. We must coordinate presenting the user his options as maintenance technology becomes a more integral and important equipment feature."

B. DECENTRALIZATION VERSUS INTEGRATION

- Vendors basically see advanced maintenance technology having an integrated impact on the field service organization.

- The vendors interviewed were asked to assess the impact of advanced technology on decentralization or integration of the field service organization. The question was stated as follows:

  - "Many companies today have separate maintenance departments for hardware and software. How important is advanced technology in creating similar organizational decentralization in your company for

communications products, DP products, and word processing/office products?"

- Decentralization is expected by 27%. The degree of this impact is rated at an average of 5.5 on a scale of 0-10 (0=low, 10=high).

- Integration is expected by 53%. The degree of this impact is rated at 8.3.

. No impact of this nature is expected by 20%.

C. REVENUE OPPORTUNITIES

- Vendors were asked to rate the significance of the revenue opportunities generated by the use of advanced maintenance technologies. A moderately high rating of 7.3 is given on a scale of 0-10 (0=low, 10=high).

- The following comments made by the vendors during the interview indicate the nature of the revenue opportunities that are expected:

  - "The revenue opportunities can be very significant. Diagnosis is the key to maintaining equipment. Diagnostic techniques are proprietary, and spares inventory becomes more complex with increased technology. Therefore users rely more heavily on service, which gives service more leverage."

  - "I don't think the gains or losses will be that significant. The opportunity may even be negative. If it's so easy to maintain the equipment because of advanced technology, the users just might do it themselves."

- "You can do whatever you want with it. For instance, you can charge extra for special maintenance features, but the key is to be the first one out with it. If everyone has it, it's no big deal."

- "For our company, there are two major considerations. Design to support depot maintenance increases the geographic area we can cover. Profitability, however, is affected by the cost-containing aspects of technology."

- "No one likes to talk about how much you make in service. However, technology has brought in cost controls and increased efficiency. It helps us maintain profit margins from erosion by inflation."

- "It's difficult for me to answer that. Advanced technology will reduce labor overall, but it will increase the number of units installed as the fear of how to repair products declines. So in the long run, service revenues should take off."

- "Remote diagnostics is the main opportunity. Users are willing to pay just to find out where a failure is in a communications environment."

- "The potential opportunities from offering new services, and applying new technologies are incredible."

VII USER REACTION TO NEW TECHNOLOGIES

VII USER REACTION TO NEW TECHNOLOGIES

A. IBM AS A TECHNOLOGY INNOVATOR

- In the 1960s, much of IBM's success in the marketplace was credited to its sales and marketing prowess rather than to its product innovation.

  - The IBM Series 360, intended to offer 360 degrees of compatibility across scientific plus business applications, was certainly innovative at the time of its introduction.

  - As IBM Series 360 models were shipped into the market in the 1965-1970 period, however, a range of hardware and software problems had to be solved in the field; it is a time recalled vividly by many field engineers who were active at the time.

  - In the early 1970s, IBM's new products, notably the Series 370, were at best modestly innovative, as IBM pulled back from the rumored "Future System." The next series, the IBM 303X, was also evolutionary, rather than truly innovative. The field force had been given time to recover from the tumultuous days of the late 1960s.

- IBM's move to a more innovative product stance began to appear in the mid-1970s particulary in the area of peripherals.

- In printers, both a laser printer (the IBM 3800) and an ink jet printer (part of the Series 6 office system) were introduced.

- In storage, IBM achieved a major breakthrough in disk technology with the IBM 3340 Winchester Drive.

- It was not until 1979, however, that IBM introduced truly new products in the mainframe area; in 1979, the IBM 4300 and IBM 8100 series were unveiled, and with them a range of performance, pricing, and field service innovations.

  . Mainframe maintenance prices were reduced, in some cases over 70% compared to the System 370.

  . Software maintenance on-site was unbundled, with prices for contract maintenance in some cases over 30% of the license fee.

  . Support centers for software maintenance, rather than on-site software maintenance, were designated as the first line of software support; the support centers were offered as a bundled part of the software license fee.

  . With these products IBM has reestablished itself as a product innovator.

- To test user reaction to technological innovation such as represented by these IBM offerings, a series of 19 users of these systems were interviewed.

  - A single user of IBM's new 3101 Display Terminal system was also encountered and is included.

  - INPUT plans to do additional research on user reaction to this new low price primarily depot-maintained terminal in 1982.

B. USER RATINGS OF PRODUCT INNOVATION IN THE IBM 4300, IBM 8100, AND IBM 3101

- Of the 20 users surveyed, 15 had IBM 4300 systems installed. What is most striking about the responses received is the absence of any peak in user reaction to perceived benefits of the system.

  - As shown in Exhibit VII-1, users rated a wide range of potential benefits all at an almost equal level.

  - The potential benefits, from reliability to price performance to ease of use, all rated approximately an 8 on a scale of 0-10 (0=low and 10=high). In typical surveys, an 8 rating reflects a high level of user satisfaction, but not an outstanding level.

  - A conclusion of the IBM 4300 user survey is that the respondents are satisfied but that they do not have a clear image of a significant new benefit which came with this new product.

- Comparing the IBM 4300 user responses with a smaller number of IBM 8100 users and a single IBM 3101 user gives some insight into the differences between the products, as shown in Exhibit VII-2.

  - The product reliability rating of the IBM 8100 was impacted by a single user who rated it a "1" with the comment "lots of downtime." The user pinpointed his problem in the software with the explanation, "IBM doesn't seem to be able to handle the software." While hardly conclusive, this response is indicative of the more complex maintenance task in the distributed environments in which a product such as the IBM 8100 operates.

  - The IBM 3101 user who responded gave ratings which correlate well with other INPUT surveys relative to a user maintained product.

EXHIBIT VII-1

RATING OF BENEFITS BY USERS OF IBM 4300 SERIES

BENEFITS USER REALIZED FROM THE PRODUCT	RATING BY USERS	
	RANGE	AVERAGE
Ability to Self-Maintain	7-10	8.3
Increased Product Reliability	5-10	7.9
Lower Expenditures for Maintenance	6-10	7.9
Lowered Operating Cost of Product	5-10	7.9
Ease of Product Use	8-10	8.3
Speedier Repair*	7-10	8.3
Less Downtime Due to Maintenance Consideration	6-10	8.0
Increased Flexibility (re: moves and installs)	6-10	7.9
Better Overall Price Performance	6-10	8.0

* MEAN TIME TO RESPOND PLUS MEAN TIME TO REPAIR

RATING: 0 = LOW, 10 = HIGH

EXHIBIT VII-2

COMPARISON OF BENEFIT RATINGS AMONG USERS OF THE IBM 4300, 8100, AND 3101

BENEFITS USER REALIZED FROM THE PRODUCT	AVERAGE RATING BY USERS — TYPE OF IBM EQUIPMENT			WEIGHTED OVERALL AVERAGE
	4300	8100	3101	
Ability to Self-Maintain	8	9	6	8.3
Increased Product Reliability	8	6	9	7.6
Lower Expenditures for Maintenance	8	7	9	7.9
Lowered Operating Cost of Product	8	8	5	7.7
Ease of Product Use	8	8	6	7.7
Speedier Repair*	8	9	3	8.2
Less Downtime Due to Maintenance Considerations	8	9	3	8.1
Increased Flexibility (re: moves and installs)	8	9	8	8.2
Better Overall Price Performance	8	8	9	8.2
Total Number of Responses	15	4	1	-

* MEAN TIME TO RESPOND PLUS MEAN TIME TO REPAIR

RATING: 0 = LOW, 10 = HIGH

- The user gave low ratings to the self-maintain, speed of repair, and downtime aspects.

- The purchase decision in this case was based on price performance, as evidenced by high ratings for price and maintenance cost.

- This user may be typical of the response IBM has received from a range of users, in that IBM is now offering on-site maintenance on this product on a contract basis, an option which was absent when the product was introduced.

- When users were asked to rate disadvantages of a range of maintenance features, the same profile of a generally satisfied group of users emerged.

  - As shown in Exhibit VII-3, users rated the negative maintenance characteristics encountered as "no disadvantage," meaning they were not encountered in their experience with the IBM products.

  - No feature received an average rating as high as "2" among IBM 4300 and IBM 8100 users, a reflection of IBM's success in accentuating the positive benefits of these systems.

- The uniformity of user ratings on both the positive and negative features discussed concerning Exhibit VII-3 reflects the generally passive attitude of the respondents toward new product performance. The users evidence no strong consensus, rather a feeling that the products are "O.K. and not wonderful."

EXHIBIT VII-3

RATING OF DISADVANTAGES OF MAINTENANCE FEATURES BY USERS OF THE IBM 4300, 8100, AND 3101

MAINTENANCE FEATURE WITH POTENTIAL DISADVANTAGE	AVERAGE RATING BY USERS*			
	TYPE OF IBM EQUIPMENT			WEIGHTED OVERALL AVERAGE
	4300	8100	3101	
Requires Too Much Time by User Personnel	0.7	0	0	0.5
Inadequate Expertise by User Personnel	0.7	0	0	0.5
Inadequate Back-up by Vendor for Problems	0.4	1.25	0	0.6
Support Inadequate for Remote Sites	1.1	0	N/A	0.9
Parts Availability	1.4	0.7	0	1.2
Low Quality of Vendor Relations	0.0	0	0	0
Increased Downtime Due to Maintenance Considerations	0.0	0	5	0.3
Slower Repair***	0.0	0	5	0.3
Increased Overall Expenditures For Maintenance	0.2	0	0	0.2
Other	–	–	8**	0.4
Total Number of Responses	15	4	1	–

* RATING: 0 = NO DISADVANTAGE, 10 = GREAT DISADVANTAGE

** RESPONDENT STATED " IBM TECHNICIANS"

*** INCREASED

C. USER PERCEPTIONS OF CHANGES IN IBM RELATIVE TO THE NEW PRODUCTS

- To determine the users' perceptions of any changes in their vendor, or in the options the user has relative to pre-4300 days, users were asked a range of questions covering their total relationship with IBM.

