ALTERNATIVE MAINTENANCE TECHNIQUES

INPUT

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INPUT Planning Services for Management

ALTERNATIVE MAINTENANCE TECHNIQUES

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CONTENTS

EXHIBITS

I INTRODUCTION

I INTRODUCTION

A. PURPOSE

- This report is produced as part of INPUT's 1981 European Field Service Programme.
- The subject of the report was chosen due to high client interest. It examines:
  - New maintenance techniques implemented (or planned) by vendors in the recent past.
  - The objectives that were set for these new maintenance techniques in terms of costs, profit, efficiency, competitiveness, etc.
  - The degree to which these objectives have been attained.
  - User reactions to the techniques.
  - Field service personnel retention.
- In addition, the degree of interest/implementation/success in using remote diagnostics (RD) was examined as a status report on the progress of RD in Europe, following INPUT's earlier report, Remote Diagnostics in Western Europe, in the Field Service Programme of 1980.

B. SCOPE

- The bulk of the research for this report was done by telephoned and mailed questionnaires to the country/European field service managers of 14 major computer equipment vendors.

- The research questionnaire is provided in Appendix B, and the research sample is shown in Exhibit I-1.

- Where interesting developments in the maintenance field have occurred, the equipment category was widened to include word processors and copiers/duplicators.

- No direct refusals were encountered from the responding vendors in providing the information requested. However, some vendors, while willing to provide a complete description of their corporate strategy, plans, etc., desired to remain anonymous to avoid undue disclosure to competitors.

- Where this occurred, the data supplied has been divided into several separate sections and all references to the specific vendor suppressed.

- Other information used for this report was taken from relevant INPUT studies, as referenced in Appendix C.

- Finally, 116 user interviews were analysed for their views on remote diagnostics. These interviews were part of the annual survey for the 1981 European Field Service Programme Annual Report.

C. REPORT ORGANISATION

- The report has been organised into sections by type of technique used, with mentions of specific vendors where possible.

EXHIBIT I-1

TYPE OF VENDOR COMPANIES INTERVIEWED

COMPANY	TYPES OF PRODUCTS OFFERED BY VENDOR				HEADQUARTERS	
	MAIN-FRAMES	MINIS	SMALL BUSINESS SYSTEMS	PERIPH-ERALS AND OTHER	EUROPE	U.S.
1				X	X	X
2				X	X	X
3		X	X	X	X	
4	X	X	X	X	X	X
5		X			X	X
6		X			X	X
7	X			X	X	X
8	X	X	X	X	X	
9		X	X		X	X
10		X			X	X
11	X	X	X	X	X	X
12	X	X	X	X	X	X
13		X	X	X	X	X
14				X	X	

- Special attention has been paid to remote diagnostics, given the interest that this topic has generated among vendors and users alike.

- Client comments on this report are welcomed.

II EXECUTIVE SUMMARY

II EXECUTIVE SUMMARY

A. MAINTENANCE TECHNIQUE ALTERNATIVES

- Over the past three years there has been a complete reappraisal by the majority of equipment vendors of the importance of field service in Western Europe in terms of its impact on revenue, profitability, user satisfaction, and company competitiveness.

- This has resulted in many vendors closely examining each other's approaches to maintenance and in the development of new techniques for cutting costs, improving engineer productivity, and system availability.

- As always in situations like this, there has been the emergence of a major new maintenance philosophy, supported by some, derided by others, and a variety of plans that all aim at the same targets, but with sharply differing techniques, as shown in Exhibit II-1.

- Remote diagnostics (RD) has emerged as the principal new technique, and most European vendors have plans to implement at least some aspects of it. Others are in the early stages of its full implementation, with varying degrees of success.

- But RD is not the only technique being examined. Some vendors are implementing a form of remote error reporting, others are establishing

EXHIBIT II-1

MAINTENANCE TECHNIQUES USED BY VENDORS INTERVIEWED

VENDOR	REMOTE DIAG-NOSTICS	CALL DISPATCH DATABASE	CUSTOMER SERVICE DESKS	DEPOT MAINTEN-ANCE	MARKET-ING FIELD SERVICE	MICRO-BASED TESTING AIDS	REDUN-DANT HARDWARE ELEMENTS	COMMENTS
1	I	I		I	I	P		RD at pilot stage
2		P	P	I	I			RD discarded
3	I*	I	I	I	I	I		*Remote error reporting
4			P	I				Changing from TPM[1]
5	I	I	I	I	I	I		
6		I		I	I			
7	P	I		I	I	P		RD planned for 1982
8	I	I		I	I		I	RD implemented 2Q 1981
9			P	I	I	I		
10	P	P		I	I	I		RD launch Oct. 1981
11	P	I	I	I		P		RD launch 1982-1983
12	P[1]		P	I	I			**1. Remote tech. asst. at pilot stage. Launch 4Q'81**
13	I[2]		P		I	I		**2. Remote tech. asst.**
14	P[3]			I	P			**3. RD launch 1982**

I = IMPLEMENTED; P = PLANNED; BLANK = NO INTEREST distributed customer service desks, while others examine the feasibility of redundant hardware designs and remote preventive maintenance.

- This is happening among computer equipment vendors, but on the fringes of the markets they serve are often product vendors whose technology and market constraints bear a direct relation to the computer and its markets. An example of the philosophy used by one of these vendors has been given in Chapter V.

- At this early stage in its implementation, it is difficult to assess the eventual acceptance of the remote diagnostic technique, since:

  - Many vendors are directly opposed to it.

  - Few have implemented it widely, and the breadth of experience is therefore not available.

  - Even those who have adopted it unreservedly admit it can only be applied to a small fraction of their installed user base, usually for technical reasons.

  - Clear measurements of cost savings and efficiency improvements are not being carried out.

- But even if approval of RD cannot be given without reservations, it is nevertheless clear that some form of remote assistance service will become the industry standard to which all vendors will be expected to comply (by users).

- Another likely industry standard is the computerised call dispatch database, which acts as a complement to remote assistance (if implemented). Whatever the in-field support/maintenance technique used (depot maintenance, customer service desks, RD, etc.), centralised, computerised call queuing/handling and field engineer dispatch are now part of every vendor's plan.

- Lastly, all vendors have begun actively marketing their field services, except those who do not have their own fully developed field engineering force (i.e., are using third-party maintenance suppliers for the moment).

- Field service has become important to vendors and is now being 'refurbished' and marketed to end users as a product. Throughout this report the term 'Remote Assistance' has been used to refer to techniques such as remote preventive maintenance, remote diagnostics, remote error reporting, and remote technical assistance.

B. COST AND PROFITABILITY MOTIVES

- It has become obvious to all vendors that field service revenues are an increasingly large proportion of total revenue (currently around 15% on average and growing to 25% over the next four years), as shown in Exhibit II-2.

- Also obvious to vendors is that, while it was possible to increase these revenues by a regular 15+% per annum by simply raising maintenance charges, users have now reached the limit of their acceptance of these price increases.

- No less significant is that, with installed bases expanding rapidly, as shown in Exhibit II-3, and engineers becoming in short supply, salary costs (the largest component of maintenance costs) are also rising rapidly.

- The pressure on field service margins that has been developing over the past three years has been a powerful incentive to devise and implement new cost saving productivity tools and techniques. With revenues somewhat constrained by user resistance to price increases, the emphasis has been placed on reducing costs. Over the 1980-1981 period, costs have been contained but not reduced, as shown in Exhibit II-4.

EXHIBIT II-2

FIELD SERVICE REVENUE
AS PERCENT OF TOTAL
COMPANY REVENUE, 1981 AND 1983

(From Annual Interview Programme)

VENDOR	1981 (percent)	1983 (percent)
1	25%	30%
2	25	25
3	12	14
4	20	24
5	-*	10
6	5	5
7	8	11
8	20	23
9	10	16
10	12	15
11	15	20
12	9	10
13	8	14
14	16	13
15	17	20
16	10	14
17	10	12
18	25	25

*-START UP SITUATION

EXHIBIT II-3

WESTERN EUROPE FIELD SERVICE REVENUE AND EMPLOYMENT FORECAST, 1981-1986

YEAR	FIELD SERVICE REVENUES ($ billions)	NUMBER OF FEs (thousands)	TOTAL VALUE OF INSTALLED BASE ($ billions)
1981	$4.1	55	$48.7
1982	4.8	58	53.5
1983	5.6	61	58.8
1984	6.6	64	64.6
1985	7.8	67	70.9
1986	9.2	69	77.9
1981-1986 AAGR (percent)	17.5%	4.7%	10%

NOTE: $B = 10^9$

SOURCE: INPUT Annual Report

EXHIBIT II-4

PER CALL FIELD ENGINEERING COSTS, WESTERN EUROPE

DOLLAR COST PER CALL	PERCENT			
	DIRECT AND TRAVEL LABOUR	TRAVEL, LABOUR, AND EXPENSE	PARTS AND MATERIAL	BURDEN AND OTHER
1980				
• Range $75-500	30-75%	5-35%	8-45%	0-34%
• Average $230.95	50.4	17.7	21.9	10.0
1981				
• Range $125-360	20-60	8-45	5-70	5-76*
• Average $262.25	37.0	13.3	18.5*	31.2*

*SOME VENDORS PUT P&M IN 'OTHER', GENERALLY INCREASING 'OTHER' AND DECREASING P&M

- While implementing new cost saving measures, it appears that few vendors have implemented strict controls to assess how successful the new measures are. Only one vendor could quantify the cost savings of implementing remote diagnostics (30%).

- While most vendors are confident that costs are being successfully tackled and that the impact of the techniques over the maintained products' lifetime is likely to be substantial, there is a lack of formal cost savings measurements which is poor management practice.

- New maintenance techniques offer more than a simple, clear-cut reduction in service costs. For example, one of the results of the use of remote diagnostics, remote error reporting, and engineer support databanks is that the need for in-field expertise is reduced.

- It would be an over-simplification to say that these new tools allow in-field engineers to be simple board swappers with all the in-depth expertise in the support centres, but certainly the new tools reduce the engineer training schedules.

- While profitability is always the prime mover in any vendor's operational divisions, cost control and engineer productivity have become very important to field service management.

- This same group is also too busy handling the implementation of the new techniques with all that that implies in organisational change, training programs, parts distribution, network development, support centre staffing, and documentation to be able, simultaneously, to carry out precise monitoring of the effect of all these changes on costs and/or profits.

- Exhibit II-5 compares the targetted profit margins of vendors in 1981 with that of 1980.

EXHIBIT II-5

VENDORS' TARGETTED PRETAX PROFIT MARGIN, 1980-1981

GROUP	TARGETTED PROFIT MARGIN	
	1980	1981
• Total Range	0-34%	4-45%
• Lowest 25%, Average	5.5	7.3
• Lower 50%, Average	8.1	10.0
• Lower 75%, Average	12.7	12.1
• Overall Average	17.8	18.1

- These increases are expected to continue into 1983, with all but four of the vendors anticipating an increase in profitability on maintenance revenues, sometimes by as much as seven percentage points.

- Those vendors anticipating a drop in profitability are benefitting from healthy margins at present, as shown in Exhibit II-6.

- With price rises somewhat constrained, this suggests that vendors feel confident in their ability to control and even reduce costs.

C. IMPACT ON CUSTOMER CALL RATES

- The initial objectives of all the new remote assistance techniques do not normally include a reduction in customer call rates. Indeed some vendors expect the availability of on-line support centres staffed around the clock to encourage users to make use of them.

- While initially this has often been the case, as soon as the 'steady state' has been reached (i.e., after the novelty of the new technique has worn off), nearly all vendors have experienced a drop in call rate.

- For some, the drop has been a small one, 5% or so. For others it has been dramatic, with as much as a 66% reduction in the volume of calls. (This results mainly from improved user education, eliminating queries which have more to do with operational inexperience than with machine failure.)

- When remote assistance is launched, the call rate can be expected to rise by 15-20% according to vendors. Obviously this is largely a function of the proportion of the installed base that is affected by the new techniques and the models within the product range that can be serviced by it.

EXHIBIT II-6

VENDORS' TARGETTED PRETAX PROFIT MARGIN, 1981 AND 1983

VENDOR	1981	1983
1	12%	14%
2	14	20
3	18	25
4	12	15
5	8	10
6	4	8
7	-	12
8	17	25
9	30	25
10	14	20
11	45	43
12	33	30
13	10	10

- The periods over which the impact of remote assistance is felt vary from vendor to vendor. Exhibit II-7 shows the typical profile of call rates. After a period of approximately four months the call rate peaks at around 115-120%, than falls by a minimum of 5% and a maximum of 66%.

- Remote error reporting, which includes a form of remote client education, shows the greatest impact.

D. IMPACT OF REMOTE ASSISTANCE ON FE SITE VISITS

- There seems to be unanimous agreement among vendors that fully 30% of all customer calls can be 'screened' from the field service force by remote assistance techniques by the use of adequately trained service response personnel.

- Where they differ is in what proportion of the site visits can be eliminated by the remote assistance personnel.

- Some vendors are adamant that 70% of site visits cannot be avoided (usually those who are also adamant that remote diagnostics is not a good method of remote assistance).

- Other vendors claim that this can be improved upon, particularly by executing preventive maintenance visits remotely (e.g., during the 12 p.m. - 7 a.m. period).

