F-FS8

INPUT

FIELD SERVICE PROGRAM

FIELD SERVICE BRIEF

SUPPORT CENTERS IN FIELD SERVICE

DECEMBER 1980

FIELD SERVICE PROGRAM

OBJECTIVE: To provide senior field service managers with basic information and data to support their planning and operational decisions.

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 att

- Major Planning Reports - Th ysis of major technical or managem that will assist in the formulatio of field services.

- Annual Report - This re the field services industry to de uture field service planning. hnical and management areas requirements of users

- Annual Presentation - tion to field service executive s research and to formul earch program for the currer rst half of each year.

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RESEARCH METHOD: INPU com- munications and associated fi

- Research topics are se representatives.

- Research for this progr vendors, universities, industry a

- Conclusions derived fr NPUT's staff.

- Professional staff mem ars of experience in data proc management positions with major vendors and users.

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SUPPORT CENTERS IN
FIELD SERVICE

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I INTRODUCTION

A. IMPORTANCE OF SUPPORT CENTERS

- A major driving force in field service today is the dramatic shift in emphasis from labor-intensive field functions toward the introduction of more capital equipment and more centralized support.

    - The production function of maintenance has traditionally focused on the diagnostic and intuitive capabilities of technicians.

    - Technological advances over the past two decades have simultaneously introduced new maintenance problems along with some of the means to overcome those problems.

        - Technology has reached a level of complexity the experienced field engineers of today did not consider possible when they first entered the profession.

        - Improvements in technology have driven the cost of computing power down so low that the current and future volumes of equipment are many times the number that could be maintained by traditional methods.

- Technology has also driven down the cost of firmware, hardware, communications and information retrieval to a point where additional hardware offers solutions to maintenance problems. Techniques include redundant circuitry, diagnostic micro-computers and built-in diagnostic software or firmware.

- Support centers represent one of several methods of introducing capital expenditures into the maintenance production function, thereby saving scarce diagnostic and logistic talents.

- This brief discusses support centers from two different perspectives:

  - Chapter I presents a summary of the evolution and current status of support centers.

  - Chapter II discusses the use of management science techniques to assist in the complex decision process relative to support centers, including labor versus capital investments and the effect of the learning curve.

- On balance, the decision regarding support centers is a result of management's response to:

  - The increasing cost of labor.

  - The complexity of current and forecasted hardware and software.

  - The trend to distribution of data processing which leads to the need to support many, smaller sites rather than a few large sites.

  - More reliable equipment which reduces the frequency with which an individual field engineer encounters a given type of failure; thus reduces the rate of learning at the field level.

- This brief provides an approach for thinking through this very complex decision process.

B. TYPES OF SUPPORT CENTERS

- There are many types of support centers within the data processing industry:

  - Conversion support centers, in the federal government, for example, which may be temporarily staffed to respond to agency requests for technical information during major equipment and/or software conversion efforts.

  - System design support centers, which assist field sales teams in configuration control of complex systems.

  - Customer support centers, which provide backup support for overloads, pre-installation support in program development and benchmarks in competitive bids.

  - Vendor software maintenance support centers for application packages.

  - Vendor systems software support centers.

  - Vendor hardware support centers.

- This report addresses the last two vendor maintenance support centers, which are most likely to be implemented by field engineering service organizations.

- Systems software maintenance and hardware maintenance support centers will be treated separately in this report, because the two types of support centers have evolved in different ways and need to be viewed from their individual perspectives.

C. HISTORICAL DEVELOPMENT OF SUPPORT CENTERS

I. SYSTEMS SOFTWARE SUPPORT CENTERS

- Prior to the mid-1960s, system control programming was largely the product of joint efforts between vendors and users.

  - As early as the 1950s there were a few control programs in relatively large systems that took advantage of I/O interrupts, thereby requiring something more than translation routines.

  - The fifties witnessed the early development of mnemonic translators and assemblers to assist in program coding.

  - The second-generation equipment, typified by the IBM 7000 series introduced in the late fifties, was supported by early compilers (FORTRAN, for example), utility programs like sorts and merges, and primitive versions of system control programs like IBSYS.

  - Software support was visible to customers in the form of highly skilled "systems engineers" who were both applications- and systems-oriented.

    - Systems engineers were usually involved with large systems customers from the initial sales proposal support through full implementation and beyond.

    - Local systems engineers had direct contact with software development engineers and kept abreast of all developments.

    - The high price of equipment, together with the relatively small volume of equipment in the field through the second generation, made it possible to afford on-site systems engineers.

- The relatively small community of systems engineers within a vendor's organization found it easy to communicate and exchange information.

- The introduction of early system control programs such as IBSYS created a need for a maintenance mentality in relatively complex environments.

    . Hardware maintenance personnel began to run into problems isolating customer complaints to specific symptoms.

    . Systems engineers with specialized applications skills had little knowledge of hardware.

- In the late fifties, a limited number of field engineers were trained to support early system control programs in large and sensitive installations, such as those in national defense and the early space program.

● Third-generation equipment introduced in the mid-1960s, typified by the IBM 360 family of systems, created the requirements of systems software support centers.

- System resources such as memory, printers, card readers and other I/O devices were designed to become transparent to the user through system programs.

- "Operating systems" were to become the focal points of the resources used by data processing installations.

- Users were suddenly isolated from absolute machine language and hardware interface.

- Vendors had placed themselves in the position of maintaining software without the required personnel in the field.

- The support center concept created for software maintenance support was based on the following fundamentals:

  - Generally speaking, software problems were not random or unique to a single location; when a fix was made in Georgia, it did not require diagnosis in Texas.

  - Software is diagnosed and maintained largely in documentation; i.e., listings and memory dumps.

  - Software problems tended to become routine in volume at a very rapid rate after the release of new software revisions. This fact made it possible to build in filtering techniques to support less-experienced personnel, saving the more qualified specialists for new and unique problems.

- The operational models established in the mid-1960s for vendor maintenance of systems software have survived, with minor modifications, through the seventies, as shown in Exhibit I-1.

  - The software maintenance activity has been one of researching symptoms and fixes, prioritizing requests for fixes and documenting problems for higher levels of support and software engineering.