- On the question of the form of the maintenance agreement under which they were operating, little shift had occurred. Of 20 users interviewed, 19 had been under contract versus time and materials, and intended to stay under contract. One user was shifting to time and materials because he was shifting to a purchase rather than lease basis on his three IBM 8100s.

- To the question of whether IBM field service personnel had increased or decreased in technical skill, only the IBM 3101 user (two terminals) perceived a change, and he saw a drastic decline. He also saw a decline in specialization talents of IBM maintenance personnel. His frustration may well be centered on the IBM depot which he described as "impossible to reach" and "faceless."

  - Users of the IBM 4300 and 8100 systems saw little change either in technical skill or degree of specialization.

  - Two IBM 4300 users perceived a decline in level of specialization because less diagnostic skill is required. These users saw no impact from this shift, because the decline in skill was compatible with the lower skill level required by the system.

- Although earlier INPUT surveys found an indication of dissatisfaction among some IBM field engineers because these new products often require lower skills, there was no perception of higher turnover of IBM personnel. All 20 respondents saw "no change" regarding IBM personnel turnover.

- The new products have had little impact on the level of service provided by IBM.

  - No respondent felt he had to deal differently with IBM. Comments included:

    . "One call does it."

    . "Still one call brings them rapidly on-site."

    . "Can be hard to get them here."

    . "Responds immediately."

    . "Service gets faster all the time."

  - This respondent sample indicates that the overall level of IBM service is remaining essentially constant.

- The respondents' reaction to mail-in equipment for depot maintenance was heavily negative.

  - Even the IBM 3101 user who felt he had no choice did not like it.

    . A typical comment was, "No need, on-site maintenance works well."

    . One user admitted to being "remote" and agreed to cooperate if IBM would send a replacement the same day the user sent the defective unit.

- With regard to doing self-maintenance, three of 20 respondents indicated a willingness to do some. This result is consistent with earlier INPUT findings that 80% of users are resistant to self-maintenance. The positive comments were:

  - "Some if needed."

  - "We do it whenever we can - we like to."

  - More typical was the comment, "Just don't do it!"

- Users were also asked about the number of user prompts the system provides to assist in user maintenance.

  - Among IBM 4300 users, 29% didn't know how many there were, 36% thought there were many, and 13% thought there should be more.

  - Among IBM 8100 users, 33% didn't know, 67% thought there were many, and 33% wanted more.

- Finally, with regard to the premium responding users were willing to pay for an on-site call versus depot, 19 of 20 declined to identify a level - a reflection of the fear that vendors would use this information to raise prices. The one user who responded identified 15-20% as the size of the increase.

  - Other INPUT research found this level of price increase to be below the "threshold of pain" for most users and within a range they will accept.

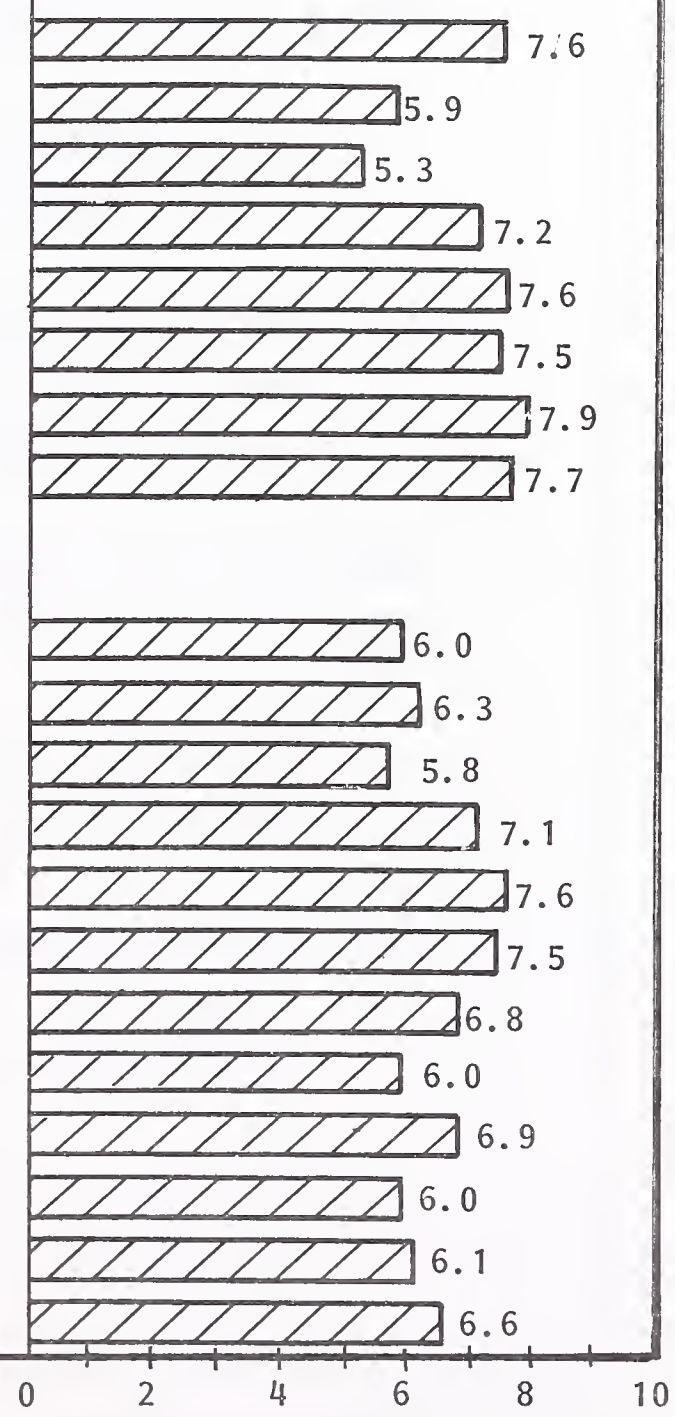
D. USER RATING OF DESIGN FEATURES

- As shown in Exhibit VII-4, a range of eight general features and 12 specific features were rated by the 20 responding users.

EXHIBIT VII-4

RATING OF ADVANCED MAINTENANCE FEATURES BY USERS RELATIVE TO FUTURE PURCHASES

MAINTENANCE RELATED FEATURE	LEVEL OF POSITIVE RATING* RANGE	AVERAGE RATING
General Features		
Ease of Installation	4-10	7.6
Ease of Use	3-10	5.9
Ease of User Training	5-10	5.3
Ease of Repair	5-10	7.2
Ease of Maintaining	5-10	7.6
Ease of Upgrade/Expansion	5-10	7.5
Increased Reliability	7-10	7.9
Improved Response Time	6-10	7.7
Specific Features		
Modularity	3-9	6.0
Portability	0-10	6.3
User Friendly Interfaces	4-10	5.8
Field Replaceable Times	3-10	7.1
Fewer Components to Increase Reliability	3-10	7.6
Built in Redundancy to Increase Reliability	3-10	7.5
Remote Diagnostics for Hardware	3-10	6.8
Remote Diagnostics for Software	2-10	6.0
Remote Diagnostics for Communications	0-10	6.9
Microprocessor - Controlled Self Test	0-10	6.0
Microprocessor - Controlled Diagnosis	3-10	6.1
Alternate Board Circuits	0-10	6.6



* RATING: 0 = LOW, 10 = HIGH.
RESPONDENTS INCLUDE IBM 4300 AND 8100 USERS

- Although users were given an opportunity to rate each of these features negatively, none did; this reflects the generally positive user attitude toward product innovation.

- Approximately 5% of the responses indicated a "neutral" position. These were treated as an "0" rating on the average values shown in the exhibit.

- As shown also in INPUT's 1981 User Survey and reported in the 1981 Field Service Annual Report, users rated "product reliability" as the most desired feature on future purchases.

  - Fewer components to increase reliability and built-in redundancy to increase reliability also rated high.

  - The success of Tandem with its redundant architecture is an exploitation of this user rating, as is the emphasis by Japanese producers on product reliability.

- The range of user responses shows that there is still much variance among them.

  - Criticality of the application being run will have an impact on the users' rating of variables; for example, reliability versus ease of use.

  - Remote diagnostics received ratings in the 6.0-6.9 range (0=low, 10=high). Users were most interested in remote diagnostics to solve communications versus hardware problems.

- The low level of rating for "ease of user training" is compatible with the low general interest in self-maintenance, as discussed earlier.

- It is of interest that responding users gave relatively low ratings to "ease of use" and "user friendly interface."

- This is a reflection of the makeup of the respondent; they were all EDP manager types, and not end users.

- A sample of end users would likely give a different rating on these features.

- Finally, users were asked to pick new maintenance features they would like to see designed with products. Responses were:

  - "Troubleshooting techniques."

  - "None. It's fine as it is."

  - "Displays that move forward and backward."

  - "Move the depot from Parsippany to a more accessible location."

  - "More performance measurement tools."

  - "More self-diagnostics." (Four mentions.)

  - "Remote diagnostics."

  - "Can't think of any they haven't."