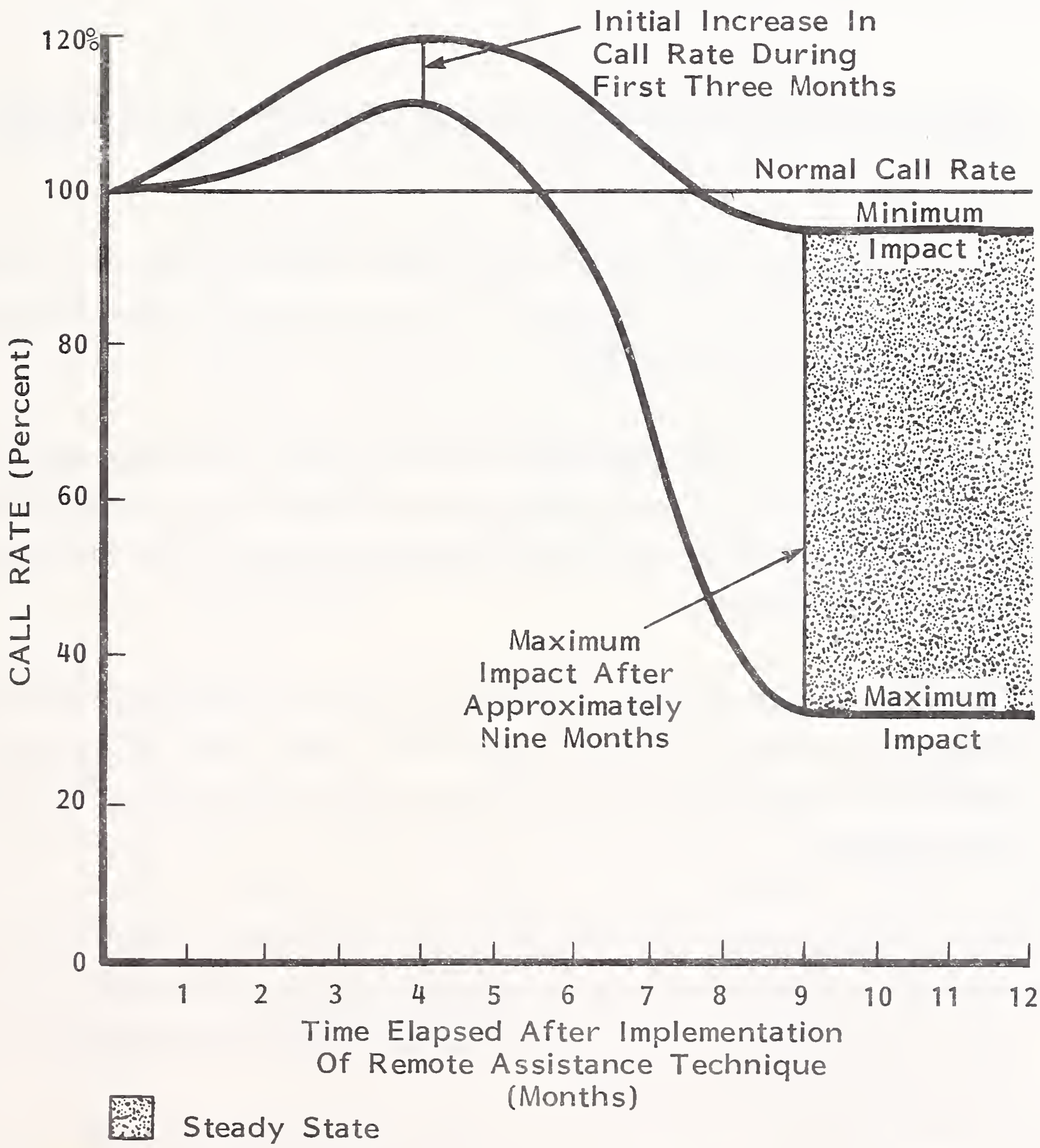
- The argument is not so much about whether site visits can or cannot be eliminated (they currently cannot), as about:

  - The frequency with which they occur.

  - What operations are executed when the FE arrives on-site.

EXHIBIT II-7

IMPACT ON CALL RATE OF
REMOTE ASSISTANCE TECHNIQUES



- Supporters of both remote error reporting and remote diagnostics say that the FE should only go to the site once the fault has been diagnosed and the likely parts needed have been obtained. The FE does not execute diagnostics on arrival, only confirmation tests once the faulty parts have been replaced.

- This means that the FE task is simplified and the level of skill needed has been reduced. This can be viewed as the first step towards asking the user to do the board swap/part replacement.

E. MARKETING NEW TECHNIQUES AND EFFECT ON COMPETITIVENESS

- There is no doubt that the user has been made aware of the new remote assistance techniques now available from some vendors and that on the whole he believes they are a good idea.

- Vendors who are concerned about remaining among the technological leaders (e.g., following each other's announcements of 32-bit minis, improved processors, cycle times, etc.) must now be prepared to present users with their plans for remote assistance.

- For a short time it will not be necessary to have a remote assistance service available, as long as a cogent plan can be shown. By 1982, however, any vendor that does not have such a service implemented will be at a distinct disadvantage.

- Many vendors have begun presenting their engineering support service as a product (fact sheet, promotional brochure, etc.) and while none of the fact sheets talk about the competition as yet, it is likely that competitive aspects will shortly have to be included.

F. RECOMMENDATIONS

- The main EDP industry and maintenance trends expected by INPUT in its 1980 report, Marketing Field Services in Europe, have been born out by developments in the market place:

  - Inflation of the call cost due to the increases in labour costs and the inability of new techniques to completely off-set this rise (new techniques have mitigated the rise but not halted it).

  - Change in the mix of equipment maintained with a heavy shift to minicomputers, small business systems, and terminals (i.e., the expanded implementation of distributed data processing).

  - Continued shortening of average product life cycles with the attendant increase in requirements for training, inventory of parts, and documentation (for third-generation equipment).

  - Intensified search for productivity tools and methods of improving per-head revenues.

- In addition, the role of fourth-generation computer equipment can now be more clearly seen. The speed of growth of users' needs, now at 25% per annum, has increased, whether they are small, medium, or large users. This means that if computer products are to have a reasonable product life cycle the power range of each model must be increased. Moreover, since vendors have a tendency to broaden the market scope of each of their computer products (to achieve higher product sales volumes), the need for a wider power spread per model is strengthened.

- Vendor plans for fourth-generation equipment, therefore, include the replacement of several older generation products by a single new generation computer with power ranges up to 10 times larger than the products they replace.

- Currently, mainframe computers have a three-year commercial life, supported by two redesigns per year. The new generation products will have one redesign every two years - a fourfold improvement.

- In terms of field service planning, this means a gradual improvement in the current proliferation of models to be serviced (with a lessening of the attendant parts inventory, documentation, training, and field specialisation engineers).

- By mid 1982, it is also likely that more than 40% of all products sold will be offered with remote assistance services, so that the impact of these services, as a percentage of the installed base, will begin to grow very rapidly.

- Field engineer specialisation will then become emphasised, with centres of excellence located in the remote support centres, on-call for the in-field engineer who has more limited skills.

III REMOTE DIAGNOSTICS - A STATUS REPORT

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A. INTRODUCTION

- In October 1980, INPUT's report, Remote Diagnostics in Western Europe, identified a reluctance on the part of many vendors to implement RD, even though 95% of those interviewed were planning to operate some type of RD system at an undefined moment in the future.

- This chapter analyses in detail the RD experiences of two vendors, their different philosophies, and the results they have achieved. In many instances original plans and expectations have not been achieved.

- It also looks at the effect (positive and negative) that RD has had on pricing of field services and examines some of the counter arguments put forward by vendors against RD.

B. DIGITAL EQUIPMENT CORPORATION (DEC)

1. SERVICE OFFERED

- Digital Equipment Corporation (DEC) offers a remote computerised diagnosis system (RCD) based on two diagnosis centres, one in the U.K. (Basingstoke) and one in France (Valbonne).

- Initiated in January 1980, the European RD service is intended to handle over 10,000 users by 1985, but already this looks highly unlikely. So far (as of September 1981 or 21 months into the five-year plan), there are approximately 400 users of the U.K. service and 600 users of the Valbonne service.

- Even allowing for an acceleration of user acceptances in the last half of the five-year plan, current usage is down by more than 50%. New users are being added at far less than the 100 per month rate anticipated.

- So far, the service in Europe is limited to the PDP 11/44 (recent replacement of the 11/34), the PDP 11/70, and the VAX 11/750 and 11/780 systems. New high-end, medium range product announcements will all be covered by RCD.

- A diagnostic sequence starts with the customer making a telephone call to a 'Freephone' number which connects him with the Service Response Group (SRG), at no charge. The SRG ascertains whether the matter concerns hardware or software and if it should be dealt with by the local branch or the Remote Diagnosis Centre (RDC), as shown in Exhibit III-1.

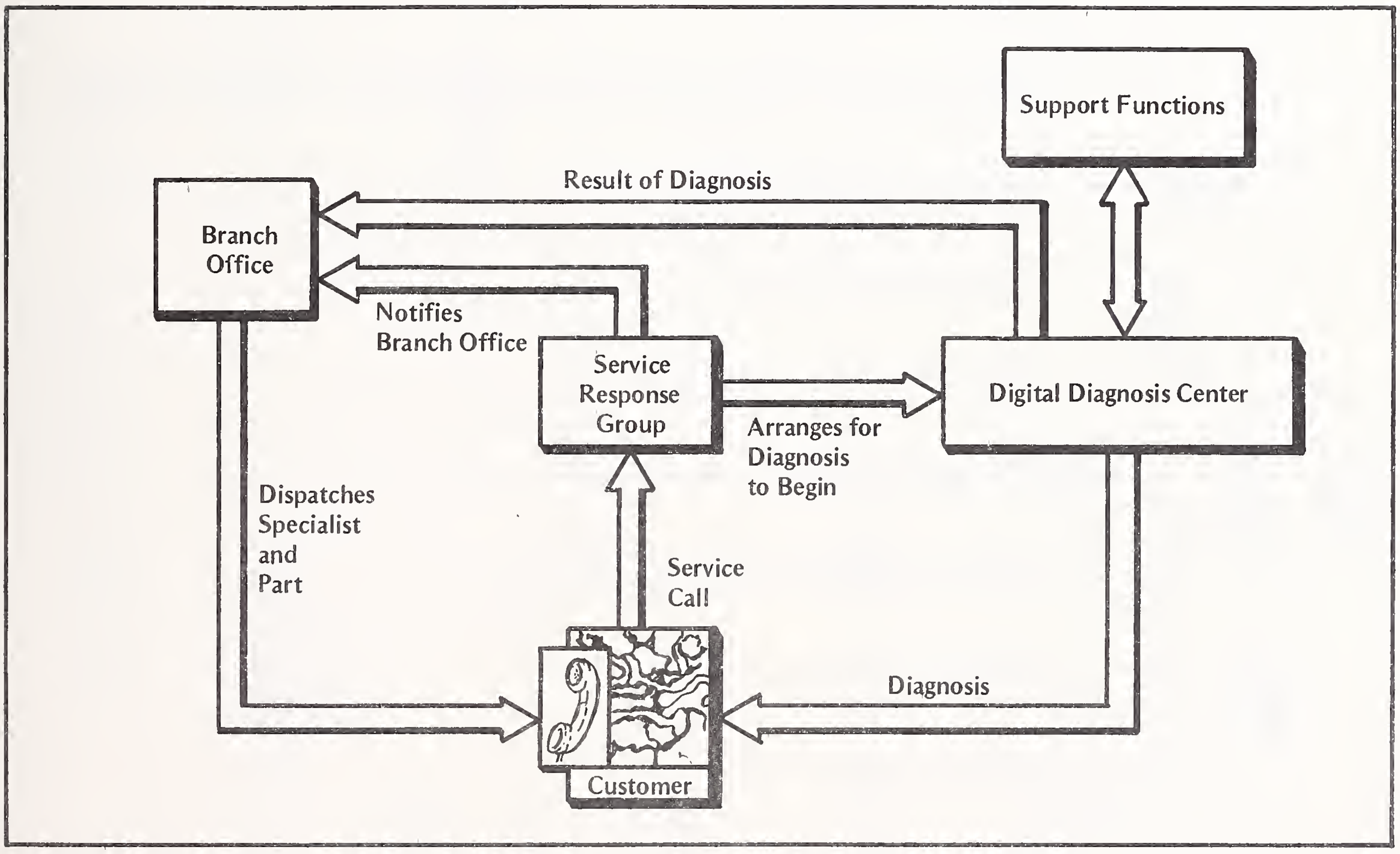
- If the need for diagnosis is confirmed, the SRG engineer asks the user to remove his storage media or ensure it is write protected. The RDC host computer then controls the running of a suite of diagnostic programs on the system being tested.

- RDC staff decide the type and extent of the tests to be carried out, bypassing unnecessary diagnostics in the testing to diagnostic engineers for analyses, along with the system history of the user's computer (stored in history files by the host computers).

- Fault handling is not simply 'clear' failure isolation and part/board replacement. A fault engineer may be able to advise the client on temporary remedial action. Intermittent faults may require prolonged on-line testing prior to problem diagnosis.

EXHIBIT III-1

SCHEMATIC OF DEC's REMOTE DIAGNOSTIC SERVICE



- When problem areas have been identified, the local branch office can be notified, allowing the dispatch of a service engineer with the most likely replacement parts.

- The net result for the user is:

  - Fast initial response to a customer problem.

  - Rapid diagnosis.

  - Rapid notification of the local branch of the exact nature of the fault.

  - Reduced response time.

  - Reduced repair time.

  - Improved system availability.

- From DEC's point of view, it results in:

  - Improved productivity of engineers.

  - Reduced travel costs.