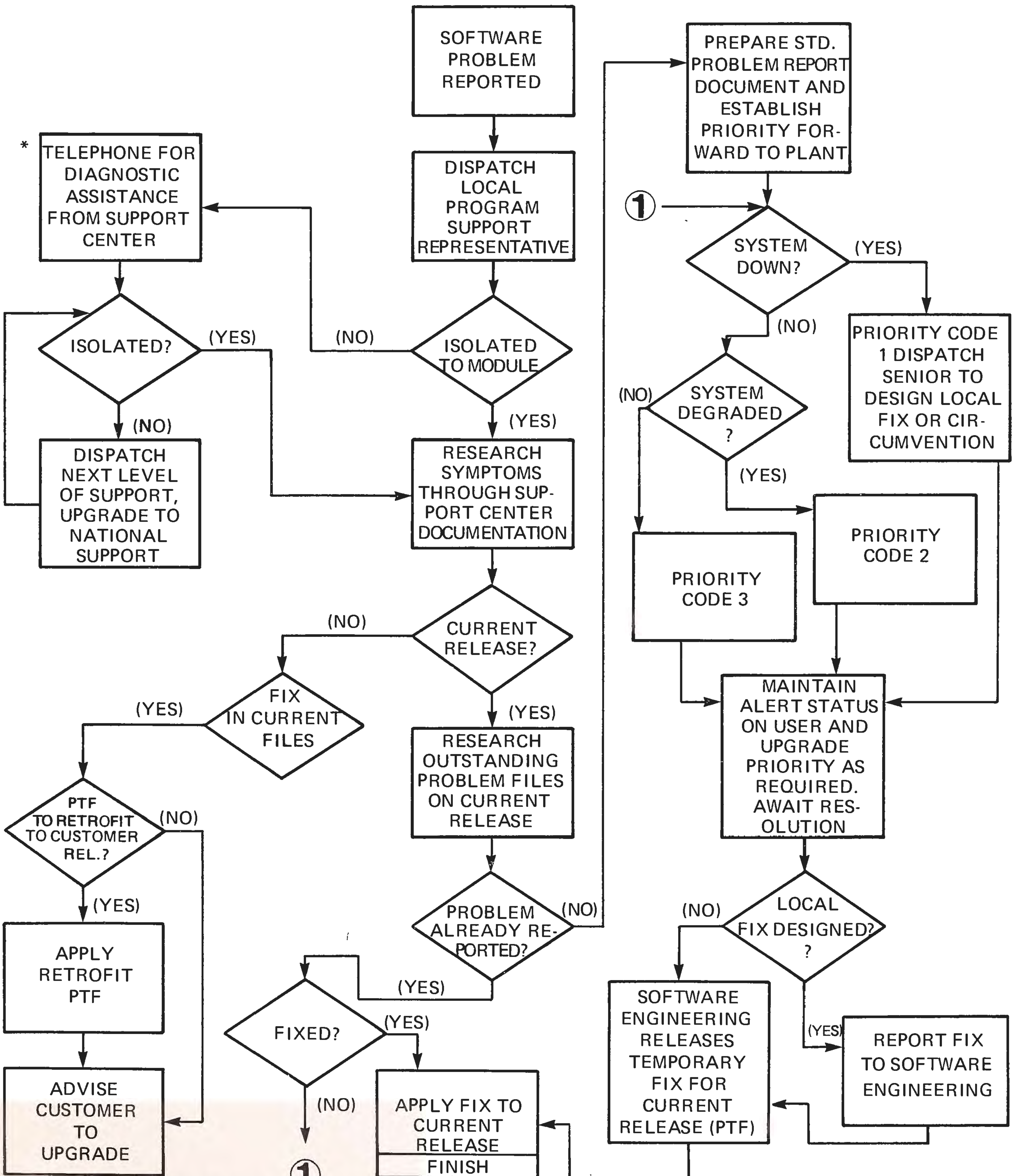
  - The major decisions made by the support centers were:

    . To determine if the failure was illegitimate; e.g., did it come about as a result of violating functional specifications?

    . To evaluate the quality of supporting evidence in order to isolate the unique symptoms and software module affected.

EXHIBIT I-1

SYSTEMS SOFTWARE SUPPORT MODEL - MID-SIXTIES



*ESTABLISH TIME CHECKS TO DETERMINE AGE OF UNRESOLVED PROBLEMS

- To involve support center management in judgment issues about priority status and sensitive situations such as insisting that users upgrade to current software releases.

- To raise appropriate status flags to alert higher management when problems remained outstanding beyond a reasonable time for software engineering to design a fix.

- The support centers for software in the mid-1960s established the basic tools for software support, microfiche documentation and the telephone.

- Historical trends in the evolution of software support centers fall into two major classifications: user involvement and tools.

  - Users have become involved in software maintenance more rapidly than in hardware maintenance.

  - The first departure from the classical model presented in Exhibit I-1 was generally in the writing of problem reports (APARs).

  - Technically, the program support representatives assisted the users in preparing APARs; the assistance level merely subsided as users became more proficient.

2. HARDWARE SUPPORT CENTERS

- The driving forces behind the centralization of technical support talents for hardware coincided with the evolution of software support centers.

  - Third-generation hardware introduced in the mid-1960s brought in new concepts and complexities not readily understood by experienced field engineers.

- The concepts of "read-only memory" (ROM), firmware and users isolated from hardware by system control programs, were revolutionary.

- Integrated circuits and timings in nanoseconds created timing bugs that required exceptional imagination and trouble-shooting talents.

- Accelerated competition in hardware resulted in accelerated shipping schedules, which adversely affected the levels of quality assurance.

- Field engineering management was not prepared to cope with the new demands in the operating systems environment.

  - Prioritization based on traditional "rules-of-thumb" became obsolete.

  - Customer organizations were in transition from simpler, dedicated data processing shops to systems and user departments. The field managers had difficulty establishing rapport with decision makers.