  - "More selection on screen for automatic monitoring of maintenance by the user."

  - "Interactive partition dump facility."

- As in many user surveys, about half of the user sample does not suggest any features they would like to have, being willing to leave the task of feature development to the vendor. From the responses to the survey in this study, however, the frequency of mention of diagnostics in the above list of responses

is significant. It is an indication that users are willing to help in problem determinations, even if they are not willing to do total self-maintenance.

- In summary, the survey shows users of IBM's new systems to be satisfied with what they are receiving, and willing to consider further enhancements. They do not, however, voice strong desires regarding new products, and that task remains with the vendors.

APPENDIX A: DEFINITIONS

APPENDIX A: DEFINITIONS

- DISTRIBUTED DATA PROCESSING - Distributed processing is the deployment of programmable intelligence in order to perform data processing functions where they can be accomplished most effectively, through the electronic interconnection of computers and terminals, arranged in a telecommunications network adapted to the user's characteristics.

- DISTRIBUTOR - Purchases the small business computer on an OEM basis from the manufacturer and markets it to the end user. It may or may not provide a turnkey system.

- END USER - May buy a system from the hardware supplier(s) and do his own programming, interfacing, and installation. Alternatively, he may buy a turnkey system from a systems house or hardware integrator.

- ENGINEERING CHANGE NOTICE (ECN) - Product changes to improve the product after it has been released to production.

- ENGINEERING CHANGE ORDER (ECO) - The follow-up to ECNs which include parts and a bill of material to affect the change in hardware.

- FIELD ENGINEER (FE) - For the purpose of this study, field engineer, customer engineer, serviceperson, and maintenance person were used interchangeably and refer to the individual who responds to a user's service call to repair a device or system.

- HARDWARE INTEGRATOR - Develops system interface electronics and controllers for the CPU, sensors, peripherals and all other ancillary hardware components. He may also develop control system software in addition to installing the entire system at the end user site.

- MEAN TIME BETWEEN FAILURE (MTBF) - The elapsed time between hardware failures on a device or a system.

- MEAN TIME TO REPAIR - The elapsed time from the arrival of the field engineer on the user's site until the device is repaired and returned to the user for his utilization.

- MEAN TIME TO RESPOND - The elapsed time between the user placement of a service call and the arrival at the user's location of a field engineer.

- PERIPHERALS - Include all input, output, and storage devices, other than main memory, which are locally connected to the main processor and are not generally included in other categories, such as terminals.

- SMALL BUSINESS COMPUTER - For the purpose of this study, is a system which is built around a Central Processing Unit (CPU), has the ability to utilize at least 20M bytes of disk capacity, provides multiple CRT work stations and offers business-oriented system software support.

- SOFTWARE PRODUCTS - Systems and applications packages, which are sold to computer users by equipment manufacturers, independent vendors and others. Also included are fees for work performed by the vendor to implement a package at the user's site.

- SYSTEMS HOUSE - Integrates hardware and software into a total turnkey system to satisfy the data processing requirements of the end user. He may also develop system software products for license to end users.

- TURNKEY SYSTEM - Composed of hardware and software integrated into a total system designed to completely fulfill the processing requirements of a single application.

APPENDIX B: USER QUESTIONNAIRE

IMPACT OF TECHNOLOGY ON MAINTENANCE
USER TELEPHONE QUESTIONNAIRE

The purpose of this interview is to determine user experiences with and attitudes toward products with advanced maintenance technologies.

1. How many of the following products are in your installation?

NUMBER	
_____	IBM 3101 Display Terminal
_____	IBM 3102 Printer
_____	IBM 4300 Series
_____	IBM 8100 Information System

2. On a scale of 0-10 how satisfied are you with the maintenance/service on the: (0=low, 10=high)

_____	3101
_____	3102
_____	4300
_____	8100

Explain_____

_____

_____

3. How would you rate your attitude toward the design of advanced maintenance techniques in products? (0=very negative, 5=average, 10=very positive)

_____

Explain_____

_____

4. How would you rate the following as benefits you have realized from the maintenance features of the: (0=low, 10=high)

	3101	3102	4300	8100
A. Lowered operating cost of product				
B. Increased product reliability				
C. Lower expenditures for maintenance				
D. Lowered operating cost of product				
E. Ease of product use				
F. Speedier repair (MTTR)				
G. Less downtime due to maintnenace considerations				
H. Increased flexibility (re: moves and installation)				
I. Better overall price performance for the product				
J. Other (specify) _____				

5. How would you rate the following as disadvantages of the maintenance features on the: (0=no disadvantage, 10=great disadvantage)

	3101	3102	4300	8100
A. Requires too much time by user personnel.				
B. Inadequate expertise by user personnel.				
C. Inadequate back-up by vendor for problems.				
D. Support inadequate for remote sites.				
E. Parts availability.				
F. Low quality of vendor relations.				
G. Increased downtime due to maintenance considerations.				
H. Slower repair (MTTR).				
I. Increased overall expenditures for maintenance.				
J. Lower price performance for the product.				
K. Other (specify) _____				

6. As a result of the new IBM maintenance features and new maintenance approach:

A. Have you shifted to using maintenance contracts or to paying on a time-and-materials basis?

( ) Shift to contracts.
( ) Shift to time-and-materials.
( ) No shift.

Why? _____

_____

_____

B. How would you rate the increase or decerase in the technical skill level of the IBM field service personnel in the following: (0=low, 10=high)

	HARDWARE	SOFTWARE	COMMUNICATIONS
Increased skill			
Decreased skill			
No change			

Explain _____

_____

_____

C. How much of an increase or decrease have you noticed in the specialization of IBM maintenance personnel by such functions as installation or diagnosis? (0=low, 10=high)

_____ Increased specialization by function.
_____ Decreased specialization by function.
_____ No change.

In which functions? _____

_____

_____

D. How much of an increase or decrease have you noticed in the specialization of IBM maintenance personnel by equipment type? (0=low, 10=high)

_____ Increased specialization by equipment type.
_____ Decreased specialization by equipment type.
_____ No change.

Which equipment types? _____

_____

_____

E. How much of an increase or decrease have you noticed in turnover of IBM maintenance personnel? (0=low, 10=high)

_____ Increased turnover.
_____ Decreased turnover.
_____ No change.

F. How much of an increase, if any, has there been in the number of departments in IBM which you contact for service? (0=low, 10 high)

_____

Explain: _____

_____

7. With products such as the IBM 3101, 4300 or 8100 that have advanced maintenance techniques:

A. How would you rate your willingness to use mail-in depot maintenance? (0=low, 10=high)

_____

Why? _____

_____

_____

B. How would you rate your willingness to perform your own maintenance? (0=low, 10=high)

_____

Why? _____

_____

_____

C. On the average, what is the number of user prompts the system provides to help you perform a maintenance function?

_____

Would you prefer:

( ) More prompts

( ) Fewer prompts

D. How much of a premium would you be willing to pay for an on-site service call?

( ) 0-5%

( ) 6-10%

( ) 11-15%

( ) 16-20%

( ) 21-25%

( ) Over 25%

8. For future purchases, how much of a positive or negative influence will the following advanced maintenance features or techniques be? (0=low, 10=high)

GENERAL FEATURES	NEGATIVE	POSITIVE	NEUTRAL
A. Ease of installation			
B. Ease of use			
C. Ease of user training			
D. Ease of repair			
E. Ease of maintaining			
F. Ease of upgrade/expansion			
G. Increase reliability			
H. Improve response time			
SPECIFIC FEATURES			
I. Modularity			
J. Portability			
K. User friendly interfaces			
L. Field replaceable units (e.g., board swap)			
M. Fewer components to increase reliability			
N. Longer component life to increase reliability			
O. Built-in redundancy to increase reliability			
P. Remote diagnostics for hardware			
Q. Remote diagnostics for software			
R. Remote diagnostics for communications			
S. Microprocessor-controlled self-test			
T. Microprocessor-controlled diagnosis			
U. Alternate board circuits			

OTHER FEATURES (SPECIFY)	NEGATIVE	POSITIVE	NEUTRAL
V.			
W.			
X.			

9. If you could pick new maintenance features to be designed into products, what would you select?

APPENDIX C: VENDOR QUESTIONNAIRE

IMPACT OF TECHNOLOGY ON MAINTENANCE

VENDOR TELEPHONE QUESTIONNAIRE

The purpose of this study is to determine how field service participates in new product design with regards to the use of advanced maintenance technology.