  - Improved travel costs.

  - Improved knowledge of the field status of each customer site and of each product line (trends, typical faults, need for ECOs, etc.).

  - Improved competitiveness of service.

2. REMOTE DIAGNOSTIC CENTRE ORGANISATION

- Exhibit III-2 shows how each RDC is equipped, and Exhibit III-3 shows typical messages as seen by the user and DEC on their respective display units.

EXHIBIT III-2

DEC REMOTE DIAGNOSTIC CENTRE

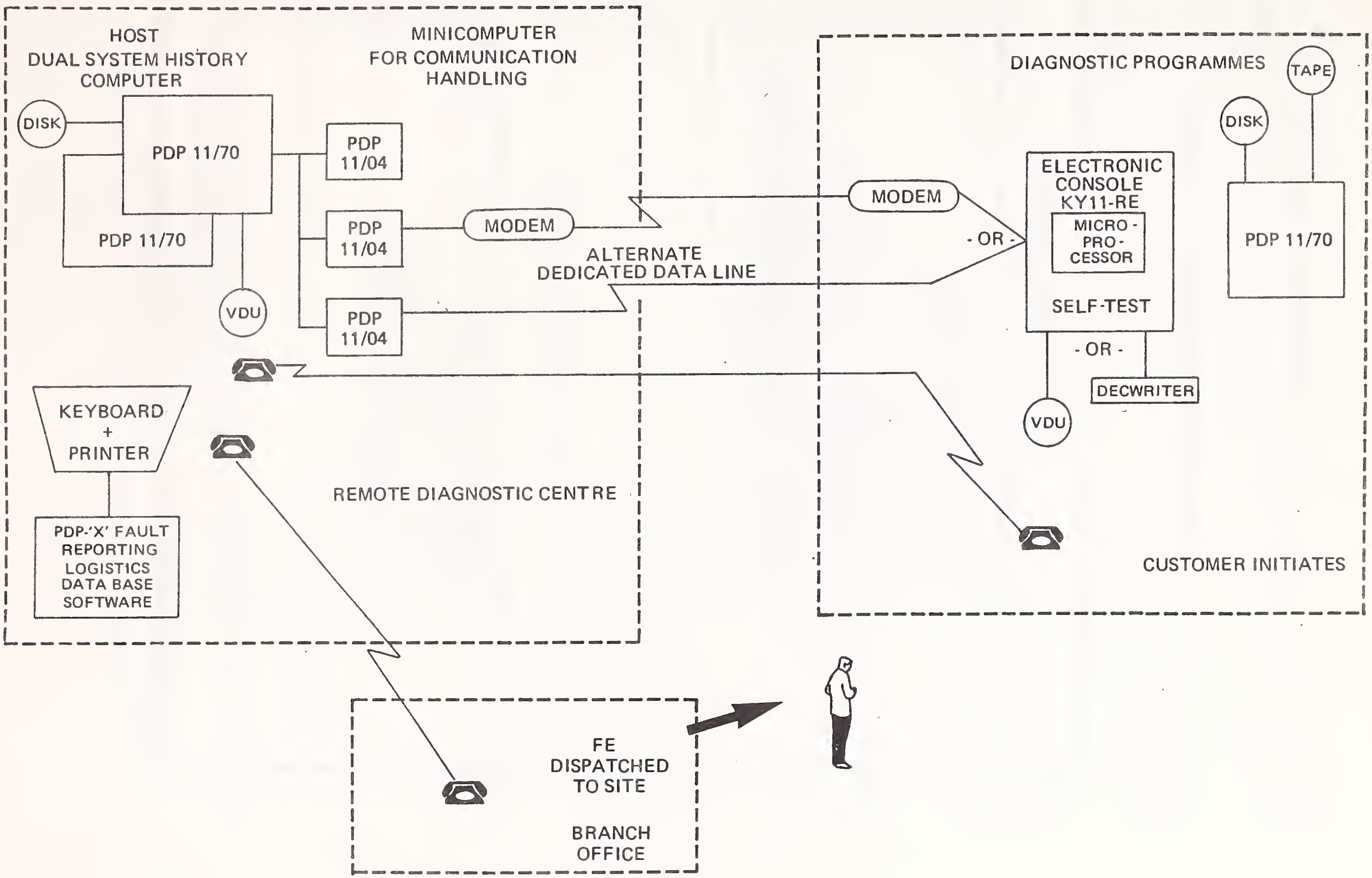


EXHIBIT III-3

DEC REMOTE DIAGNOSTIC MESSAGES

USER CONSOLE DISPLAY

THIS IS THE UK-RDC BASINGSTOKE
YOUR CALL HAS BEEN LOGGED.
LOG NO. X8 3725 CALL TIME 13.23
YOUR LOCAL FIELD SERVICE OFFICE IS
BEING INFORMED.
THE UK-RDC ASSUMES THAT IN THE CASE OF
ANY DIAGNOSTIC TESTING ALL CUSTOMER
MEDIA HAS BEEN REMOVED OR WRITE PROTECTED.
DIAGNOSTIC LOAD MEDIA MUST BE WRITE PROTECTED.
DIAGNOSIS BEGINS IN TEN MINUTES

RDC CONSOLE DISPLAY

LOG NO. X8 3725 CUSTOMER ______________
CONTRACT: DECSERVICE
SYS TYPE: 11/70 SERIAL: 55833
PROBLEMS: RPOG D2 WRITE ERROR
ENGR ASSIGNED: 56823 ANBAR PC
ACTION OUTAGE: 0

- The dual PDP 11/70s represent the host computer whose disk files hold full details of the customer systems including configuration, service history and revision levels of hardware and software.

- The three PDP 11/04s control automatic dial-up of the customer site, either by dedicated line or via a modem link.

- At the user site, the 11/44 or 11/70 must have a microprocessor-based electronic console (KY11-RE) which is designed to self-test, operate a special communications protocol for security, and provide the customer-operated security interlock.

- In the case of the VAX systems, the user mounts a diagnostic disk pack, loads a diagnostic floppy disk on the console, selects RD, and calls the diagnostic centre; no further intervention is required. The diagnostic centre then runs the VAX Remote Diagnosis Package.

- The electronic console and the Remote Diagnosis Package are considered to be service tools associated with the RD service. They are installed free of charge, or considered to be the property of DEC throughout the RD service agreement and are removed upon the termination of such agreements.

- A typical RD centre has a manager, a SRG supervisor, three service response persons, eight engineers, and twenty software specialists.

3. OBJECTIVES AND RESULTS

- The three main objectives of the implementation of DEC's RDC were:

  - Increase the ratio of sites serviced per engineer ('we were running out of adequately trained engineers').

  - Improve productivity of each person involved in the repair sequence.

- Reduce response and repair time, improve system availability, and therefore improve service competitiveness.

- There were no specific cost reduction objectives, but DEC claims that they have saved more money than the cost of the RD centre - a massive saving indeed.

- The targets set for number of users on-line (10,000 by 1985) are unlikely to be achieved. This must mean that the high overheads associated with the creation of each centre must have worsened costs at this stage.

- The service is a definite success on the sales side, and is a major sales item. Users like it, field service engineers like it, and it has been extended to include after hours (12 p.m. - 7 a.m.) remote preventive maintenance.

- Call rates per client have increased by 15-20%, since the user has a tendency to call at the slightest problem. However, 30% of the calls are dealt with over the phone, immediately, and 90% of the remainder are diagnosed to a single board or group of boards within an hour. The goal is to reduce this to one-half hour. These boards are then processed by the regional repair centre.

- There is no doubt that DEC will gradually expand RD coverage to all the new systems sold. The size of the installed base dictates that the percentage of installed systems not covered by RD will remain high for a long time to come, however.

C. NIXDORF COMPUTER

1. SERVICE OFFERED

- In Europe, Nixdorf Computer has not uniformly implemented remote diagnostics, with some major country markets yet to announce the capability to their users. Notable among the absentees is the U.K., where the service will not be available until 1982.

- The service offered covers only part of the installed base (approximately 35%), since the technique cannot be retrofitted to earlier product generations. This means that RD will cohabit with traditional service methods for a long time to come.

- All future systems will systematically include a built-in communications device, at no extra cost to the user, enabling remote service over PTT lines.

- Nixdorf offers 'Remote Support', a term describing the full system support offered, as opposed to those vendors whose software is provided (and supported) by third-party vendors.

- The service is organised around a central support office through which the branch office can route a telephone call to the user CPU, or from which he can receive details of the system history.

- A call is initiated by the user to his local branch, which may decide to interrogate the error log and failure trace that is stored automatically by the system operating software. This type of link is achieved from a branch office terminal with accoustic coupler, and can only execute inquiry type operations.

- If system history data and/or remote diagnostics are required, the field engineer may either request that the central Remote Support site initiate a call or ask for his own call to be routed through the Remote Support centre. The latter is discouraged, however.

2. REMOTE DIAGNOSTIC CENTRE ORGANISATION AND POLICY

- Each RD centre is set up to remotely diagnose and handle hardware and software faults.

- The centre combines remote support with an automatic call dispatch facility and system history file held on computer.

- The philosophy employed is based on the assumption that there is no valid alternative to RD, that all vendors will ultimately have to adopt RD, and that therefore the questions asked should be how and when, not if.

- On present evidence, RD lends itself better to software support than hardware, mainly because the units that are most likely to fail are electromechanical (printers, card readers, etc.) which exhibit a low level of intelligence.

- For example, if a printer prints the wrong character it may not even be 'conscious' of the error, and certainly cannot log it.

- However, with the advent of electronic devices, not only will device uptime improve but remote diagnosis of failure trends and 'hard' faults will be extended to these peripherals.

- Long-term plans call for the ability to diagnose faults of a system that is 'DEAD', by having a microprocessor tied into the back plane of the processor. If main current supply is still present, diagnosis can then still proceed.

3. OBJECTIVES AND RESULTS

- The main objectives targetted by the introduction of Remote Support were:

    - Reduce travel time and costs.

    - Reduce response time and system downtime.

    - Improve engineer productivity.

    - Ensure the field engineer has the right spares before he leaves for the customer site.

- It is too early to quantify results in some countries (e.g., the U.K., where only 20 pilot sites have the service at present, even though the initial response by users is very good).

- In other countries where Remote Support has already been implemented, the engineering force is well pleased, since it allows them to optimize their time and reduces the number of unnecessary client visits (or visits where customer education is the real problem, not the system).

- In these countries the experiences so far show that as much as 40% of calls can be handled over the phone, circumventing the need for an FE visit completely.

D. OTHER VENDORS IMPLEMENTING REMOTE SUPPORT

- Many vendors have reached the stage of either advanced planning, limited implementation, or field testing of remote diagnostics. Each has a slightly different approach. A typical large system remote diagnostic set-up is shown in Exhibit III-4. The main companies that have reached this stage are discussed in this section.

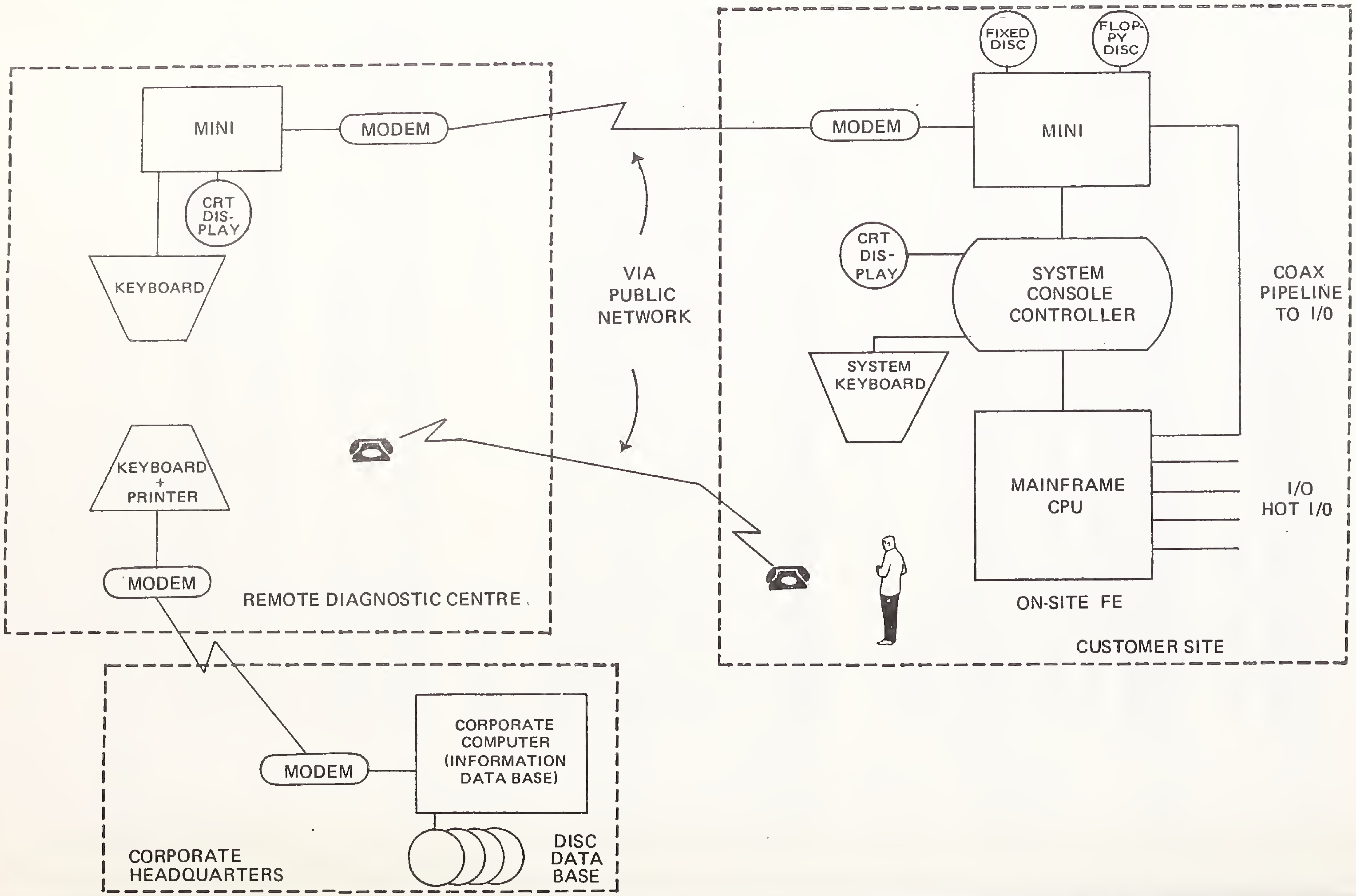
1. HONEYWELL

- Unlike most other vendors (who begin offering Remote Support services at the highest end of their computer lines) Honeywell has so far limited its remote diagnostic field tests to the low end Level 62.