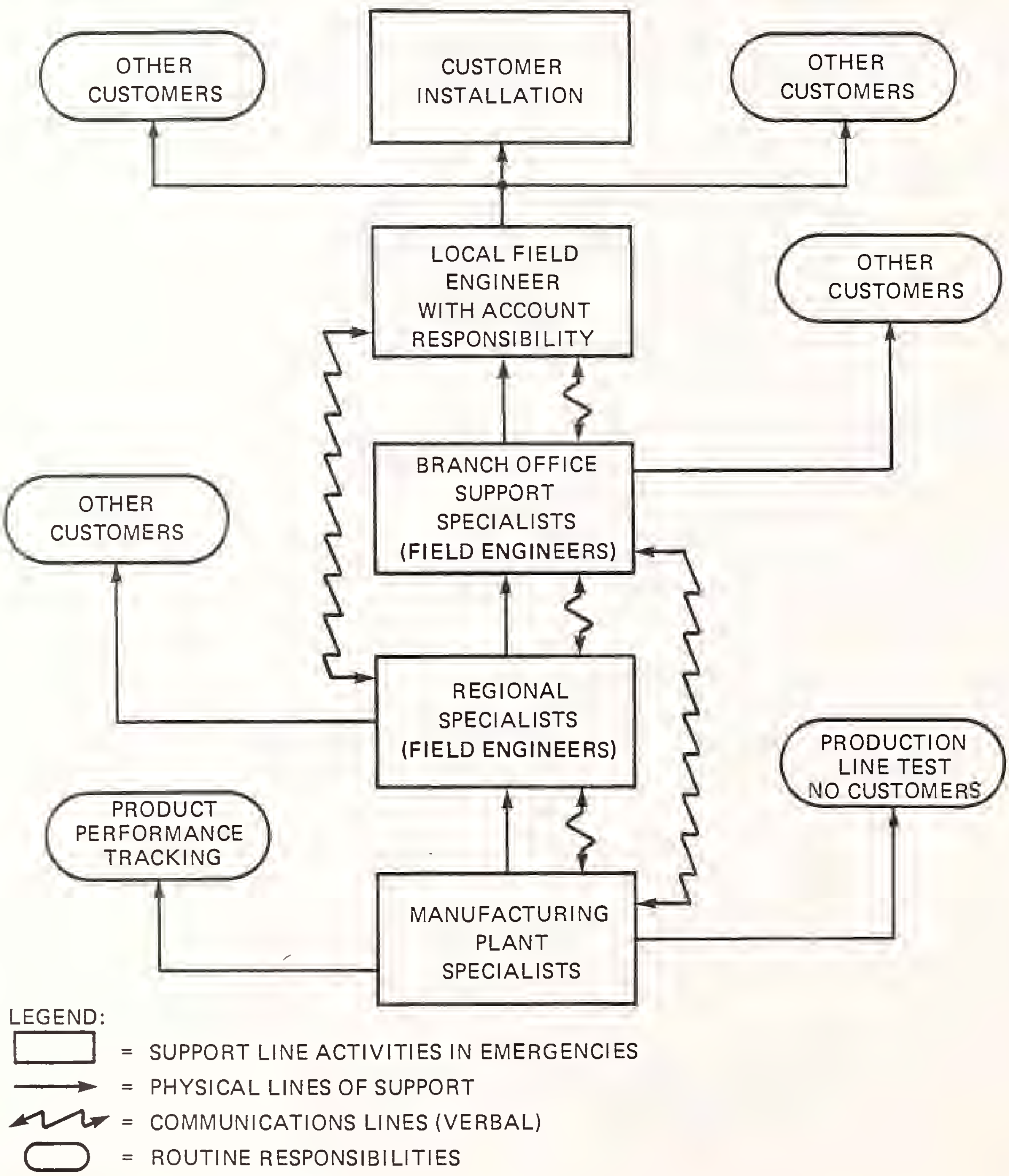
- Prior to 1964, technical support in hardware was largely a function of designated specialists on equipment who would be contacted in their own territories for assistance, as shown in Exhibit I-2.

  - Conflicts of priorities were difficult to resolve, as specialists had to maintain local customers while remaining responsive to others at the branch, district, regional or even national levels.

  - Standards for the designation of district specialists or higher were practically nonexistent and were often ignored to offer a local field engineer additional status.

EXHIBIT I-2

TYPICAL FIELD ENGINEERING TECHNICAL SUPPORT HIERARCHY PRIOR TO 1964



- The distinguishing characteristics of technical support since the introduction of third-generation equipment are:

  - Regional support centers staffed with dedicated support specialists without customer territory responsibilities.

  - Procedural requirements for local field engineers to attempt diagnosis through telephone assistance before dispatching specialists to provide physical assistance, as shown in Exhibit I-3.

  - Centralization of data on symptoms and fixes.

  - Higher-level functional authority vested in technical support staff management.

  - Formal communications linkage between support centers and manufacturing plants.

  - The integration of technical support in diagnosis with other support functions:

    - Physical planning support.

    - Configuration/systems assurance.

    - Software support.

    - Field education.

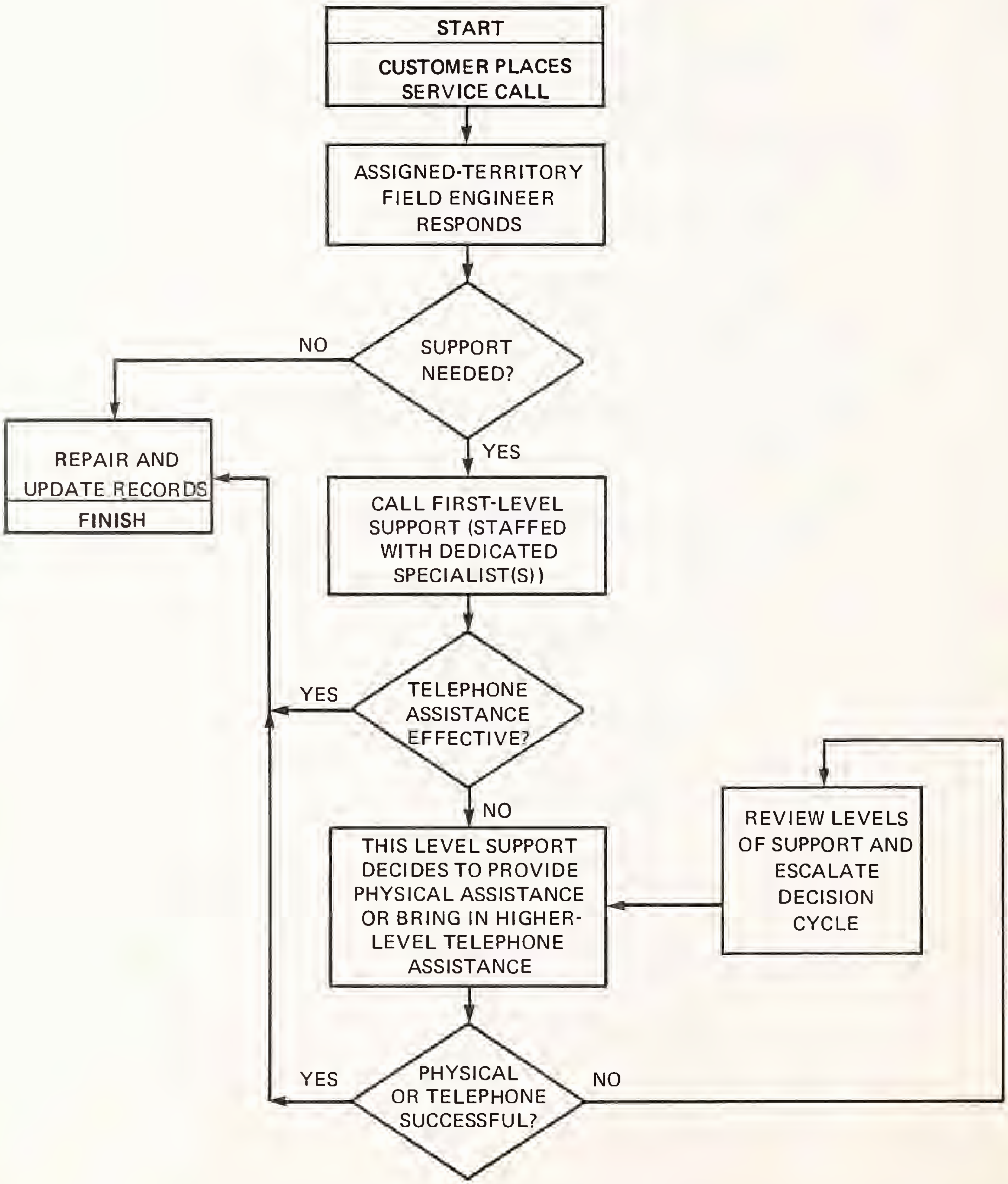
    - Engineering change controls.