1. Please indicate the products your firm maintains.

COMPUTERS

A.( ) Mainframe
B.( ) Minicomputer or small business computers
C.( ) Peripherals (disks, tapes, printers)
D.( ) Terminals (CRT's, teleprinters)
E.( ) Communications equipment (PBX, CBX, modem, fax)
F.( ) Wordprocessors
( ) Other (specify)
G.( ) _____
H.( ) _____
I.( ) _____

2. In your firm, how active is field service in initiating new products? (Scale 0-10: 0=low, 10=high)

A. _____ as of 1981.

B. _____ projected for 1985

C. Does this vary by product line?
( ) YES ( ) NO
If yes, in which is field service:
Most active? _____
Least active? _____

3. How active is field service in introducing advanced maintenance technologies in product design? (0=low, 10=high)

A. _____ as of 1981.

B. _____ projected for 1985

C. Does this vary by product line?
( ) YES ( ) NO
If yes, in which is field service:

Most active? _____

Least active? _____

4. Are departments other than field service active in introducing advanced maintenance technologies?

IDENTIFY DEPARTMENT	RATE ACTIVITY (0=LOW, 10=HIGH)
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

5. What department(s) in your company most frequently initiates new product(s)? (Please list)

_____

_____

_____

_____

_____

_____

6. By what process or steps do these departments initialize, implement, review, and finalized a new product design?

_____

_____

_____

_____

_____

_____

7. On the average, how long does this process take? _____

8. What department(s) are responsible for specification of new products? (Please list)

_____

_____

_____

_____

9. How many phase reviews are typical for a new product?

_____

What are they? _____

_____

_____

_____

10. To what degree does field service participate in phase reviews? (0=never, 10=very active)

_____

Explain _____

_____

_____

11. Does field service have final sign-off authority on new product design? (0=never, 10=always)

Explain _____

_____

_____

12. In the product design process, is there provision for veto of the product or some facet of it?

( ) YES ( ) NO

Explain _____

_____

_____

13. Is field service given the option of exercising a veto in new product design? (0=never, 10=always)

_____

Explain _____

_____

_____

14. To what extent does field service have responsibility for continuation engineering on new products (0=low, 10=high)

_____

Explain _____

_____

_____

_____

_____

15. What is the mechanism for performance feedback?

16. How active is field service in performance feedback? (0=low, 10=high)

Explain

17. For those products being designed with advanced maintenance technology how important are the following? (1=low, 10=high)	OVERALL IMPORTANCE	MAINFRAME	MINI OR SMALL BUSINESS COMPUTERS	PERIPHERALS	TERMINALS	COMMUNICATIONS EQUIPMENT	WORDPROCESSORS	Price impact for maintenance (indicate%)			Price impact for product (indicate %)		
								INCREASE	DECREASE	NO CHANGE	INCREASE	DECREASE	NO CHANGE
GENERAL FEATURES													
A. Ease of installation													
B. Ease of use													
C. Ease of user training													
D. Ease of repair													
E. Ease of maintaining													
F. Ease of upgrade/expansion													
G. Increase reliability													
H. Improve response time													

CATALOG NO. ☐☐☐☐☐☐

(CONTINUED) 17. For those products being designed with advanced maintenance technology how important are the following? (1=low, 10=high)	OVERALL IMPORTANCE	MAINFRAME	MINI OR SMALL BUSINESS COMPUTERS	PERIPHERALS	TERMINALS	COMMUNICATIONS EQUIPMENT	WORDPROCESSORS	Price impact for maintenance (indicate%)			Price impact for product (indicate %)		
								INCREASE	DECREASE	NO CHANGE	INCREASE	DECREASE	NO CHANGE
SPECIFIC FEATURES													
I. Modularity													
J. Portability													
K. User friendly interfaces													
L. Field replaceable units (e.g., Board swap)													
M. Fewer components to increase reliability													
N. Longer component life to increase reliability													
O. Built-in redundancy to increase reliability													
P. Remote diagnostics for hardware													

CATALOG NO. □□□□□□

(CONTINUED) 17. For those products being designed with advanced maintenance technology how important are the following? (1=low, 10=high)	OVERALL IMPORTANCE	MAINFRAME	MINI OR SMALL BUSINESS COMPUTERS	PERIPHERALS	TERMINALS	COMMUNICATIONS EQUIPMENT	WORDPROCESSORS	Price impact for maintenance (indicate%)			Price impact for product (indicate %)		
								INCREASE	DECREASE	NO CHANGE	INCREASE	DECREASE	NO CHANGE
SPECIFIC FEATURES CONTINUED													
Q. Remote diagnostics for software													
R. Remote diagnostics for communications													
S. Microprocessor-controlled self-test													
T. Microprocessor-controlled diagnosis													
U. Alternate board circuits													
OTHER FEATURES (SPECIFY													
V.													
W.													
X.													

CATALOG NO. □□□□□□

18. How would you rate the importance of the following advanced maintenance technologies to your various products? (0=low, 10=high)

PRODUCT TYPE	VLSI	LASERS	FIBER OPTICS	SATELLITES	BUBBLE MEMORIES	OTHER (SPECIFY)
A. Mainframe						
B. Minicomputers or Small Business Computers						
C. Peripherals						
D. Terminals						
E. Communications Equipment						
F. Wordprocessors						
G. Other						
H. Other						
I. Other						

19. With regards to delivery methods for maintenance, how do you rate the importance of the following relative to products technologies? (0=low, 10=high)

	DEPOT MAINTENANCE		USER SELF MAINTENANCE					
	MAIL-IN	WALK-IN	INSTALLATION	DIAGNOSIS	REPAIR	OTHER (SPECIFY)	ON-SITE	OTHER (SPECIFY)
A. MAINFRAME PROCESSORS								
B. MINICOMPUTERS OR SMALL BUSINESS COMPUTERS								
C. PERIPHERALS								
D. TERMINALS								
E. COMMUNICATIONS EQUIPMENT								
F. WORD PROCESSORS								
G. OTHER _____								

CATALOG NO. ☐☐☐☐☐☐

20. What effect will the delivery method(s) indicated in question #19 have on the prices your firm will charge for a product?

	INCR-EASE	PERCENT	DECR-EASE	PERCENT	NO IMPACT
Depot Maintenance					
User Self-Maintenance					
On-site					
Other_____					
_____					

21. How important to your firm is the use of advanced technology to design test equipment, as an out-of-product alternative? (0=low, 10=high)

_____

Explain _____

_____

_____

_____

22. How do you see your requirements for maintenance personnel being affected by the use of advanced maintenance technology in future products?

A. Management

1. Number required:

( ) Fewer

By what percent _____%

( ) More

By what percent _____%

( ) No change

Why? _____

_____

_____

2. Skills required. (0=low, 10=high)

A. Interpersonal skills (i.e., customer contact skills) _____

B. Technical skills _____

o Hardware.

( ) Less required (0-10)

( ) More required (0-10)

( ) No impact

Why? _____

_____

_____

o Software.

( ) Less required (0-10)

( ) More required (0-10)

( ) No Impact

Why? _____

_____

_____

o Communications.

( ) Less required (0-10)

( ) More required (0-10)

( ) No Impact

Why? _____

_____

_____

3. How much do you believe the use of advanced maintenance technologies will increase or decrease specialization by function for management? (0=low, 10=high)

( ) Increase (0-10)

( ) Decrease (1-10)

( ) No Impact (0-10)

Which functions (e.g., installation, diagnosis) and why?

_____

_____

_____

4. How much do you believe specialization by equipment type will be increased or decreased for management? (0=low, 10=high)

( ) Increase (0-10)

( ) Decrease (0-10)

( ) No Impact (0-10)

Which equipment types and why? _____

_____

_____

5. How much of an impact do you see this having on management training?

_____

_____

_____

6. What other impacts do you foresee technology having on field service management? (Specify) _____

_____

_____

B. Technicians

1. Number required.

( ) Fewer

By what percent _____%

( ) More

By what percent _____%

( ) No change

Why? _____

_____

_____

2. Skills required. (0=low, 10=high)

A. Interpersonal skills (i.e., customer contact skills) _____

B. Technical skills _____

o Hardware.

( ) Less required (0-10)

( ) More required (0-10)

( ) No impact

Why? _____

_____

_____

o Software.

( ) Less required (0-10)

( ) More required (0-10)

( ) No Impact

Why? _____

_____

_____

o Communications.

( ) Less required (0-10)

( ) More required (0-10)

( ) No Impact

Why? _____

_____

_____

3. How much do you believe the use of advanced maintenance technologies will increase or decrease specialization by function for technicians? (0=low, 10=high)

( ) Increase (0-10)

( ) Decrease (0-10)

( ) No Impact (0-10)

Which functions and why? _____

_____

_____

4. How much do you believe specialization by equipment type will be increased or decreased for technicians? (0=low, 10=high)

( ) Increase (0-10)

( ) Decrease (0-10)

( ) No Impact (0-10)

Which equipment types and why? _____

_____

_____

5. How much of an impact do you see this having on technician training? _____

Explain _____

_____

_____

6. What other impacts do you foresee technology having on field service technicians? (Specify) _____

_____

_____

23. What group in your company is responsible for marketing and sales of maintenance products?

( ) Equipment sales force.
( ) Field service sales force.
( ) Other (specify). _____

24. To what extent will the field service/sales organization relationship be impacted by the use of advanced maintenance technology? (0=low, 10=high)

_____

Explain _____

_____

_____

25. How important is the use of increasingly advanced maintenance technology in impacting maintenance sales responsibility in your company?

( ) Supports equipment sales force having responsibility.
( ) Supports a separate field service sales force.
( ) No impact.

26. Many companies today have separate maintenance departments for hardware and software. How important is advanced technology in creating similar organizational decentralization in your company for communications products, DP products, and word processing/office products?
(0=low, 10=high) _____

Explain _____

_____

_____

27. How significant are the revenue opportunities that will be generated by the use of advanced maintenance technology? (0=low, 10=high)

_____

Explain _____

_____

_____

28. To what degree do you feel the use of advanced technology will increase field service management's span of control? (0=low, 10=high)

_____

Explain _____

_____

_____

29. What products with advanced maintenance technology have recently been announced or are soon to be announced by your firm?

_____

_____

_____

_____

_____

_____

REQUEST LITERATURE TO BE SENT

APPENDIX D: PROFILE OF VENDORS SURVEYED

APPENDIX D: PROFILE OF VENDORS SURVEYED

A. PRODUCT TYPES MAINTAINED

- The vendors surveyed were asked to indicate the types of products they were currently maintaining. These responses are indicated in Exhibit D-1.