- Along with all of the usual benefits claimed, Honeywell cites the fact that engineers using remote diagnostic techniques spend more time on actual fault solving which speeds their learning curve dramatically.

EXHIBIT III-4

TYPICAL LARGE SYSTEM REMOTE DIAGNOSTIC SET-UP



2. PRIME

- Prime claims to have initiated remote diagnostics on the largest of the 50 series (750, 850) through the use of the Virtual Control Panel (VCP).

- The technique is a carbon copy of DEC's approach for the VAX series: a 'remote enable' button on the local console authorizes remote terminal access to the system via the console, including the ability to bootstrap.

- PRIME says that software as well as hardware errors can be remotely diagnosed but there is no field evidence of this yet.

3. BURROUGHS

- Burroughs has a Remote Analysis Diagnostic and Reporting Facility, similar to the Sperry Univac Trace system described in Chapter IV, Section B.

- This is a remote access facility for engineers in difficulty that ties into a U.S. database. It is planned to implement it in Europe in 1982.

4. ICL

- ICL has adopted the Remote Error Reporting Approach described in Chapter IV.

- ICL sees the main change coming as being the bringing together of hardware and software support activities under a single management. This has been implemented in the U.K., Australia, New Zealand, and South Africa and is under consideration for the rest of Europe.

5. DATA GENERAL

- Data General has initiated a remote error reporting system, as shown in Chapter IV, for the high end of its minicomputer range (MV600, MV8000).

- Most peripheral units initiate self-testing when switched on and the MV memory self-tests every four seconds.

- The MVs are provided with a console processor which logs any faults, both transient and hard. By local manipulation it can move voltage levels up and down and speed clocking circuits up. This has the objective of bringing transient faults out into the open.

- MVs can also be remotely interrogated by a direct dial into the console, which allows the contents of the error log to be examined as well as register contents if necessary.

6. WANG

- Wang is in the process of examining remote diagnostics for the later Wang models (VS25 and all new systems).

- No precise data is yet available, since too many options are yet to be decided (Who pays for the modem? Does client pay for remote diagnostics? etc.).

- The service has begun field testing in the U.S. but a decision on Europe is yet to be finalised.

E. EFFECTS ON PRICING

- One of the key aspects of remote diagnostics, which is visible to users as well as to vendors, is the reduction in maintenance costs that can be achieved by reduced travel and improved engineer productivity.

- Since a substantial saving is being made, it is in the interest of the vendor to encourage users to adopt RD. This most European vendors do by, for example, making the modem/console unit necessary for the remote link a non-charge item (although there are some vendors who expect the user to buy/lease/rent his own modem).

- But the users are conscious of losing the vendors' attention in accepting to be remotely diagnosed, and while they generally have good opinions of the results that can be achieved (shorter response time, faster repair, etc.) they nevertheless believe that the principal beneficiary of RD is the vendor.

- Therefore, they argue, the vendors should share the benefits of RD with the users in the form of credits, or price reductions. Very few vendors are willing to do this, as shown in Exhibit III-5.

- Most do not feel that a price reduction can be justified, given the costs of establishing RD and the fact that RD generally cannot be applied to all of their installed base.

- DEC provides a small maintenance charge credit, which in effect offsets the rental of a modem. These charges are:

  - $35/month on PDP 11/70 and VAX systems.

  - $75/month on PDP 11/44 systems.

- Only one vendor, Tandem, provides for a substantial discount incentive for users accepting RD (19% on the basic system maintenance charge, or $245/month credit). This will ensure that all TANDEM users adopt RD and feel well treated by their supplier.

F. A COUNTER ARGUMENT

- Not all manufacturers are rushing to implement remote diagnostics. Some are opposed on principle, some on costs, and some on the basis of the results that they believe can be achieved by RD.

EXHIBIT III-5

COMMENTS FROM VENDORS
ON PRICE REDUCTIONS FOR
USERS ADOPTING REMOTE DIAGNOSTICS

- 'Our approach is to tell users that, thanks to remote diagnostics, future maintenance price increases will be less than they would otherwise have been'.
- 'Users get an improved service through remote diagnostics, why should we offer them a discount'?
- 'Maintenance service is part of our product; if we adopt remote diagnostics, that's our dicision. In any case we're not charging them for it, and it's optional'.
- 'We offer a small discount off the monthly maintenance charge to allow them to rent the modem; but they must handle the contract side (supplier, duration, maintenance, etc.)'.
- 'We want all of our users on the same maintenance system so we incentivise them with a fixed monthly credit against the maintenance contract charge; we also give them the modem'.
- 'We encourage our users by intimidation; if they don't purchase a modem to allow remote diagnostics they incur a 25% increase in the monthly maintenance charge'.

- The arguments put forward against the use of RD are cogent and, in the interests of providing the full picture of European vendor sentiment, the following counter arguments are provided.

I. PRINCIPLE

- Remote diagnostics is based on a number of assumptions. First, a 'hard' failure has to occur (i.e., one which is not recovered by machine retry) when the customer registers a complaint (call for service).

- Next, the assumption is that by linking a remote host service computer, via telephone lines, with the failed customer site, the service centre will be able to reproduce the error condition (if a 'hard' failure is not present), or diagnose the fault (if a 'hard' failure is present) with a general, all-purpose diagnostic suite and locate the board(s) or replaceable unit(s) which the local engineer must then take to the customer site.

- The final assumption is that the part needed is located in the same spot as the engineer who is being sent to effect repair. This is because most engineers go from one client site to another directly, without returning to the branch office.

- Many of the above assumptions are questioned by European vendors, who object strongly to the underlying principle of RD.

- The first objection is that it is not logical to ask a remote complex system to diagnose the problems of another complex system when there is a local alternative that can do the job much better - the operating system.

- All errors, including transients, can be logged by the operating system during operation (or by microcoded logic included in firmware), so that register status at time of fault, error logs, threshold values, error trends etc. can all be retained on magnetic media.

- The engineer can therefore trace the problems of the system (or the likely problems that can be expected, if an actual 'hard' fault (i.e., a fault that is not intermittent) has not yet occurred). The remote diagnosis sequence is thus eliminated, and if the service desk people are adequately trained, the field engineer can take the appropriate part(s) with him, based on the local 'tracer'.

- Thus the machine is made to do as much as possible for the customer <u>and</u> the vendor before any dialogue is initiated. This particularly applies to mainframes, where hardware resources and CPU cycles are not in short supply.

- Some vendors insist that improved technology makes CPU, memory controller, and disk faults uncommon, and that printers and displays, etc. are the real culprits, most of which cannot use RD and need a site visit anyway.

2. COST TO VENDOR

- The second major argument against RD is its cost. Certainly the numbers published by DEC and others ($6 million investments) suggest that a decision to adopt the RD approach cannot be made lightly.

- But, the argument goes, why bother setting up duplicate computer centres, with highly trained staff and administrative overhead? RD is being offered at no charge to clients (i.e., no revenue to vendors) so that all costs fall through to the bottom line.

- Again, to design and program an all-encompassing, general-purpose diagnostic suite, to which modifications and updates must constantly be added, is a very expensive exercise.

- Lastly, communications via telephone links play a vital part in the RD system. In Europe, telephone links are unreliable and very costly, particularly since the average customer link can last from half an hour to an hour.

- As far as price reductions to users of remote diagnostics are concerned, most vendors are firmly against such a move. User comments on RD are given in Exhibit III-6.

3. RESULTS

- Vendors who have implemented RD claim that 30% of the customer calls can be handled over the phone and that a diagnosis of 90% of the remaining faults can be achieved within an hour.

- Opponents of RD claim that the same results can be achieved by regional service desks, without all the overheads that RD implies and without the communications costs (customer pays for the call).

- From a user standpoint, an analysis of a sample of 116 users shows that 32% are unconditionally in favour, 30% approve with reservations, 16% have certain doubts, and 22% reject the idea of remote diagnostics.

- The sample of some of the users' comments shown in Exhibit III-6 clearly demonstrates that users are far from won over to the concept at present.

- Particularly notable is the proportion of users who are convinced that this is simply a way for vendors to reduce their costs at the expense of attention to the user.

- Exhibit III-7 shows the user rating (by equipmment category) of their 'experience' in the use of remote diagnostics. Judgements are still reserved by many vendors (in fairness many of them have less than a year's experience to call on).

- If RD is to be accepted more broadly, the benefits must be more apparent to the user, either in the form of reduced maintenance prices (or credits) or in improved performance.

EXHIBIT III-6

COMMENTS FROM USERS ON REMOTE DIAGNOSTICS

- 'If it costs nothing - great. But there is no substitute for a CE who knows his stuff'.
- 'Most faults are mechanical; difficult to use remote diagnostics'.
- 'I would expect to see remote diagnostics incorporated in all medium-sized systems by 1983'.
- 'Excellent - if it will speed up the diagnosis of a fault'.
- 'May be useful - not essential; will it work if our machine is completely down'?
- 'If spares are not locally it is an excellent idea; quality of CE must be maintained'.
- 'Can be useful, but not applicable to out site'.
- 'Good if diagnostics can be run outside normal working hours or without affecting system'.
- 'Highly desirable, particularly in a distributed processing environment'.
- 'If I can get a CE on-site in less than two hours I prefer not to use remote diagnostics'.
- 'The vendor should pass back some savings to the user'.
- 'Saves supplier money which he is unlikely to share with me'.
- 'I would prefer redundant hardware'.
- 'A bit of a gimmick; might help with obscure faults'.

EXHIBIT III-7

USER REACTION TO THE USE OF REMOTE DIAGNOSTICS BY EQUIPMENT CATEGORY

CATEGORY	RATING*
Large Mainframes	3.4
Medium Mainframes	2.5
Minicomputers	3.0
Small Business Systems	3.8
Word Processors	4.0
Terminals	3.1
Peripherals	3.0

*1 = LOW, 3 = MEDIUM, 5 = HIGH

4. UNANIMITY

- One area of complete agreement amongst all vendors is the usefulness of RD applied to software (systems and applications).

- The availability of software engineers and system specialists at centralised locations for on-line assistance is also appealing to users.

- At least this aspect of 'RD' is therefore likely to expand and develop, although it does not always entail the use of a remote computer to computer link.

G. CONCLUSIONS

- The pressures on vendors for improved maintenance techniques have resulted from:

  - Need for improved response and repair times.

  - Increasing shortage of qualified engineers and hence the need for improved productivity.

  - Internal pressures to improve cost control and profit performance.

  - Increased complexity and diversity of equipment demanding a more effective management reporting system.

- Remote assistance techniques have certainly contributed to relieving some of this pressure in every single area mentioned above. The contribution has not been broader because usually only new products are affected by the new techniques and these represent a very small percentage of the installed base.

- Nevertheless, it is already clear that a broader emphasis on remote assistance services will partially bring the answers that field engineering management has been searching for, for so long; in particular to the questions of increased productivity, control of costs, and improved service response.

- This does not mean that the problems have been solved; only redundant hardware architecture will really resolve the response/repair time problem, for example, and this is unlikely to be a widespread reality for the next three to four years. (Perhaps the value of such designs will be recognised in time for the next generation of computers.)

- Costs are being brought under control, but the implementation of remote assistance networks backed by computerised support centres using costly diagnostic suites will not alleviate the cost picture - and may worsen it in the short term. Nevertheless, such systems are contributing positively to the lack of skilled engineers.

- The increasing complexity of equipment is unlikely to be attenuated. However the diversity of models will be, and this will facilitate the implementation of standard services. Meanwhile, remote assistance services, computerised call/dispatch databases, and remote diagnostic services will contribute to an assurably improved management reporting system, and to a statistical analysis of failures.

IV ALTERNATIVE TECHNIQUES

IV ALTERNATIVE TECHNIQUES

A. REMOTE ERROR REPORTING

- There appears to be an increasing number of vendors in Europe who have made a conscious decision to avoid implementing remote diagnostics (i.e., the remote initiation via telephone links of diagnostic routines, run on a faulty computer through an intelligent console).

- These vendors have adopted a separate approach for, on the one hand, large- and medium-sized mainframe systems and, on the other, small systems.

- For the small systems, geographically dispersed service desks are being used, which receive calls from clients and 'qualify' the service requirement.

- For large and medium mainframe systems, the emphasis is on building error monitoring and logging functions into the operating system so that diagnosis is to a large extent unnecessary.