    - "Alert" system and status monitoring for management.

    - Asset controls - tools and test equipment.

EXHIBIT I-3

TYPICAL DEDICATED TECHNICAL SUPPORT HIERARCHY AFTER 1964



- Product performance tracking.

- Maintenance-level component failure analysis.

- Technical information dissemination control.

- Both software and hardware support centers will continue to evolve. Some vendors, notably IBM, are trending toward a few large centers. Others, such as Prime, are opting for smaller, regional centers.

II USE OF MANAGEMENT SCIENCES TECHNIQUES IN DECISION MAKING RELATIVE TO SUPPORT CENTERS

A. THE PRODUCTION FUNCTION

- Some readers of this brief may want further explanation of the complex concepts presented in the following pages. They are invited to use the inquiry privileges for subscribers to the Field Service Program to call INPUT for a complete discussion of the application of these concepts to their particular situation.

- Maintenance has traditionally been managed as a labor-intensive activity, with capital inputs limited to portable tools and test equipment. The following are some of the results of holding such a view of the maintenance function:

  - Heavy capital investments in spare parts have been analyzed by a "threshold of pain" method, not by trade-offs against relatively inexpensive labor.

  - The acceptance of the belief that labor will always be plentiful and that slack time will be available to offset reductions in capital investment has led to the continued use of obsolete rules of thumb.

  - The major obstacles to progress in building more efficient maintenance organizations are the result of relying on traditional approaches rather than principles of management science.

- Traditionally, field service managers have not been schooled in the techniques of the management science disciplines. This has limited the use of more scientific methods to optimize the trade-offs between capital expenditures and labor in field service organizations. Traditional views that are still generally held include:

    - Customers' expectations that equipment availability is directly proportional to the visibility of maintenance efforts; that is, to on-site maintenance.

    - Acceptance of inefficient personnel resources allocation during peak activity periods under the standard queuing philosophy.

    - Belief that maintenance is primarily a human endeavor and that tools are incidental to the process.

    - Acceptance that the point of diminishing returns on the labor/capital mixture lies somewhere beyond current visibility, a belief based on traditionally expensive capital improvements to maintenance production. The result is that labor is added when often a capital improvement is a better investment.

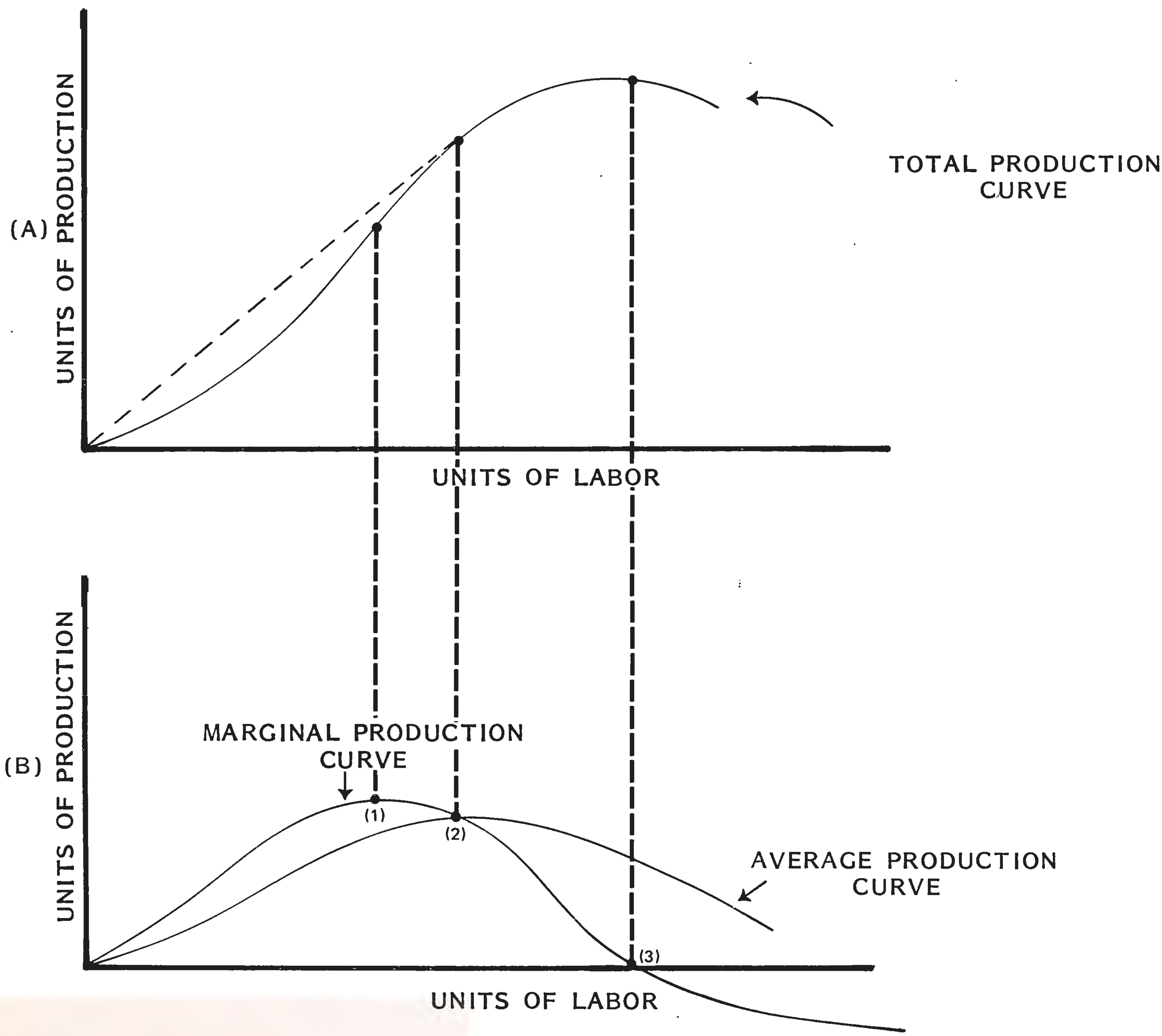
- This study analyzes support centers as one capital investment strategy available to FE management to increase the marginal rate of return on labor. The analysis is conceptual in nature to demonstrate an alternative to the traditional approach.

- Exhibit II-1 is a graphic representation of one of many classic production functions.

    - In the conceptual example represented by Exhibit II-1, capital equipment is held constant while labor is changed to observe the effects of adding labor to a fixed investment.

EXHIBIT II-1

THE PRODUCTION FUNCTION



- The "capital equipment" could be a support center, increased test equipment, etc.

- "Labor" is increased field force.

- The concept of diminishing returns is illustrated by both graphs (A) and (B). Graph (A) is the total of the two lines on (B).

  - Two schools of thought debate which point represents the point of diminishing returns. Both points are visible in the example.

  - Point (1) represents the maximum level of marginal production; that is, it defines the unit of labor that adds the most incremental production. In the case of an FE field force, adding an FE at this point would have the maximum beneficial effect. Adding FEs beyond this point would still increase average production, but at a decreasing rate.