- The scope of products being maintained by these companies can be indicated as follows:

  - Six (40%) of the respondents are maintaining four or more product types.

  - Three (20%) of the respondents are maintaining three product types.

  - Six (40%) of the respondents are maintaining one or two product types.

- When the sample is broken down by product type, the following distribution results:

  - Mainframes are maintained by five (33%) of the respondents.

  - Minicomputers or small business computers are maintained by nine (60%) of the respondents.

EXHIBIT D-1

PROFILE OF VENDOR RESPONDENTS

RESPONDENTS	PRODUCT TYPES MAINTAINED					
	MAINFRAMES	MINICOMPUTERS OR SMALL BUSINESS COMPUTERS	PERIPHERALS	TERMINALS	COMMUNICATIONS EQUIPMENT	WORD PROCESSORS
A	X	X	X	X	X	X
B	X	X	X	X	X	
C		X	X	X	X	
D					X	
E	X	X	X	X	X	X
F			X	X		
G				X	X	
H					X	
I	X	X	X			
J			X			
K		X	X	X	X	
L				X		
M		X	X	X		
N		X		X	X	
O	X	X	X	X	X	X

- Peripherals (such as disks, tapes, printers) are maintained by 10 (67%) of the respondents.

- Terminals (such as CRTs, teleprinters) are maintained by 11 (73%) of the respondents.

- Communications equipment (such as PBX, CBX, modems, and multiplexers) are maintained by 10 (67%) of the respondents.

- Word processors are maintained by three (20%) of the respondents.

B. COMPANY SIZE

- Gross annual sales data were obtained for 12 of the 15 companies interviewed.

- The average size of these 12 vendor companies is $1.04 billion in gross annual sales.

  - The highest response is $5 billion.

  - The lowest response is $30 million.

C. TITLES OF INDIVIDUALS INTERVIEWED

- The following is a list of the titles for the individuals interviewed:

  - Manager of Advanced Service Technology.

  - Director of Technical Operations.

- Product Planning Manager, Product Service.
- Service Operations Manager.
- Vice President, Field Engineering.
- Vice President Sales, Service, Marketing.
- Vice President, Field Service.
- Assistant Vice President, Field Service.
- Manager, New Product Planning and Support.
- National Service Manager.
- Manager, Product Performance.
- Director of Technical Services.
- Manager, National Technical Support.
- Vice President, Field Operations.
- Director, Field Engineering Planning.

ROUTE:

_____

_____

_____

_____

MANAGEMENT PLANNING PROGRAM
IN
INFORMATION SYSTEMS

EXECUTIVE SUMMARY
OF REPORT ON

IMPACT OF TECHNOLOGY ON FIELD SERVICE

This summary is from a report issued as part of INPUT's Management Planning Program in Information Systems. Readers interested in more detail should obtain the complete report.

DECEMBER 1981

INPUT

MANAGEMENT PLANNING PROGRAM
IN
FIELD SERVICE

OBJECTIVE: To provide senior field service executives with basic information and data to support their management of the total field service activity.

DESCRIPTION: Clients of this program receive the following services each year:

- Field Service Briefs - Six reports which analyze important new technical and management issues within the field service areas. Reports focus on specific issues that require timely attention by senior management.
- Major Planning Reports - Three reports that will present an in-depth analysis of major technical or management issues. They make recommendations that will assist in the formulation of major policy alternatives in the planning of field services.
- Annual Report - This report summarizes the year's major activities in the field services industry to determine important trends and their effects on future field service planning. Forecasts are provided of likely changes in technical and management areas which, when they occur, may affect the future requirements of users of these services.
- Annual Presentation - INPUT staff makes an annual in-house presentation to field service executives to summarize the results of the previous year's research and to formulate, jointly, the strategic guidelines for the research program for the current year. These presentations will occur in the first half of each year.
- Inquiry Service - Individual consultation with INPUT research staff on an as-needed basis through telephone inquiries and visits. A special "hot line" is staffed every working day to facilitate handling of client requirements.

RESEARCH METHOD: INPUT carries out extensive research in computers, communications and associated fields:

- Research topics are selected by INPUT based on discussions with client representatives.
- Research for this program includes professional interviews with users, vendors, universities, industry associations, and other analysts.
- Conclusions derived from the research are based on the judgement of INPUT's staff.
- Professional staff members supporting this program have 20 or more years of experience in data processing and communications, including senior management positions with major vendors and users.

For further information on this report or program, please call or write:

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II EXECUTIVE SUMMARY

- Recent reports in the press reflect a new optimism about the development of technology in the United States. After a period of pessimism, particularly with regard to overseas competition, research and development spending by the U.S. is on the increase, having exceeded the 1980 rate of inflation by an estimated 4%.

  - The information processing industry has been largely technology driven from its inception.

  - It is essential that field service management have an appreciation for and participate in the impact of technology on the industry.

- In this study, the focus is on electronics technology with emphasis on those elements of direct interest to field service. The study will deal with product development issues, and also will examine the impact of advanced technology on field service.

A. IMPORTANCE OF THE ROLE OF TECHNOLOGY IN FIELD SERVICE

- It is important to recognize that field service organizations have a primary responsibility to maintain the current installed base of products, and as such the impact of technology on the field service organization is often not

immediate; it awaits the shipment of new products and a buildup of significant density. In field service organizations the bulk of available management time is spent on current or obsolete products and therefore on "old" technology.

- If field service management is to retain and build on the gains in stature won over the past decade, it will have to take an active part in research and development because these functions are a key part of the total industry.

  - In 1980, IBM spent $1.5 billion on R&D, trailing only General Motors and Ford among U.S. companies.

  - In terms of R&D as a percent of sales, computer manufacturers Amdahl (15.8%) and Cray Research (14.5%) led all U.S. companies. Other companies with very high investment in R&D as a percent of sales included Auto-trol (12%), Intel (11.3%), and Floating Point Systems (10.8%).

  - In terms of R&D dollars per employee, the figures are even more impressive, with Amdahl and Cray again leading the list at $15,333 and $11,591 respectively, compared to $2,982 at General Motors and only $864 at an old-line company like Combustion Engineering.

  - The average R&D spending for computer companies in 1980 was $3,979 per employee and for peripherals and services companies it was $3,060 per employee, compared to a $1,834 average for the total of U.S. industry.

- R&D is a major part of the information processing industry and field engineering must play its rightful role in applying technology through participation in the R&D function. As installed bases grow, the contribution of field service to revenue and its impact on profit increases in significance. The only opportunity field service management has of influencing the maintainability of the products they are later called to service is in the R&D stage.

- The technology impact on field services over time is presented conceptually in Exhibit II-1.

  - The impact of new equipment builds in relation to its shipping rate and the replacement rate of old equipment, however, because old equipment needs more relative maintenance and a more complex inventory of spare parts, the old equipment continues to heavily influence manpower and revenues long after it has become a minority member of the installed base.

  - Some field service functions, particularly preventive maintenance (PM), will decline in importance as new products require less (if any) PM.

  - This trend is another side of the shift to more user self-maintenance; even in the face of user resistance, self-maintenance is growing, particularly among terminal users.

  - Technology includes more than hardware - in particular it includes software; software maintenance is a growing factor and ultimately will impact all field service organizations.

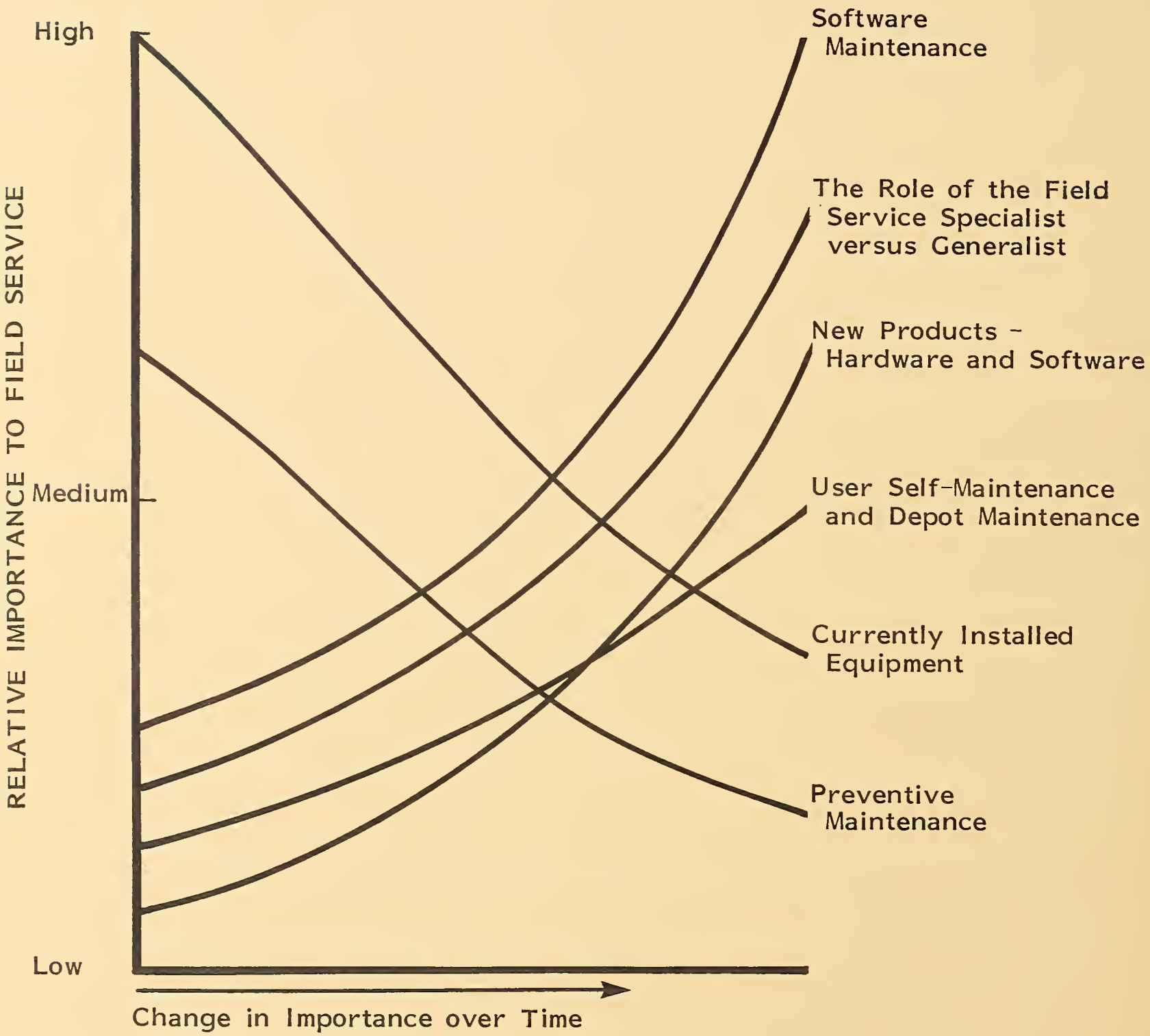
  - Finally, the new technologies will change the makeup of the field service organization. Specialists will increasingly take over such functions as board swapping from the generalist who has been able to service entire systems. Higher level specialists will be concentrated in service center locations.