1. SMALL SYSTEMS SERVICE DESKS

- The service desk concept is a distributed version of the support centre concept (which is normally centralised). It required each branch or local district to set up a staff of trained system analysts, specialised by product, who can separate hardware problems from software problems (and customer education problems from both).

- Emphasis is placed on 'talking' the user through his documented procedures on the phone to establish whether there is a real fault and to gradually encourage the user to follow a fixed procedure each time he is in difficulty.

- Users of this approach say that, providing the support documentation is of good quality, fault processing can be procedurised and partially executed by the user. When that happens a rapid diminution in the number of calls occurs (which is, in effect, the elimination of customer education from the role of the field engineer).

- One vendor claims that, thanks to this approach, two-thirds of the original volume of calls have been eliminated and customer satisfaction has risen tremendously. Field engineers also like it since it eliminates unnecessary site visits.

- Local computer support is provided to each field service district in terms of client maintenance contract details, whether the customer is up to date with his payment of maintenance fees, what the system configuration details are, and what is the system fault history.

- The philosophy is to get the user to identify the fault area through standard documentation and system printouts and remotely report the error, thereby eliminating the vast majority of no fault found calls prior to site visit.

2. LARGE/MEDIUM MAINFRAME SYSTEMS

- The on-site monitor of system performance is the operating system, which logs transient faults, register status, threshold values, and error trends and stores them on magnetic media. This error log can then be remotely interrogated in an error reporting sequence, or the user operator can initiate specific test sequences and telephonically report the results to the engineer.

- Highly sophisticated (and very expensive) diagnostics are in this way avoided altogether, with the emphasis on getting the on-site intelligence (processor and client) to work for the vendor.

- Fault duplication is not then necessary and the error correction sequence usually consists of the replacement of a specific board and the running of standard in-built board tests to ensure that the fault has been corrected.

- This also usually means that 70% of visits cannot be avoided, but at least ensures that the field engineer goes with the right part.

3. CDC'S REMOTE SUPPORT SERVICES

- CDC operates a typical remote error report system on the CYBER series, as shown in Exhibit IV-1. The operating system operates a series of resident maintenance routines including the hardware performance analyser (HPA) and site performance analyses (SPA). In addition, operator-entered data on system performance, including cold starts, malfunctions, peripheral failures etc. are logged for retention.

- The user system holds history files on details of the system past performance and data on transient errors. All this data is available for remote interrogation, either concurrent with normal usage or, if the remote engineer decides to run diagnostics on part or all of the system, he can obtain sole use of the system via the operator.

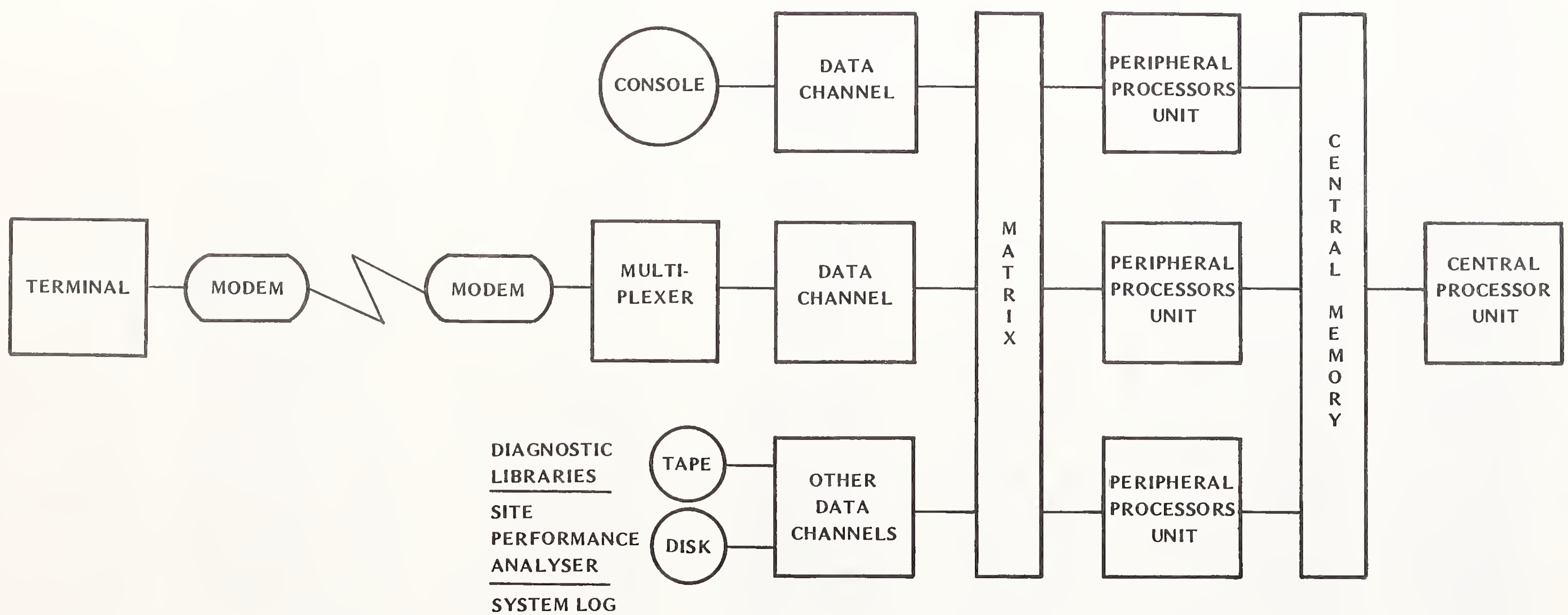
4. IBM'S REMOTE SUPPORT FACILITY

- IBM has similar systems to that of CDC operating under the name Remote Support Facility (RSF). Half of IBM's RSF is dedicated to remote diagnostics and half to remote error reporting.

- The 'customer log transfer option' enables the customer system to be momentarily connected to IBM's RETAIN database, and to transfer the contents of

EXHIBIT IV-1

REMOTE ERROR REPORTING ON A DISTRIBUTED PROCESSOR



the error log to the IBM system. Engineers, both local and remote, can then examine the log.

- The 'remote console option' is a straightforward remote diagnostic link, requiring that the remote system be entirely dedicated to diagnostics. It enables an engineer to operate the system as if he were at the failed system's own console, as shown in Exhibit IV-2.

B. REMOTE TECHNICAL ASSISTANCE

- A number of vendors such as IBM, Sperry Univac, and Burroughs, have for years utilized a computerised field engineer fault assistance database.

- This essentially consists of enabling each field engineer to benefit from the experience of all other field engineers, along with the worldwide log of faults that have occurred on a given product.

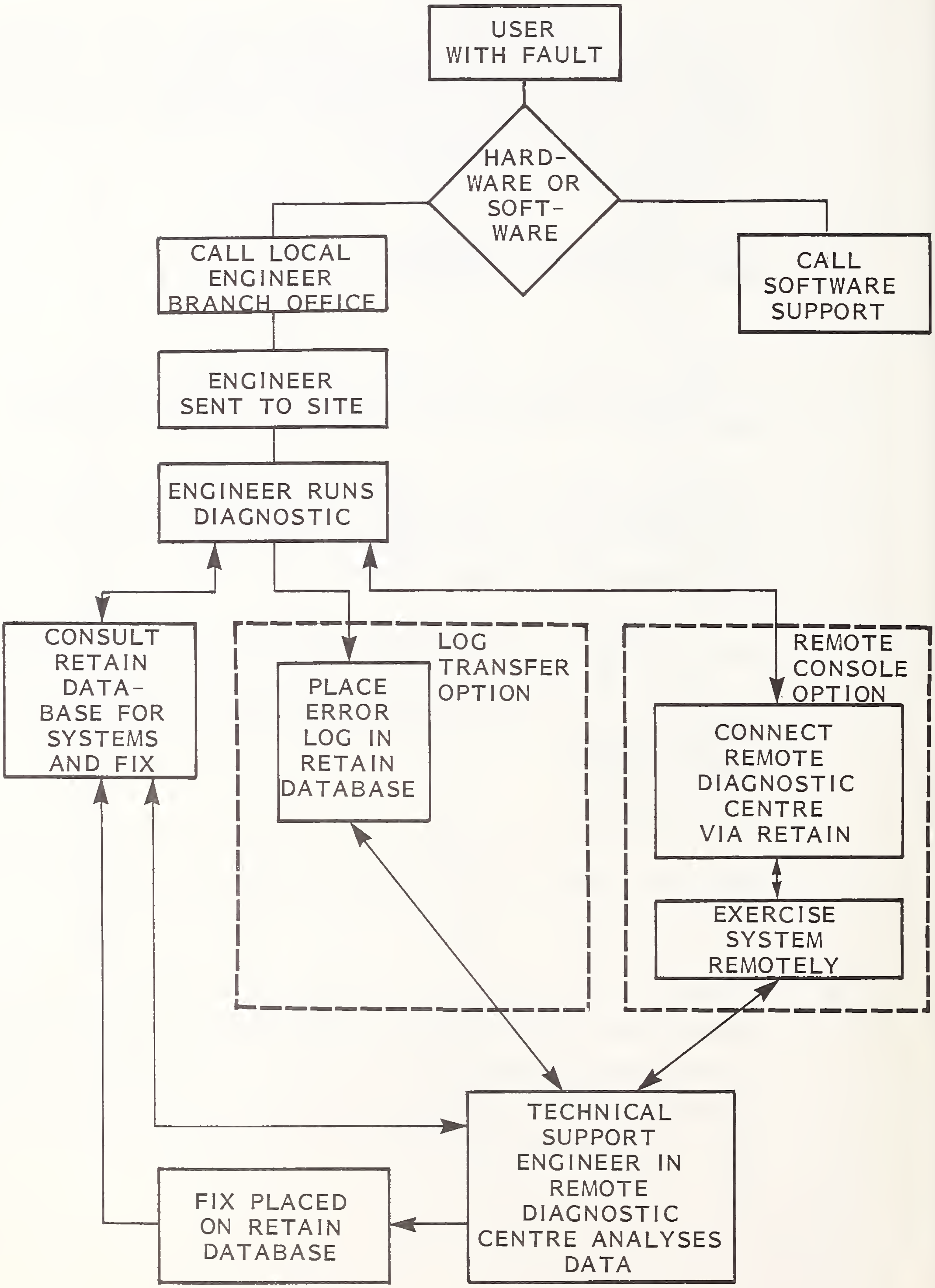
- Sperry Univac has had Total Remote Assistance Centre (Trace) in operation for years, consisting of an on-line link to a U.S. database of logged faults. This year Trace II went into operation based on a computer centre in Walton-on-Thames in the U.K.

- Trace I allowed engineers who were in difficulty to remotely contact the U.S. based fault centre to obtain diagnostic assistance. Trace II will allow the initiation of the remote link to be executed by the customer.

- It applies only to Univac's new 1100/60 system (which is based on multi-microprocessor architecture). The 1100/60 is the first Univac machine to have its own dedicated diagnostic processor which executes diagnostic sequences on the system. The output from these sequences is provided either to the user, or, if the user so decides, to the Univac remote assistance centre in the U.K.

EXHIBIT IV-2

IBM RETAIN SYSTEM SCHEMATIC



- IBM's RETAIN database has a 'symptom' feature that allows the engineer to describe the failure and receive a list of possible causes. Each time a fault is fixed the RETAIN database log can be updated if it is a new problem; since all engineers use the RETAIN database the global knowledge of the field service force gradually increases.

C. REMOTE SOFTWARE SUPPORT

- This refers to remote systems support (operating system mainly) as opposed to applications software support which, unless it is a standard vendor product, is not supported.

- Increasingly, all on-site support for software is chargeable once the machine has been installed and commissioned, although credits are given by some vendors. Thereafter the charges can be raised:

  - On an ad hoc (T&M) basis.