  - Point (2) is the point of maximum average production, after which the average production diminishes. Adding FEs at this point still provides increased production, but at a diminishing average rate.

  - To be absolutely precise, call point (1) the point of diminishing marginal returns and point (2) the point of diminishing average returns.

  - Adding an FE at point (3) will actually decrease total production because of contention between people and other causes.

- What does all this have to do with support centers?

  - One way to look at the production function when labor must increase, or has already increased beyond the point of diminishing returns, is to introduce additional working capital assets into the function. One such capital asset function is the support center.

- Management must understand where their labor force is relative to the production curve.

    - Exhibit II-2 illustrates the effect of introducing more capital.

    - While Exhibit II-2 is not meant to be exactly accurate, the concept is more easily absorbed in two dimensions than in three.

    - The labor and production rates are both shown to increase more rapidly by decreasing the scale size. On the chart, before addition of capital, two units of labor resulted in one and one-half units of production; after addition of capital, two units of labor produced almost five units of production.

- The curve in the example should be conceptually representative of production returns of support centers versus field maintenance personnel.

    - Increases in production will begin slowly as the support center gathers feedback from more people.

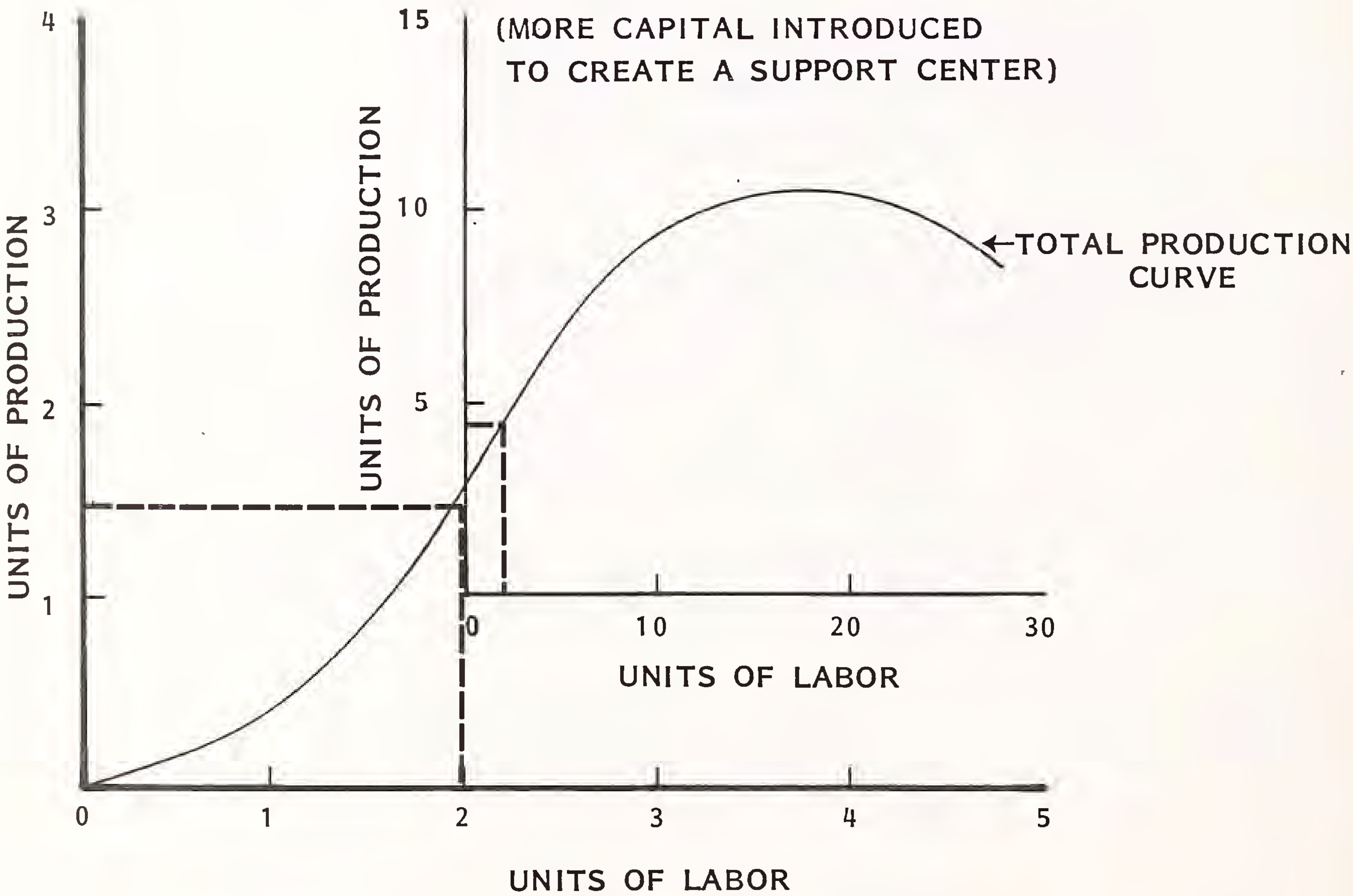
    - The acceleration will occur with synergistic effects, learning curve phenomena and procedural adjustments.

    - As more personnel use the facility, telephone lines are overloaded and overall service efficiency begins to deteriorate under pressure to service too many people.

    - More people using the facility adds to the amount of duplicate information and other efficiency-degrading events. In the previous chart, this situation first occurs at point (1). Further declines in productivity occur at points (2) and (3).

EXHIBIT II-2

IMPACT OF ADDED CAPITAL
ON THE PRODUCTION FUNCTION



CURVE IS CONCEPTUAL

- Some of the factors causing premature diminishing returns can be addressed by adjustments in procedures; filtering calls with less experienced personnel would be one example.

- An effective way to use knowledge of the production function in planning is to track marginal rates of production attributable to the support center.

  . When the marginal rate peaks, as in Exhibit II-1, diminishing returns of the first class, point (1), will follow.

  . There should be time between points (1) and (2) to introduce new capital improvements, such as additional support centers or better data bases, before diminishing average returns are experienced.

B. THE FE LEARNING CURVE

- Another aspect of the support center is its effect on the learning curve as reflected in its impact on MTTR and, therefore, direct labor costs.

- MTTR (Mean Time To Repair) is a function of the FE learning curve.

- The synergistic effect on normal FE direct learning is an added value of support centers.

  - The effect is dependent on the quality of data collection, data analysis and timely dissemination of the benefits of collective experience.

  - The enhancement effect is directly (logarithmically) proportionate to the number of shared experiences feeding the data base.

- Typical field engineer learning rates can be calculated from a company's historical records on specific categories of equipment.

  - Direct unit learning rates for labor-intensive activities like field service are usually in the range of -10% to -20%.

  - By convention, a -10% learning rate will result in a 10% improvement in time/cost per unit of production each time the units are doubled.