B. FIELD SERVICE PARTICIPATION IN PRODUCT DEVELOPMENT

- The influence of field service activity in product design remains long range.

EXHIBIT II-1

CHANGES IN RELATIVE IMPORTANCE OF
FIELD SERVICE FACTORS DUE TO TECHNOLOGY



- Field service currently has a low level of activity in new product design, and vendor respondents do not expect a significant increase in this activity level through 1985, as shown in Exhibit II-2.

- Since product development cycles range between one and one-half to two and one-half years, it will be the end of the 1980s before significant impacts can be expected from field service activity in new product design.

- This lull indicates a strategic opportunity for field service organizations to move early into product design.

  - Recent announcements from IBM indicate it may be taking advantage of this opportunity.

  - If this is the case, the vendor community may be forced to increase its activity level sooner than is now planned.

- Short-term impacts from new maintenance techniques will be experienced over the next two years, and can be expected to increase throughout the 1980s.

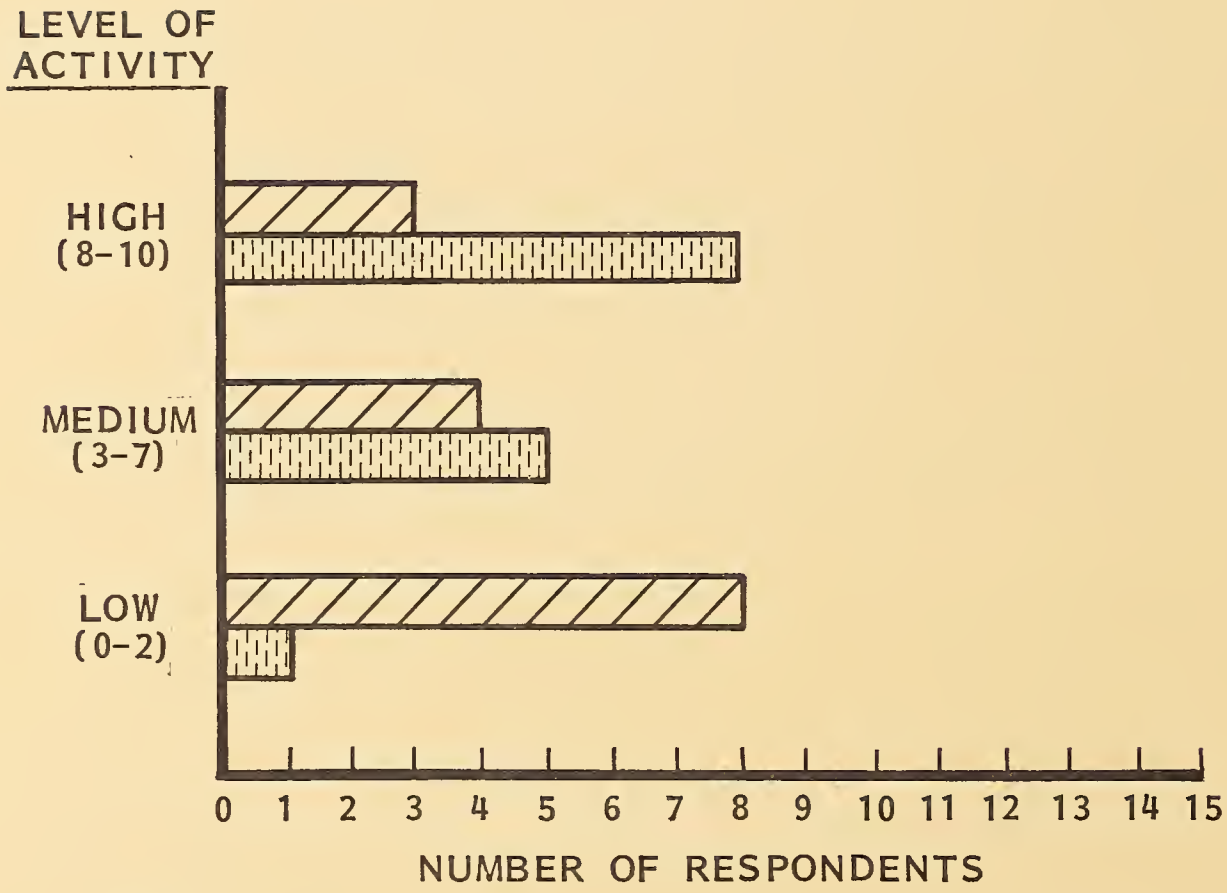
  - Field service organizations are very active in introducing new maintenance techniques now, and expect this activity level to increase through 1985.

  - In the short term, the most dramatic impacts will be in on-site maintenance since this is the area of major focus for new maintenance techniques.

  - User self-maintenance and depot maintenance are receiving less emphasis from field service. This might be because these concepts are currently more closely tied to the lower end of the product line (e.g., terminals).

EXHIBIT II-2

FIELD SERVICE ACTIVITY LEVELS IN NEW PRODUCT DEVELOPMENT



RATING: 0 = NO ACTIVITY, 10 = HIGH ACTIVITY

- Results of the survey of 15 vendors carried out for this study indicate the non-aggressive stance of field service in new product R&D.

  - As shown on Exhibit II-2, approximately half the respondents had a low level of involvement, and only 20% had a high level.

  - Furthermore, field service usually gets involved in the design process after the product concept is decided.

    . This study indicates an average of eight steps in the product design process. On the average, field service's participation begins almost one-third of the way through the process.

    . Field service is rarely involved in the marketing studies that are conducted at the beginning of the product design process. This is despite the fact that field service as an organization has one of the highest levels of direct customer contact.

    . Engineering typically develops the product specifications, including the maintainability factors.

    . In firms that have a centralized business planning group, field service may be represented by marketing or operations, rather than participating directly.

  - This low activity in new product initiation has at least two adverse effects:

    . First, it means that the extensive knowledge which field engineering develops in day-to-day contact with clients is often wasted - it is not communicated back to where it can be valuable, the point of new product development.

- Second, it means that field engineering management is not taking this opportunity to shape its future. Certainly much of the ultimate profit potential in servicing a product is determined in the early product concept, and field engineering often does not participate in that phase, but will later be expected to take on a significant share of profit responsibility.

- To balance the picture, survey results do indicate a high level of field service participation in the introduction of advanced maintenance techniques in new product development.

  - However, marketing and engineering also have an active role in introducing maintenance techniques according to this survey.

  - Of the vendors interviewed, 40% indicated that two or more departments other than field service are consistently involved in introducing advanced maintenance techniques.

  - It is logical that field service should play a dominant role in the maintenance aspect of new product development.

  - Input from field service in product design could reasonably be increased to parallel the involvement of other departments in service aspects.

C. IMPACT ON FIELD SERVICE PERSONNEL

- Most vendors project fewer field service managers and field engineers will be required due to advanced technologies.

- A shift in skills requirements is also anticipated.

- For field service managers, business orientation becomes more important. Other areas of increased importance for management are depot management and total systems service responsibility.

- Depot maintenance with its implications of multiple skill level requirements is expected to have the biggest impact at the field engineer level.

- Requirements for interpersonal skills are expected to be somewhat more in demand due to increased technology, but there is not a consensus as to whether this will occur at the management or field engineer level.

- Due to the use of advanced technology, requirements for hardware skills are expected to decline, while requirements for software and communications skills are expected to increase. This applies to both field service management and field engineers.

- Longer range personnel considerations are as follows:

  - Increased engineering requirements for higher level field service personnel, who require a more advanced educational level and hence a higher salary scale.

  - Redefinition of field service career paths, as demand for hardware expertise becomes more a thing of the past and software and communications skills become more critical.

D. COMPARISON OF VENDOR AND USER VIEWPOINTS REGARDING MAINTENANCE FEATURES

- Vendors and users surveyed for this study are in close agreement regarding the objectives of the application of advanced technology to products as it relates to maintenance.