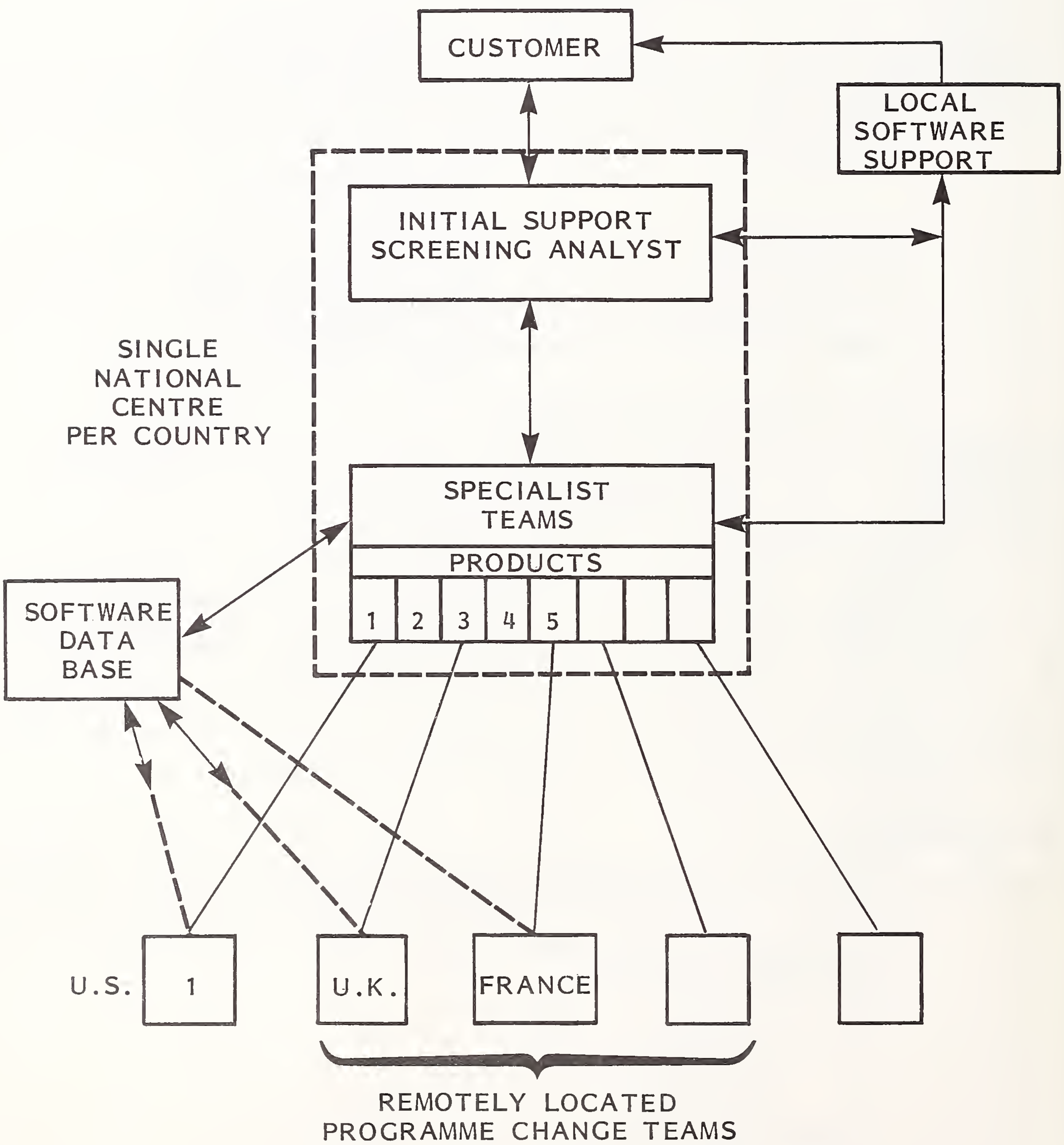
  - By a monthly software maintenance rental.

- IBM's national support centres, as shown in Exhibit IV-3, provide assistance on all IBM licensed program products (control programs, system software, utility programs, and standard IBM application products) from a single location. This location is staffed with 'centres of excellence' on all products and has remote access to European and U.S. support centres for backup.

- Error correction through standard product updates operates through formal channels, initiated by program change teams in the software centres responsible for each product (which may be located in the U.S. or a European country).

EXHIBIT IV-3

IBM SOFTWARE SUPPORT
ORGANISATION



- As with customer service handling of hardware fault calls, a large proportion of software fault calls are dealt with over the telephone without on-site visits. IBM claims that nearly half the software 'fault' calls are dealt with in this manner.

- IBM, for once, appears to have adopted a stance that few other vendors are following - that of functionally and physically separating system software support centres from hardware support centres. Most other vendors are gradually centralising call support at regional support centres that handle all fault calls, as shown in Exhibit IV-4.

- This calls for a significant reorganisation of the regional centre. Until now, each activity (field engineer, software support, education, etc.) reported to a national manager of the functions. In the new organisational format, some local authority will have to be delegated to the regional customer service manager, although reporting to national managers will no doubt continue.

D. REMOTE PREVENTIVE MAINTENANCE

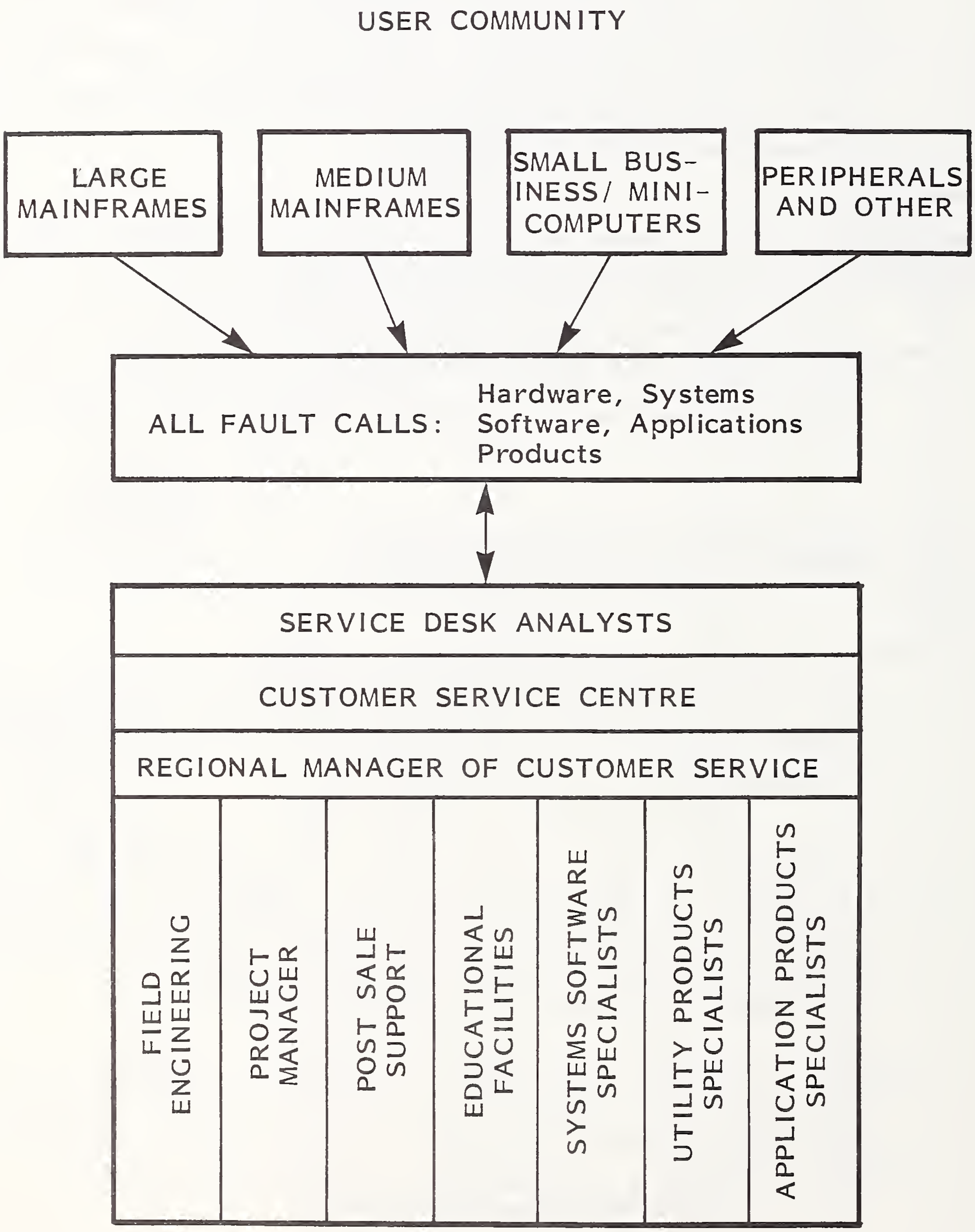
- The ability to remotely control the customer site hardware opens up an interesting opportunity in reducing on-site engineer visits: remote preventive maintenance.

- Providing the client is willing, and local site precautions are taken (for example write-protecting customer files, loading vendor diagnostic suites, switching local console to remote access mode, etc.), PM can be accomplished outside normal customer operations (e.g., at night).

- On-site visits may still be necessary if faults are found, but a proportion of the visits will be saved and customers will not be interrupted in the course of their daily operations, a perfect example of a dual benefit operation.

EXHIBIT IV-4

FUTURE REGIONAL SUPPORT CENTRE ORGANISATION



V XEROX - A SERVICE PHILOSOPHY

V XEROX - A SERVICE PHILOSOPHY

A. INTRODUCTION

- The experience of Xerox in servicing a high-volume product market requiring high system availability (and which has a minicomputer price of $90,000), such as the 9200 copier, offers some interesting lessons that can be applied to the small business system/minicomputer market.

- As product specialisation in field service organisations increases, the approach taken by the world's largest copier supplier may contribute usefully to the thinking of service managers under similar high-volume/low response time environments.

B. ROLE OF THE TECHNICAL REPRESENTATIVE

- The Xerox technical representative operates in a specific territory which has defined geographical boundaries. The machine population of the models/products he is qualified to service is in a constant state of flux as new machines are installed or as older ones are replaced or upgraded.

- A technical representative's job is varied, and comprises as many as five functions:

- Customer interface after the salesman has sold the machine.

- Training, both initial and ongoing.

- Supplies salesman.

- Service manager, assigning priorities for handling service calls.

- Field service.

- When acting as the field engineer, the technical representative carries out emergency maintenance, upgrade/retrofit and preventive maintenance. He also prepares equipment for shipment (removals) and is responsible for installation.

- The product population is thus a direct function of the number of technical representatives and their efficiency, combined with the response/repair/reliability values of the product maintained. As with all service organisations, the technical representative is a limited resource and a costly one.

- Xerox's normal line of copier/duplicator products does not generally affect a customer's revenue. The machine that goes down is an inconvenience only. However, the 9200 is aimed at markets where machine downtime can mean a loss of revenue. The pressure experienced by the field service organisation has therefore become similar to that experienced by computer vendors.

- Technical representatives are grouped in teams of six to twenty under field service managers in branch locations and they have had established responsibilities for years.

C. CONTRIBUTION OF MANAGEMENT SCIENCE

- Each geographical territory is assigned a team of technical representatives the size of which is determined on the basis of an optimum response/installed base population relationship.

- The first level of service strategy analysis can be carried out by an analytical model, as shown in Exhibit V-1, using queuing theory. This is usually based on the average number of machines per territory, the average number of technical representatives per territory, the mean time between failures (MTBF), and the mean time to repair (MTTR).

  - Such models are used to derive:

    . Average response time.

    . Average queue length.

    . Percent active time per engineer.

  - They are based on data from:

    . An entire country market.

    . Or a region.

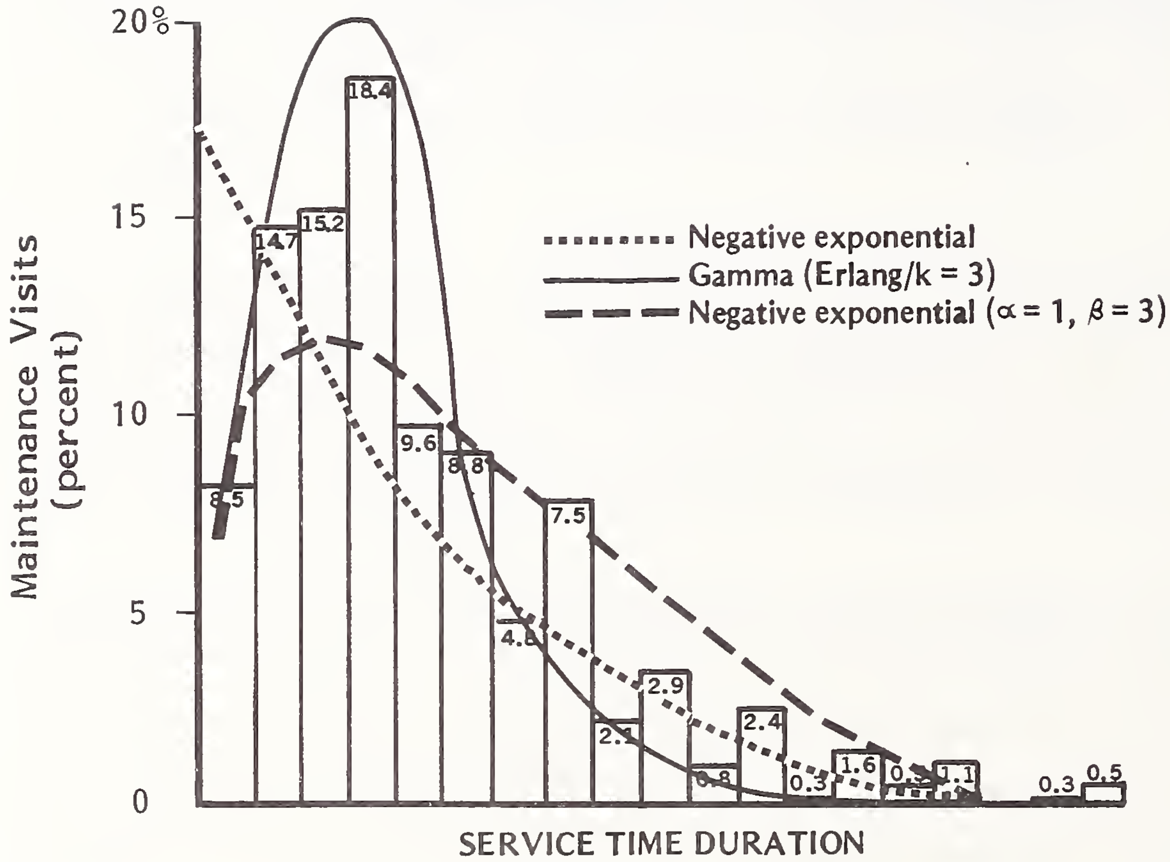
    . Or a branch.

- A number of important assumptions are then made, e.g.:

  - Does the system population mix per territory vary considerably from the national average? (Where this is true, additional models are needed.)

EXHIBIT V-1

ANALYTICAL MODEL SAMPLE



- Emergency calls and PM calls are serviced according to a negative exponential distribution.