  - The direct learning rates can be calculated usually by simple curvilinear regression analysis.

- The calculation of synergistic effects on group learning and the enhancements provided are part of a very complex mathematical exercise in multiple regression analysis.

  - It is safe to assume that the synergistic learning rate is less than the direct learning rate.

  - With good control of data collection, analysis and feedback, the synergistic learning rate that enhances direct learning would normally be in the range of -1% to -5%, and would be weighted by the number of inputs to the data base.

- Exhibit II-3 represents theoretical cost trends in a typical field service territory containing a number of new devices on which the savings provided by a support center can be forecast.

  - The mathematical development of the model in Exhibit II-3 is beyond the scope of this study, but the following simplifications were introduced:

    . The direct learning rates of all territory field engineers is the same (-15%).

EXHIBIT II-3

EFFECT OF SYNERGISM ON THE NORMAL LEARNING RATE

AVERAGE FE NUMBER OF CALLS	DIRECT LABOR COST OF CALL		MULTIPLIER EFFECT ON SAVINGS TIMES 100 TERRITORIES
	NORMAL DIRECT LEARNING RATE (-15%)	ENHANCED LEARNING RATE SYNERGISTIC EFFECT = (-3% x 100)	
1	$ 300	$ $253	$ 4,700
2	255	202	5,300
:	:	:	:
4	217	167	5,000
:	:	:	:
8	184	137	4,700
:	:	:	:
16	157	113	4,400
:	:	:	:
32	133	93	4,000
:	:	:	:
60	115	78	3,700
SUBTOTAL	$ 8,824	$ 6,600	$222,400
:	:	:	:
64	113	77	3,600
:	:	:	:
128	96	63	3,300
:	:	:	:
180	89	58	3,100
SUBTOTAL	$11,859	$ 7,871	$398,800
TOTAL	$20,683	$14,471	$621,200

- There are 100 similar territories exchanging information through the support center.

- The synergistic effect is equal among all affected field engineers (-3%).

- This model quantifies the financial decision criteria over a two-year period based on the following projections:

  - The typical territory containing the new devices will have 60 repair calls in year number one.

  - The installed base will grow and repair calls will double in year number two.

- The model represented by Exhibit II-3 indicates financial justification, on a two-year payback criteria, for using a support center for the new devices if the incremental cost of providing the service for two years will be less than $621,000.

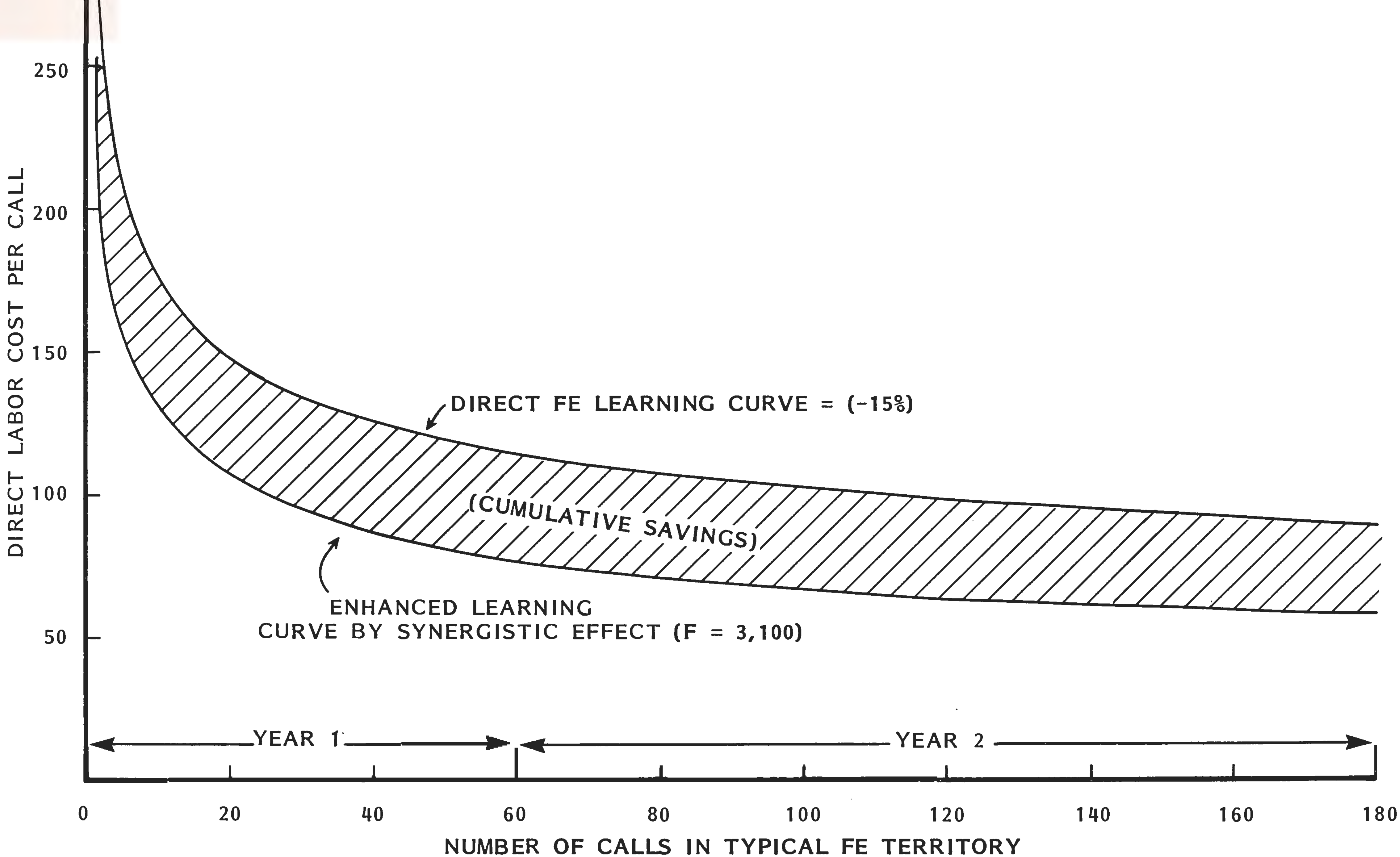
● Exhibit II-4 displays the above data in graphic form.

- The greatest incremental savings are, as expected, in the beginning where learning is most evident; this fact justifies the organization of the support center at or before the shipment of the first units.

- The learning curves tend to converge over time; a fact that justifies the withdrawal of specific device support before the product life cycle is completed.

EXHIBIT II-4

EXAMPLE OF SYNERGISTIC EFFECT ON LEARNING



C. EQUIPMENT RELIABILITY AS A DRIVING FORCE

- Support centers in hardware maintenance are justified more in higher-reliability equipment, for some unexpected reasons.

- Overall reliability is measured not only by the mean time to fail, but by the combinations of failure rates and repair times that ultimately result in error-free availability to the user.

  - The image of reliability is relatively more dependent on what happens when the equipment has a random failure, than on how long it runs without failure.