  - As shown in Exhibit II-3, the profile of ratings by vendors and users tracks well, with both groups rating product reliability highest.

  - The vendor understandably rates ease of installation, repair, and maintenance slightly higher than the user does.

  - Just as understandably, the user rates ease of upgrade/expansion a bit higher than the vendor; the user has to live with the problem of adapting the equipment to an expanding applications mix.

  - Both vendors and users rated ease of user training lowest. This indicates the continuing attitude that maintenance is not part of ongoing operations.

  - The close agreement between the vendor and user response adds substance to the value of a field service viewpoint in the initiation phase of new product development.

- In setting priorities for a list of maintenance features, vendors and users do not respond with similar priorities. As shown in Exhibit II-4, vendors rate those features higher which tend to reduce maintenance costs, while users rate those features higher which tend to increase uptime.

  - Features designed to reduce repair time - field replaceable units, modularity, and microprocessor controlled self-test - were rated highest by vendors.

EXHIBIT II-3

VENDOR VERSUS USER RATINGS OF MAINTENANCE OBJECTIVES

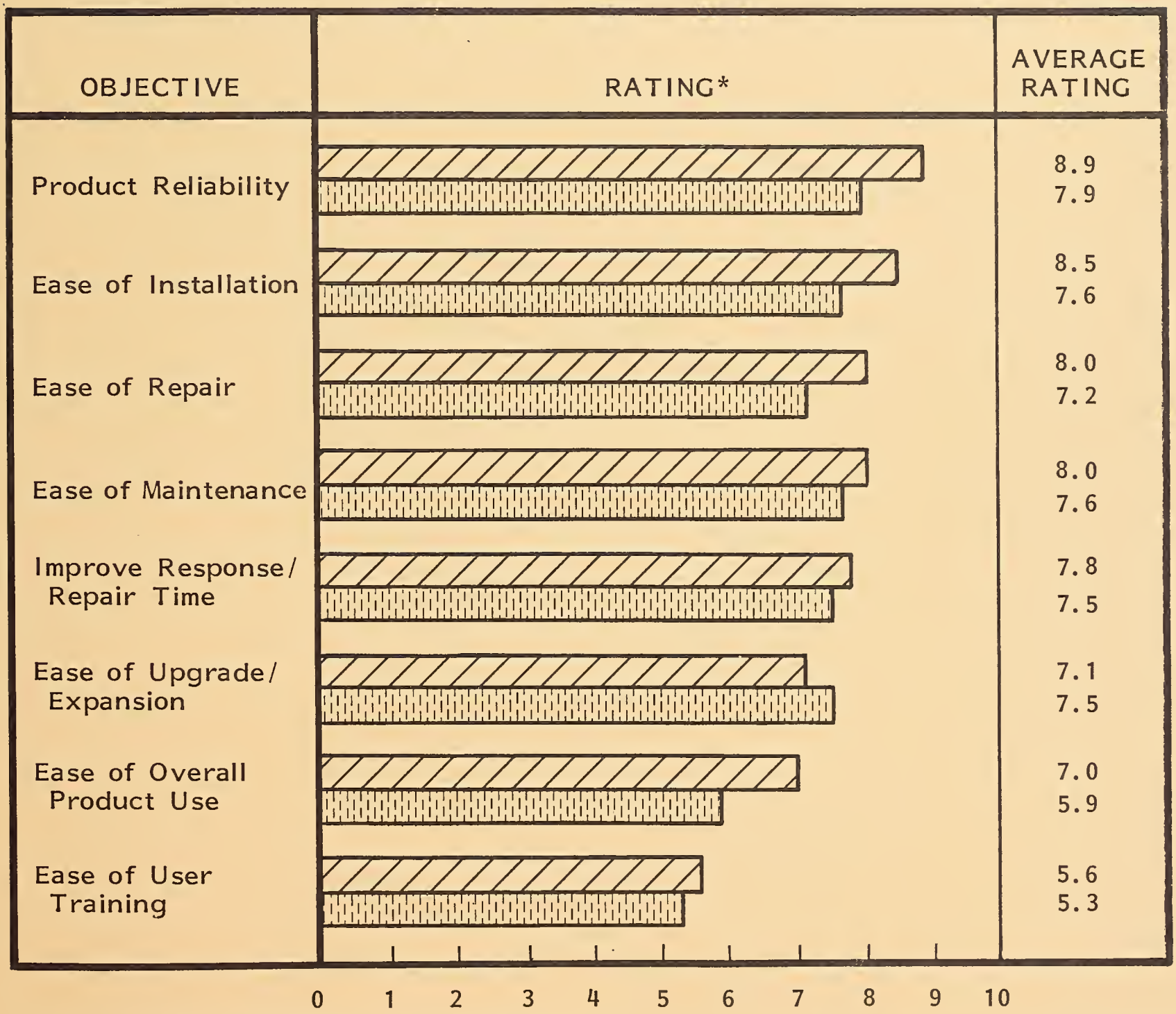
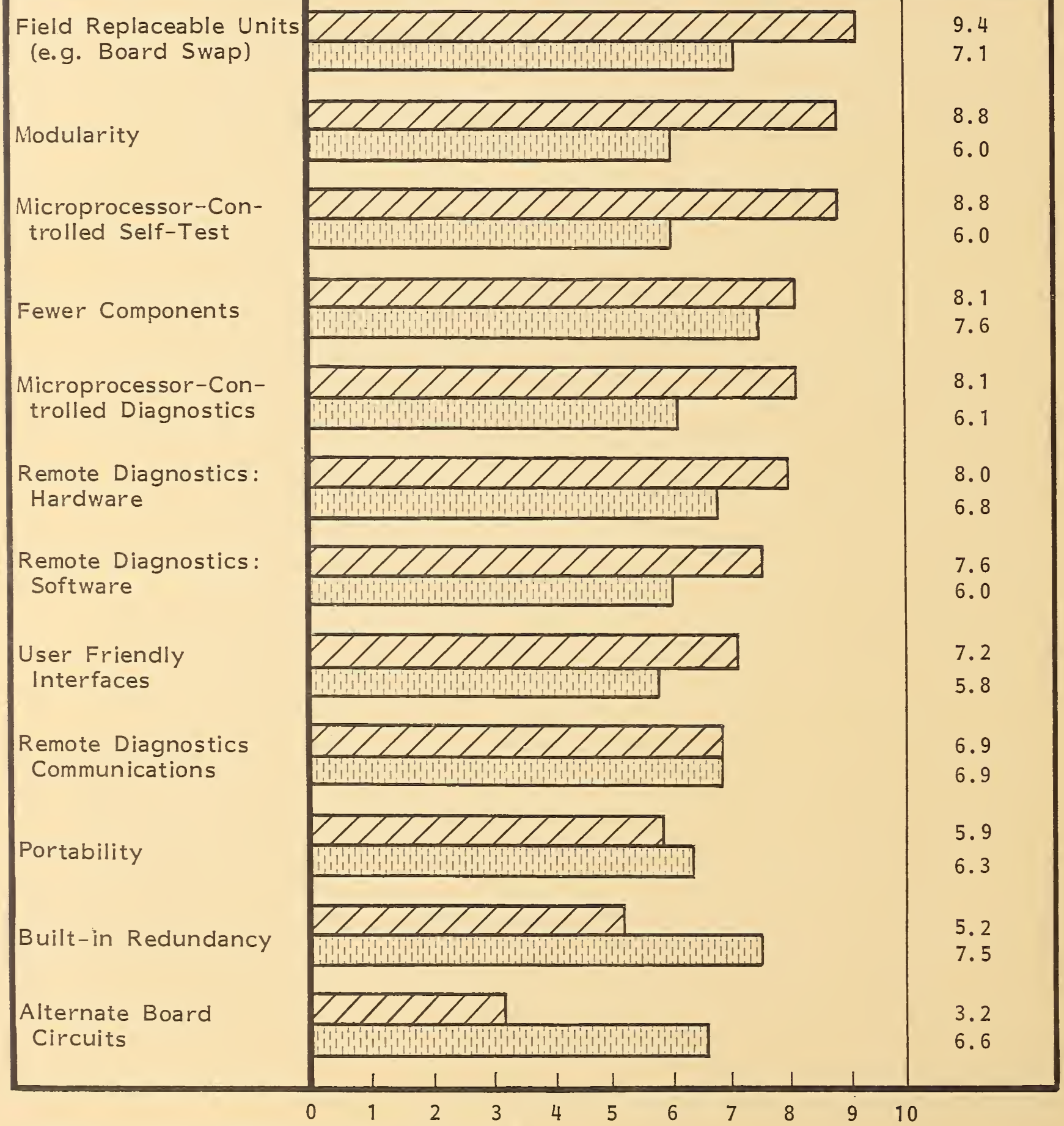


EXHIBIT II-4

VENDOR VERSUS USER PRIORITIES OF MAINTENANCE FEATURES

FEATURE	AVERAGE RATING
Field Replaceable Units (e.g. Board Swap)	9.4 7.1
Modularity	8.8 6.0
Microprocessor-Controlled Self-Test	8.8 6.0
Fewer Components	8.1 7.6
Microprocessor-Controlled Diagnostics	8.1 6.1
Remote Diagnostics: Hardware	8.0 6.8
Remote Diagnostics: Software	7.6 6.0
User Friendly Interfaces	7.2 5.8
Remote Diagnostics Communications	6.9 6.9
Portability	5.9 6.3
Built-in Redundancy	5.2 7.5
Alternate Board Circuits	3.2 6.6



* SCALE 0 - 10 (0 = NO IMPORTANCE, 10 = HIGH IMPORTANCE
BASED ON 15 VENDOR RESPONSES AND 20 USER RESPONSES

VENDOR USER

- Both rated "fewer components" high, a recognition that this feature carries the image of both lower maintenance cost and higher reliability. However, field service organizations usually attribute component responsibility to engineering, not to field service.