- Response times do not include idle time incurred by interruption of work at the end of the day, when repairs carry over to the next day.

- Travel time is averaged out and assigned a fixed rather than variable value.

- Other nonproductive time such as holiday, training, and sickness is excluded.

- Actual data from existing systems of similar characteristics as opposed to hypothetical data from business plans usually provides the basis of calculation.

- There then follows an analysis at a finer level using a simulation model developed to allow a variable number of representatives to service specific territories and including the following additional parameters.

  - Geography.

  - Queue discipline.

  - Technical representative work schedules.

- Some of the output is shown in Exhibits V-2 and V-3.

- The Xerox simulation model was developed to work in an interactive mode so that variation could be fed in conversationally. The output includes values for technical representative usage, overtime, travel time distribution. It has not been possible to date, to develop an all-embracing model, given the high degree of interrelationship between variables.

- Validation is performed with line data from a specific territory.

EXHIBIT V-2

SAMPLE TERRITORY SIMULATIONS

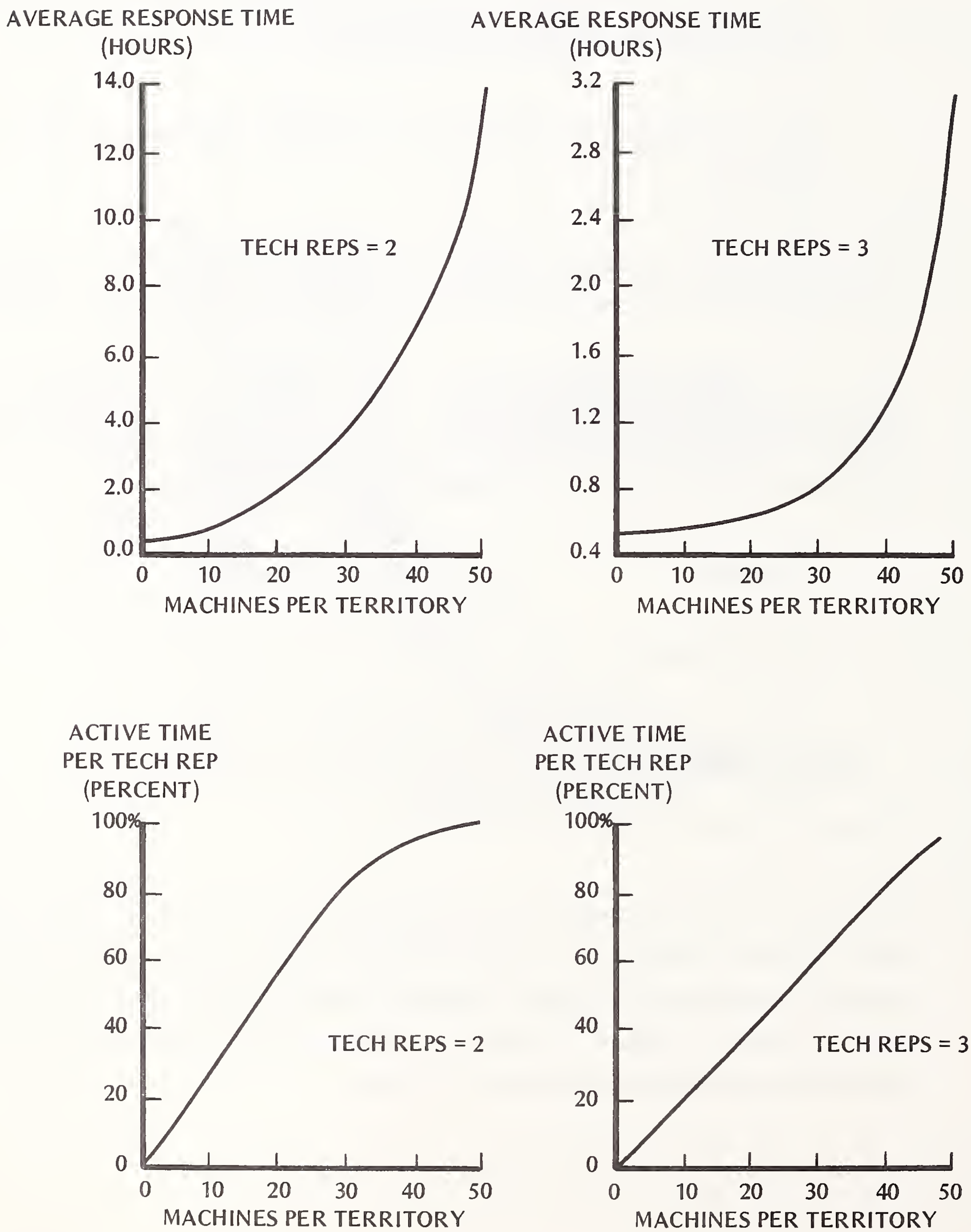
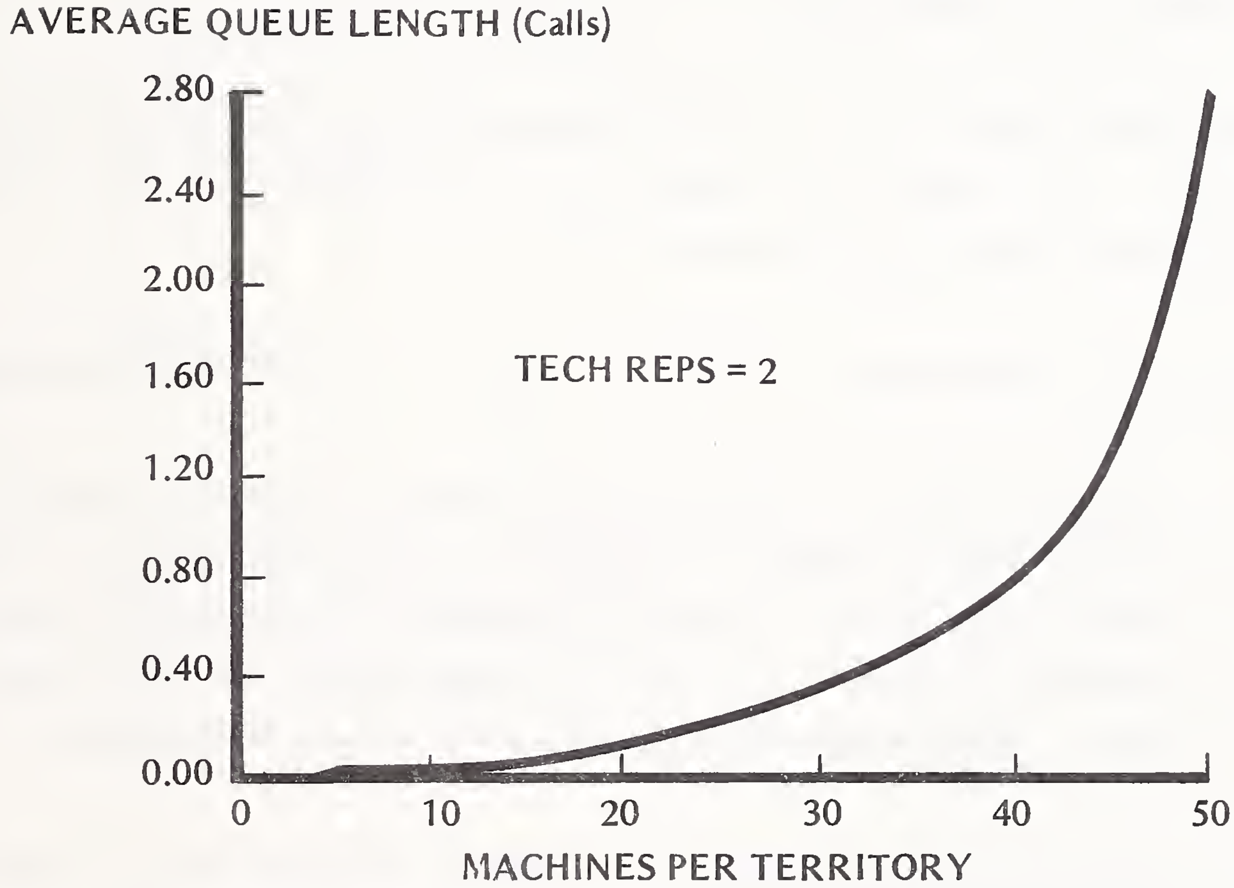
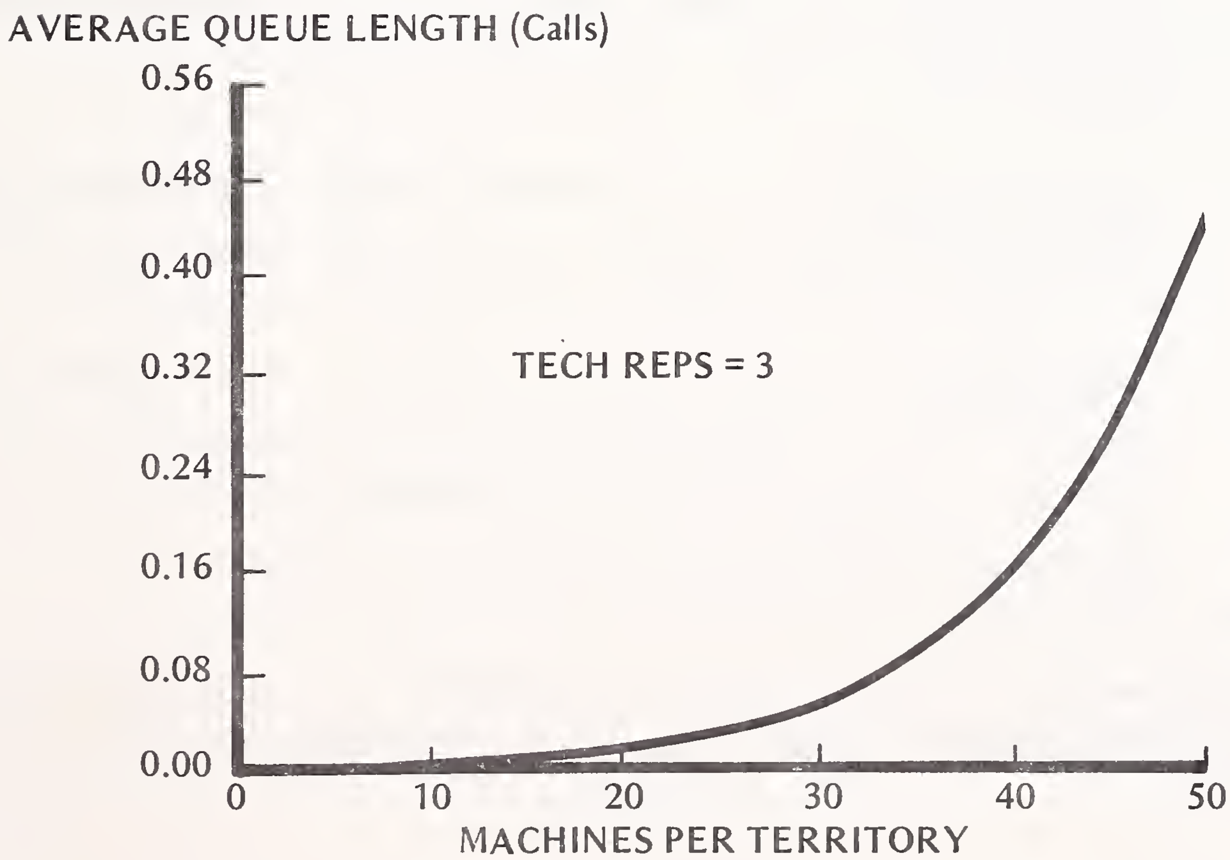


EXHIBIT V-3

SAMPLE SIMULATION OF
IMPACT OF TEAM SIZE ON QUEUE LENGTH





D. THE HUMAN FACTOR

- One of the principal considerations taken into account by Xerox is the impact of every part of the strategy on the individual engineer.

- This extends from how the service response is managed in relation to the optional team size to the impact on team performance of a technical representative who is not performing well.

- Many factors make such considerations important elements of the strategy:

  - Unionization: this has been attempted on several occasions by the service force in the U.S. but each time a majority of the technical representatives have come out against it, principally because each technical representative acts as a businessman for 'his' territory and 'his' machines; in Europe unionization has nevertheless occurred.

  - Customer Responsibility: many technical representatives have 'their' clients, similar to a sales force, and strong beliefs are held that the customer likes to see the same technical representative on each service call.

  - Job Requirements: a team approach to service is totally different to a one-man per territory approach, from the job content standpoint.

  - Organisation: quite apart from the needs of a reporting structure that caters to a one-man/one-territory approach as opposed to a team per territory, independent, direct line reporting has a different status value to that of being part of a team in a territory.

- These human factors are frequently disregarded by many vendors in corporate planning, particularly when efficiency and productivity are the key driving forces. It is easy to opt for the 'optimum' plan, only to find that it creates havoc in the field in human terms, so that normal levels of performance decrease rather than increase.

- Motivation, job satisfaction, status, and human relationships are not easily parameterized. In addition, there is a strong undercurrent of conservatism or support for the status quo in Europe that is not encountered to the same degree in the U.S.

E. RESULTS

- Xerox claims that as a result of the application of the foregoing principles, they were able to determine the optimum team size per territory in terms of response time, queuing of calls, etc. In particular, a three-man mini-team has been shown to be highly efficient from a productivity standpoint.