  - Reliability becomes a live issue in the minds of users when they need maintenance.

  - Reliability has a psychological quotient to users, field engineers and salespersons, which is heavily distorted by the Mean Time To Repair variable.

  - The logical quotient for reliability places MTTR in logical perspective as a probability function, which is meaningful only to engineers.

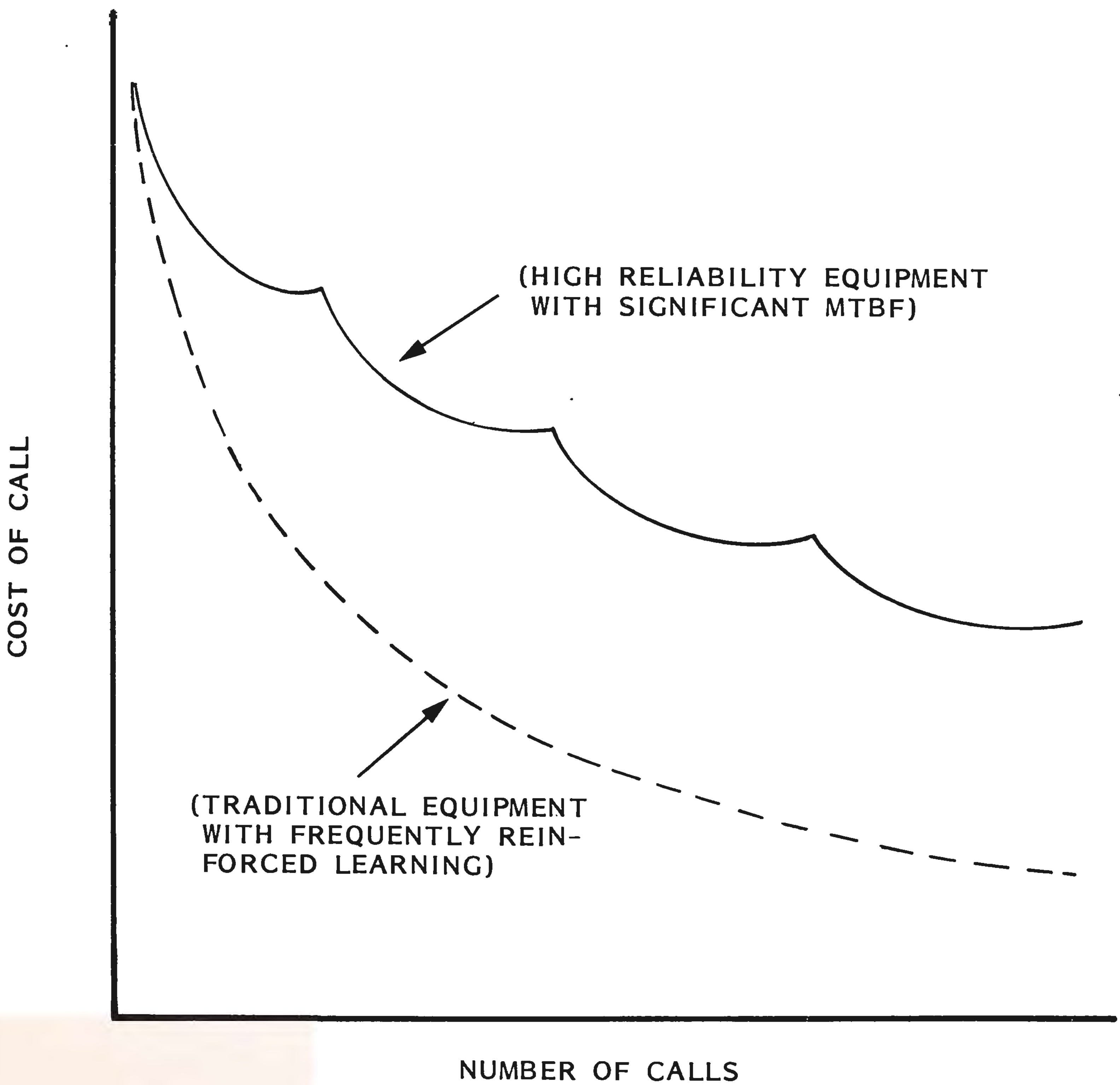
  - Support centers are somewhat justified, as a psychological device, in offsetting the distorted weight applied to MTTR in systems with higher reliability.

- A more practical reason for support centers in high-reliability support functions is subtly related to the learning phenomena discussed earlier.

  - Exhibit II-5 displays the "scalloping" effect of elapsed time between troubleshooting experiences on learning curves.

EXHIBIT II-5

EFFECT OF ELAPSED TIME BETWEEN CALLS ON RETENTION OF LEARNING



GRAPH IS CONCEPTUAL TO DRAMATIZE THE EFFORT OF LEARNING EXTINCTION AS ELAPSED TIME BETWEEN CALLS INCREASES.

- The "scallops" will be more pronounced as the average time between calls increases.

- This effect is the basis of support center justification where higher-reliability equipment has a significant effect on retention of learning; an individual field engineer would usually not have enough experience with the equipment to move along the learning curve.

- Support centers provide cumulative experience to aid in the retention of knowledge in the aggregate.

D. CURRENT DEVELOPMENTS

1. SOFTWARE SUPPORT

- Software support centers are now working directly with users.

  - IBM software service for customer problems essentially follows the decision algorithm presented in Chapter I and shown in Exhibit I-1.

  - The fundamental difference is that the user replaces the local program support representative and deals directly with the support center to determine whether fixes are available, or whether local fixes are required.

  - Depending on the level of priority and need for local fixes, the IBM program support representative may become involved only in assisting the customer in writing APARs and delivering corrections (PTFs).

  - Local support remains an option to the user for an additional charge.

- IBM expects a dramatic improvement in response times to software maintenance calls, as shown in Exhibit II-6.

  . Most calls should be covered in less than one hour.

  . Exhibit II-6 is conceptual only and is not a reflection of current response times for IBM in software maintenance.

● New tools are available to software support centers.

- Remote diagnostics and associated communications interfaces allow software specialists to become interactive with the customer.

  . PTFs can be installed down-line in some cases.

  . Dumps can be ordered and delivered up-line.

  . Error logs and other statistical data can be observed from the support center.

  . The software specialist can take control of the remote system and observe the software failures at the support center.

- Terminals provide access to more current files than microfiche.