- Built-in redundancy and alternate board circuits were rated much higher by users, a reflection of the high up-time associated with redundancy; the success of Tandem computers is an example of a vendor capitalizing on the high user receptivity to the concept of redundancy.

- Users and vendors rated remote diagnostics on communications at exactly the same level, with the vendors rating remote diagnostics on hardware and software higher than did users. This follows from the likelihood that the user is receptive to more help on communications, where he feels more a part of the problem, while he views hardware and software maintenance as primarily the vendor's problem.

E. RECOMMENDATIONS

- To promote field service participation in new product initiation, field service management should assign this function to an individual within field service.

  - Survey results show that field service executives have a low level of interest in including the impact of technology in their planning and product thinking.

  - The identification of responsibility for technology will allow field service to be a full participating partner in a company's exploitation of technology.

- Field service management must review personnel plans to ensure that the impact of technology has been fully considered.

  - Lower component counts, fewer mechanical devices, and better pre-testing techniques will reduce repair time in the field which will require less skilled manpower in the field.

  - The reduction in the amount of preventive maintenance will further reduce in-field manpower requirements.

  - Shipment of more equipment, and the wider distribution of this equipment will increase field manpower requirements.

  - Management must balance these forces. One alternative is to develop area support centers where field engineers can be employed during slack times, and still be available for on-site calls when required.

- Also with regard to personnel, management must develop a clear understanding of its plan regarding "generalist" versus "specialist" field engineers.

  - The traditional generalist who can maintain an entire system is giving way to specialists in defined areas of hardware and software. Specialists may be resident in support centers rather than in the field.

  - The specialist's knowledge is being leveraged through remote diagnostics, and centralized software maintenance, reducing the dependency on on-site techniques.

  - As vendors press for greater efficiency through specialization, they must take care not to overlook the user who is looking for the total solution provided by the generalist.

- The trend toward smaller, more distributed equipment has pressed forward the development of depot maintenance and user self-maintenance.

- Traditional EDP users resist the trend.

- Newer, non-EDP users, tend to be less resistant.

- Vendors must design their depot maintenance and user self-maintenance strategies with a clear idea of the uniqueness of their product line and their user base; a misreading on this issue can lead to expensive and unprofitable maintenance on the one hand, or an angry user base on the other.

- Management must consider software as an increasingly important field service consideration. Virtually every piece of equipment has a software aspect, even previously hard-wired devices such as disk drives and modems. Much of the force shaping products in the 1980s will come from software rather than hardware technology.

- Management must begin thinking in terms of a multilevel service which optimizes available manpower.

  - Technology is making diagnostics available in several forms - remote, customer activated built-in diagnostics, and built-in self-test. Combined with equipment which "degrades gracefully" through redundant circuitry, the user will often have time to more clearly define the problem before releasing the equipment for repair.

  - The better diagnostics and potentially longer time available for response will allow vendors to understand the problem more clearly before dispatching a field engineer.

  - In this environment, the specialist with exactly the required talents can be dispatched, rather than the first person available, which is the traditional method.

- Technology will impact virtually every aspect of field service, and management must organize to capitalize on it.

IMPACT OF TECHNOLOGY ON FIELD SERVICE

CONTENTS

		Page
I	INTRODUCTION	1
II	EXECUTIVE SUMMARY	3
	A. Importance Of The Role Of Technology In Field Service	3
	B. Field Service Participation In Product Development	5
	C. Impact On Field Service Personnel	10
	D. Comparison Of Vendor And User Viewpoints Regarding Maintenance Features	12
	E. Recommendations	15
III	THE ROLE OF FIELD SERVICE IN PRODUCT DESIGN	19
	A. An Overview Of The Product Design Process	19
	B. The Role Of Field Service	24
	C. Initiating New Product Design	26
	D. Introducing Advanced Maintenance Technologies	29
	E. Phase Reviews	35
	F. Sign-Off And Veto Of Product Designs	36
	G. Performance Feedback And Continuation Engineering	39
IV	IMPACTS OF ADVANCED TECHNOLOGIES ON PRODUCTS, DELIVERY METHODS, AND PRICING	41
	A. Technologies Of Importance To Maintenance	41
	B. Impact On Maintenance Design Of Products	43
	1. Vendor Maintenance Objectives	43
	2. Vendor Priorities Of Maintenance Features	49
	C. Impact On Maintenance Delivery Methods	55
	D. Impact On Pricing	58
V	IMPACTS OF ADVANCED MAINTENANCE TECHNOLOGIES ON FIELD SERVICE PERSONNEL	61
	A. Number Of Personnel Required	61
	B. Demand For Interpersonal Skills	62
	C. Skill Requirements	63
	D. Training	65
	E. Other Impacts On Personnel	68
VI	IMPACTS OF ADVANCED MAINTENANCE TECHNOLOGIES ON THE FIELD SERVICE ORGANIZATION	69
	A. Relationship Of Field Service To Sales	69

		Page
	B. Decentralization Versus Integration	71
	C. Revenue Opportunities	72
VII	USER REACTION TO NEW TECHNOLOGIES	75
	A. IBM As A Technology Innovator	75
	B. User Ratings Of Product Innovation In The IBM 4300, IBM 8100, And IBM 3101	77
	C. User Perceptions Of Changes In IBM Relative To The New Products	82
	D. User Rating Of Design Features	84
	APPENDIX A: DEFINITIONS	89
	APPENDIX B: USER QUESTIONNAIRE	93
	APPENDIX C: VENDOR QUESTIONNAIRE	103
	APPENDIX D: PROFILE OF VENDORS SURVEYED	121

IMPACT OF TECHNOLOGY ON FIELD SERVICE

EXHIBITS

			Page
II	-1	Changes In Relative Importance Of Field Service Factors Due To Technology	6
	-2	Field Service Activity Levels In New Product Development	8
	-3	Vendor Versus User Ratings Of Maintenance Objectives	13
	-4	Vendor Versus User Priorities Of Maintenance Features	14
III	-1	Generic Steps In The Product Design Process	20
	-2	Activity Level Of Field Service In Initiating New Products	27
	-3	Responses For Field Service Product Initiation That Varies By Product Line	30
	-4	Activity Level Of Field Service In Introducing Advanced Maintenance Technologies In Product Design	31
	-5	Responses That Vary By Product Line For Introduction Of Advanced Maintenance Technologies	33
	-6	Activity Of Other Departments In Introducing Advanced Maintenance Technologies	34
IV	-1	Technologies Important To Maintenance	42
	-2	Advanced Technology: Vendor Maintenance Objectives	44
	-3	Advanced Technology: Vendor Priorities Of Maintenance Features	50
	-4	Maintenance Delivery Methods Supported With Technology	57
	-5	Impact Of Advanced Maintenance Technology On Pricing	59
V	-1	Impact Of Technology On Skills Requirements Of Field Service Personnel	64
VII	-1	Rating Of Benefits By Users Of IBM 4300 Series	78
	-2	Comparison Of Benefit Ratings Among Users Of The IBM 4300, 8100, And 3101	79
	-3	Rating Of Disadvantages Of Maintenance Features By Users Of The IBM 4300, 8100, And 3101	81
	-4	Rating Of Advanced Maintenance Features By Users Relative To Future Purchases	85
D	-1	Profile Of Vendor Respondents	122

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- CAD/CAM System and Service Market Opportunities

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- Determination of the U.S. market for small computer systems in 1985.

- Analysis of the opportunities and problems associated with field service capabilities for CAD/CAM systems.

- Analysis of the market potential for third-party maintenance.

- 1981 ADAPSO Survey of the Computer Services Industry.

- Evaluation of the current status and future trends of software terms and conditions.

- Analysis and forecast of user self-maintenance for a vendor's line of equipment.

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INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions. Continuing services are provided to users and vendors of computers, communications, and office products and services.

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Many of INPUT's professional staff members have nearly 20 years experience in their areas of specialization. Most have held senior management positions in operations, marketing, or planning. This expertise enables INPUT to supply practical solutions to complex business problems.

Formed in 1974, INPUT has become a leading international consulting firm. Clients include over 100 of the world's largest and most technically advanced companies.

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February 26, 1982

Dear Client:

The enclosed report, Impact of Technology on Field Service, contains data of particular importance to the long-range goals of field service organizations.

As part of INPUT's Field Service Program, this report presents the tactical and strategic implications of advanced maintenance technology in field service.

INPUT has investigated the various sophisticated technologies field service organizations are using to meet service requirements on new products. This includes analysis of the ramifications of new service delivery methods such as depot repair and user self-maintenance, pricing of products and maintenance, and changing training and skills requirements for field service personnel.

Market analysis evaluates the reception in the user community of recent IBM products that have advanced maintenance features. INPUT reports on the advantages and disadvantages perceived by these users, as well as their experiences and expectations relative to service.

The strategic impacts of changing product design to reflect maintenance technologies are far reaching. It means the actual equipment environment in data processing installations is being altered.

The more active field service organizations are in product design, the more significant their influence will be in shaping the future profitability of field service.

Cordially,

Emily J. Rieker

Emily J. Rieker
Program Manager

EJR:ml

Enclosure