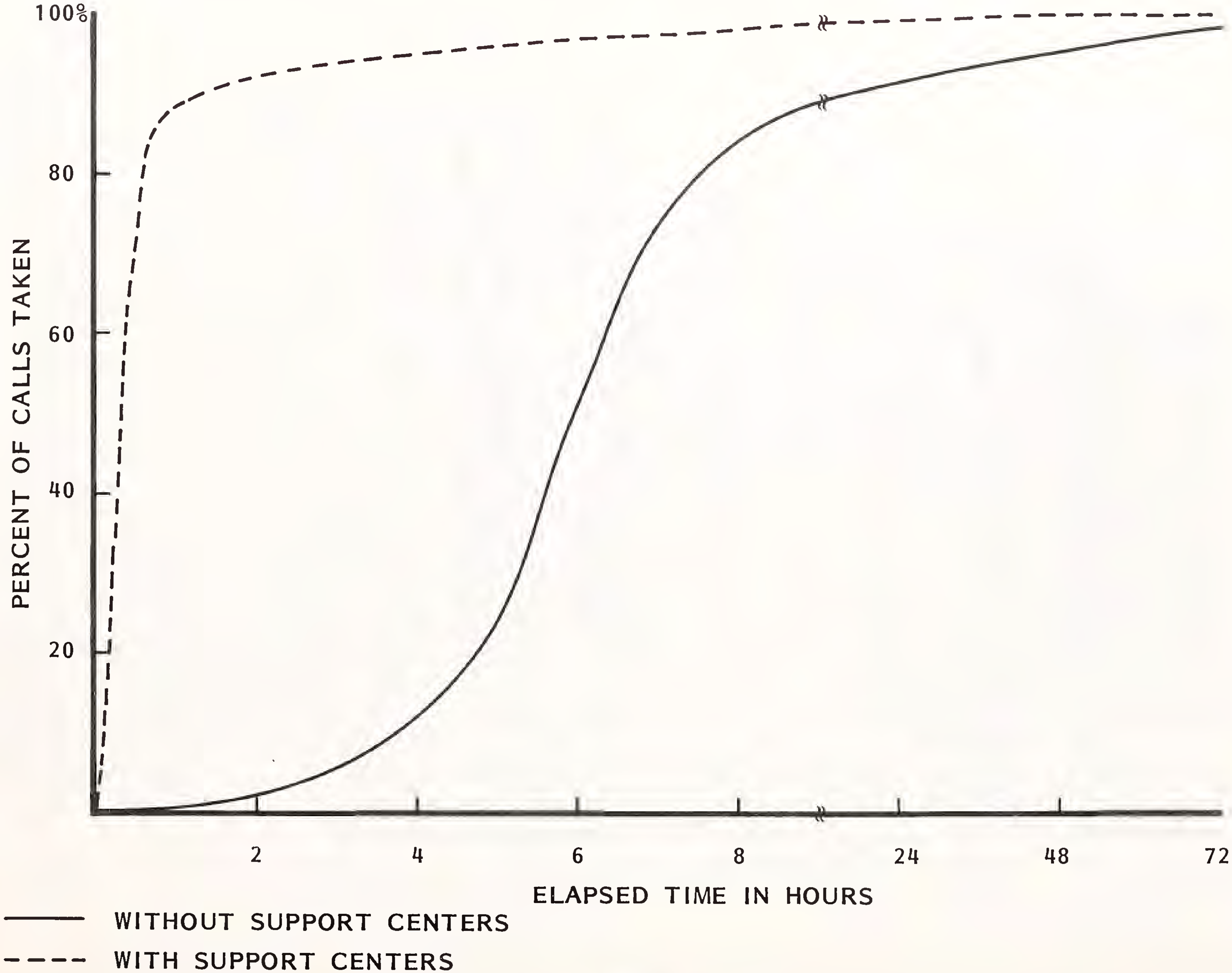
- Customized preventive update tapes can be forwarded through support centers from central history files on customer systems supported by the center.

2. HARDWARE SUPPORT

● Approximately half the vendors now employ remote diagnostics in their hardware support centers. (Refer to <u>Trends in Remote Diagnostics</u>, published by INPUT in December 1980.)

EXHIBIT II-6

RESPONSE TIME TO SOFTWARE MAINTENANCE CALLS WITH/WITHOUT SUPPORT CENTERS



(CONCEPTUAL MODEL)

- Communications linkages transferring logic analyzer memories to support centers are becoming popular in plug compatible operations.

- Modern test equipment such as signature analysis is being evaluated and employed by some support centers at this time.

- Basic Timesharing, Inc. (BTI) has provided direct customer hardware support from the beginning.

E. RECOMMENDATIONS

- The 1980s should find an almost total conversion of first-line user support in software maintenance to the support center level. Vendors will need to employ this technique in order to remain competitive.

- Operations research should be employed to optimize the trade-offs between capital expenditures and labor in field service organizations. Most field service managers are not schooled in the management science disciplines, but such scientific methods of planning will be required to meet the price/performance challenges of the 1980s. Where appropriate, outside expertise in operations research should be employed.

- Requirements to use support centers will create tension among experienced field personnel as their local control diminishes. Management should consider assignment rotations for job enrichment to avoid morale problems.

- For most equipment introduced in the 1980s, it is expected that the maintenance function will trend to 95% logistic and 5% diagnostic, because of new diagnostic aids, both local and remote. This is almost a complete reversal of the 1970s' situation. The support centers for these new products should be organized to reflect expected changes:

- Data base management and information retrieval will be more important.

- Logistic capabilities will be needed, getting the correct resources isolated and applied quickly.

- More efficient ways of servicing the 1970s' equipment still in service should be a priority project of support centers. The 1970s' equipment may be a profit drain on maintenance organizations if the cost and personnel realities of the 1980s are not applied to field service strategies.

SUBSCRIPTION PROGRAMS: Designed for clients with a continuing need for information about a range of subjects in a given area. All subscription programs are fixed-fee and run on a calendar-year basis:

- Planning Service for Computer & Communications Users - Provides managers of large computer/communications facilities with timely and accurate information on developments which affect today's decisions and plans for the future.

- Computer Services Market Analysis Service - Provides market forecasts and business information to software and processing services companies to support planning and product decisions.

- Computer Services Company Analysis and Monitoring Program - Provides immediate access to detailed information on over 2,500 companies offering software and processing services in the U.S. and Europe.

- Field Service Program - Provides senior field service managers, in the U.S. and in Europe, with basic information and data to support their planning and operational decisions.

MULTICLIENT STUDIES: Research shared by a group of sponsors on topics for which there is a need for in-depth "one-time" information and analysis. A multiclient study typically has a budget of over $200,000, yet the cost to an individual client is usually less than $30,000. Recent studies specified by clients include:

- Maintenance Requirements For The Information Processing Industry

- The Market for Small Computers in Large Corporations

- Productivity Improvement, 1980-1983, Survival Strategies for EDP Executives

- Opportunities in Communications Services for Digital Information: A Study of User Networks and Needs

CUSTOM STUDIES: Custom studies are sponsored by a single client on a proprietary basis and are used to answer specific questions or to address unique problems. Fees are a function of the extent of the research work. Examples of recent assignments include:

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

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

- An analysis of the market potential for third-party maintenance.

- The 1980 ADAPSO Survey of the Computer Services Industry.

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

ABOUT INPUT

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.

The company carries out continuous and in-depth research. Working closely with clients on important issues, INPUT's staff members analyze and interpret the research data, then develop recommendations and innovative ideas to meet clients' needs. Clients receive reports, presentations, access to data on which analyses are based, and continuous consulting.

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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