- This reduced the service force idle time and reduced the response time on the average customer call. Benefits claimed were an average increase in productivity of the service work force sufficient to support a machine population that is 15-20% larger, the ability to include response time specific to the proportion of customers, and as an additional feature, and a 30-40% reduction in response times.

- In addition a product lifetime savings of significant proportion is claimed due to:

    - Reduced training requirements.

    - Smaller engineer work force than would otherwise be needed.

    - Reduced labour costs per call due to increased efficiency.

- Beyond the efficiency and cost savings, Xerox also claims that customer service and satisfaction have been maintained if not improved.

- However, a service philosophy has to be seen as a function of the people it is applied to, and variations are to be expected in Europe. For example in Italy and Spain, assigning a territory, client, or title to an individual is seen (by local legislation) as a semi-permanent act. As a result, if that engineer is absent for any reason, including illness, the vendor may not be able to reassign the task with complete freedom.

- Many things have changed since Xerox first began using this approach, in particular the development of the specialist engineer who has a high degree of knowledge and experience on a small number of products.

- In addition, like today's computer engineer, the technical representative obtains his task assignments by calling a work control centre which prioritises customer calls for him (i.e., he does not have complete freedom in managing his territory).

- Nevertheless it is encouraging to see that practical benefits can accrue from the reasoned application of management science to the field service strategy, and the Xerox experience is relevant to the problems of the minicomputer and small business system vendor.

VI TANDEM - REDUNDANT HARDWARE ARCHITECTURE

VI TANDEM REDUNDANT HARDWARE ARCHITECTURE

A. INTRODUCTION

- The principal objectives behind all new maintenance techniques are:

  - Reduced response time/repair time and similar efforts to improve system availability.

  - Reduced service costs for what the vendor estimates is an acceptable level of service.

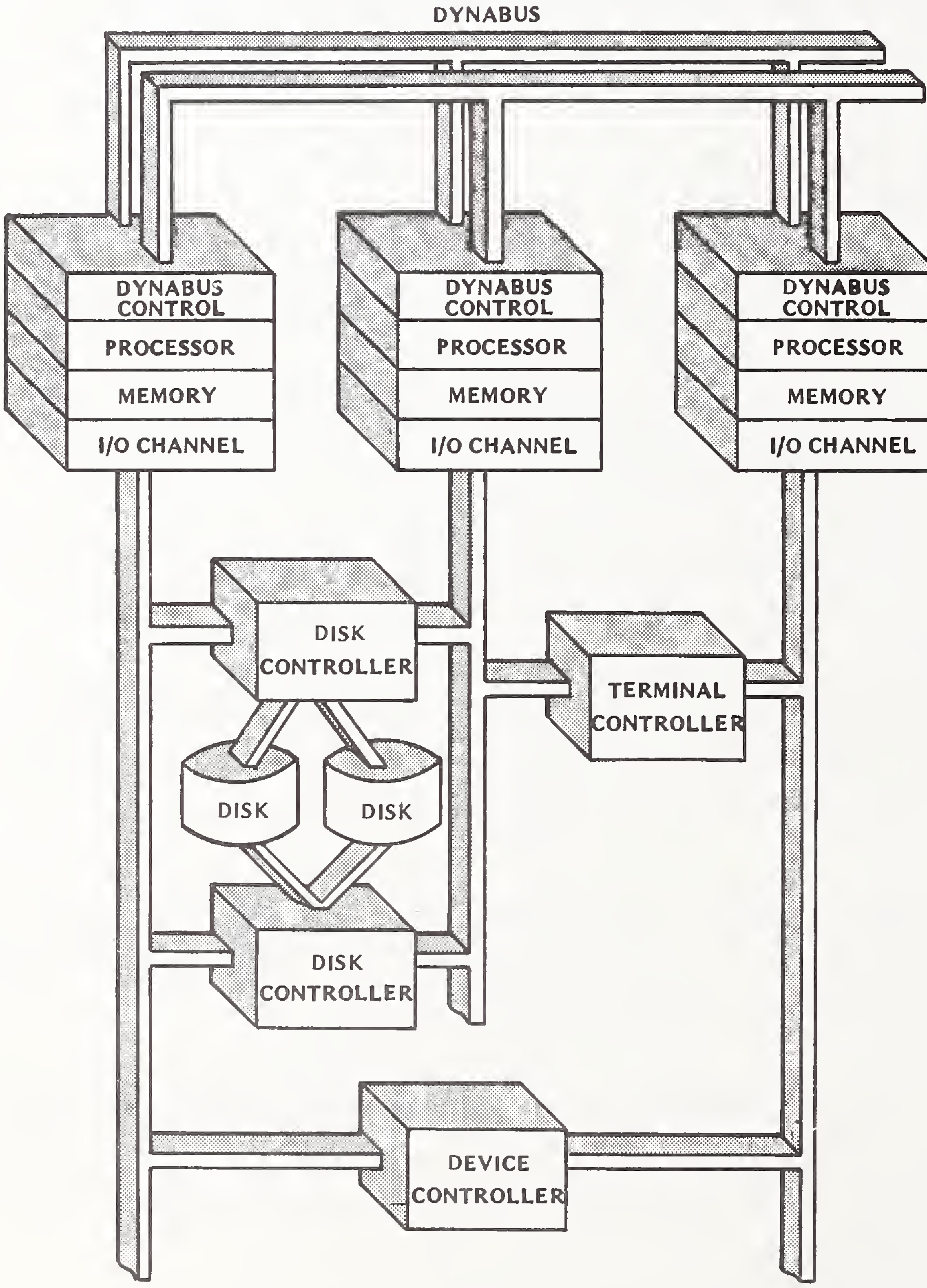
- System availability is a direct function of system reliability as well as field service response after failure, and the most significant improvements are in system availability, not in response/repair times.

- This is, of course, where the biggest gains in user satisfaction lie, since system reliability not only keeps the user content but also allows reasonable maintenance prices to be practised.

- Redundant hardware architecture is the ultimate safeguard against component/subsystem failures and Tandem has been in the forefront of these designs since the company's inception in 1974. Exhibit VI-1 shows the Tandem architecture.

EXHIBIT VI-1

TANDEM'S REDUNDANT HARDWARE ARCHITECTURE



B. FAULT TOLERANT DESIGN

- Redundant hardware architecture does not provide fail-safe systems, but it does allow for systems to be tolerant to single faults, transient or 'hard', and permit continued service to users in a degraded configuration. Users do perceive the system to be virtually non-stop.

- Tandem's Non-Stop systems operate in this manner but go one step further: each processor is an autonomous computer system with its own memory, power supply, diagnostic facility, and I/O. Since processors do not share resources, the addition of a processor doubles the power of a single processor.

- Tandem also makes the point that, despite the improvements in reliability from each successive generation of computers, the averge reliability of 98.8% currently available from other systems is not enough when multi-node networks are built.

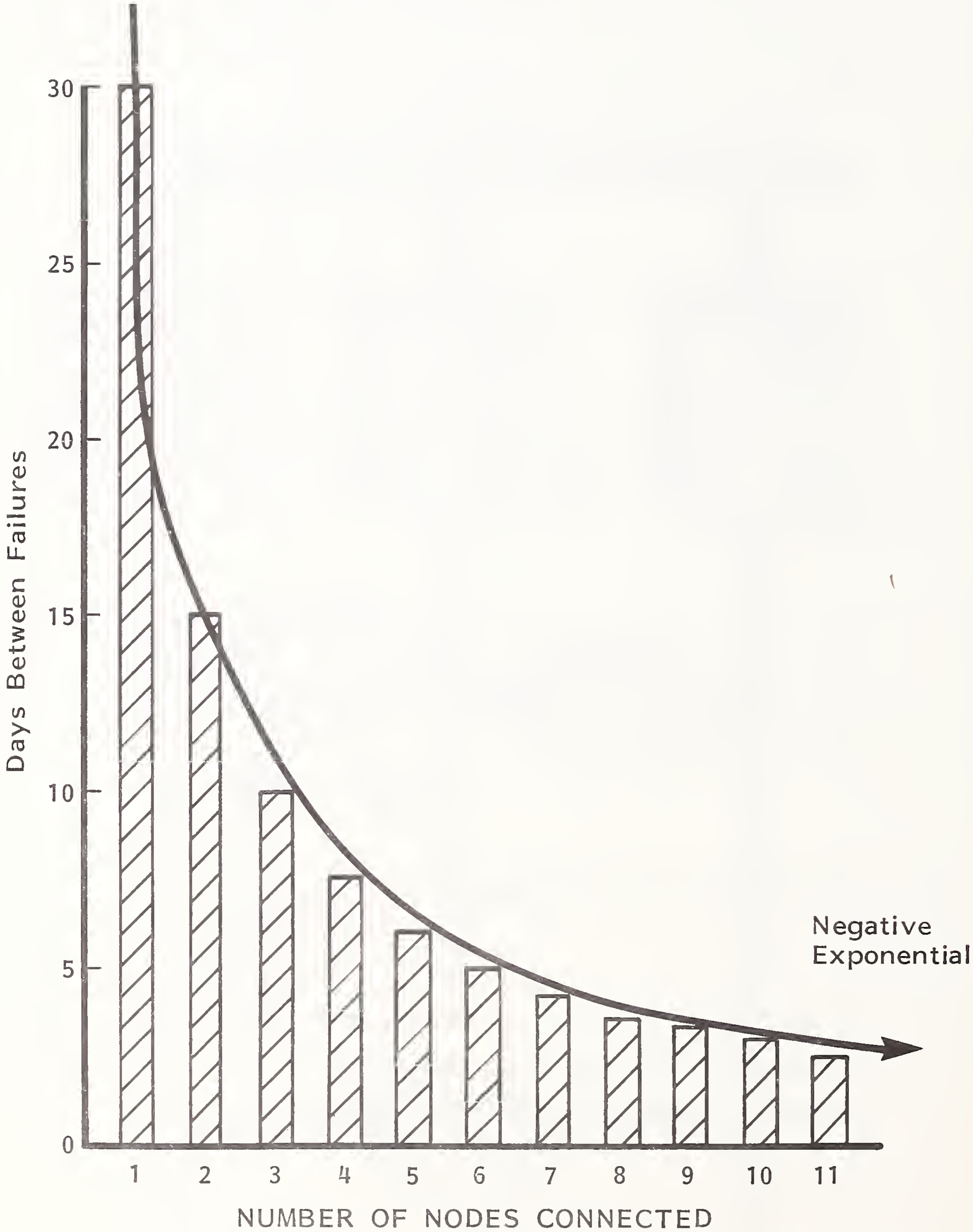
- Exhibit VI-2 shows the impact of the addition of extra processor nodes on overall system reliability, which decreases exponentially. From processors that have a MTBF of one month, a four-node network reduces the system MTBF to eight days.

C. THE TANDEM SYSTEM PHILOSOPHY

- Tandem's answer to the multi-node network problem, to the non-stop system problem, and to the system expansion problem, as shown in the next section (VI D), is one and the same: redundant system.

EXHIBIT VI-2

IMPACT ON SYSTEM NETWORK MTBF
OF THE ADDITION OF NODES



- Assumes each node is a processor with MTBF of 30 days.
- Cumulative MTBF, is given by $\frac{1}{\alpha} = \frac{1}{a} + \frac{1}{b} + \frac{1}{c}, + \ldots\ldots$ where a, b, and c are MTBF of component parts.

- Since each processor has its own memory, power supply, and I/O, and communicates with other processors and peripherals over a dual channel, the loss of a processor has no other effect than to slightly downgrade the overall system performance.

- Similarly, system expansion, whether in one loction or several geographically distinct locations, means adding a processor.

- Non-Stop II systems also include support for remote diagnostics in the form of an operations and service processor (OSP) with built-in modem for connection to a remote terminal or another OSP. Each OSP has its own processor, memory, power supply operating system, and floppy disk storage.

D. IMPACT OF REDUNDANT SYSTEM ELEMENTS ON CONFIGURATION MTBF

- When redundant system elements are discussed with vendors the first element mentioned is a redundant processor. This may be because in terms of non-stop operations it seems obvious that a system must have a processor, or that an extra CPU board seems a feasible possibility from a cost and design standpoint.

- However, from a user's standpoint, an extra processor is the last thing he needs, as shown in Exhibit VI-3.

- The worked example in the exhibit is given as an indication of the kind of results obtained from adding a redundant element of one kind or another to a given configuration.

- A number of assumptions are made, including:

  - The MTBF values for each element (which are relative orders of magnitude only).

EXHIBIT VI-3

IMPACT OF REDUNDANT ELEMENTS ON CONFIGURATION MTBF OF TYPICAL MINICOMPUTER

A. BASIC SYSTEM COMPONENTS MTBF ASSUMPTIONS

FOR	ASSUMED MTBF (hours)
• Central Processor	3,000
• Memory 256K	2,000
• Printer Subsystem	600
• Disk Controller	1,500
• Disk Unit	1,000
• Terminal	2,500

B. SAMPLE CONFIGURATION MTBF

1. Two Disks, Four Terminals 147.8 hours, or 0.84 months
2. Four Disks, Eight Terminals 96.5 hours, or 0.55 months
3. Four Disks, Eight Terminals, 512K 92.0 hours or 0.52 months

C. USING CONFIGURATION B.2, IMPACT OF REDUNDANT . . .

1.	Processor	99.7 hours or 3% Improvement
2.	Disk Controller	103.1 hours or 6% Improvement
3.	Disk Unit	209.8 hours or 117% Improvement
4.	Memory Board	101.4 hours or 5% Improvement
5.	Printer	122.0 hours or 126% Improvement

NOTE: TERMINALS DO NOT NORMALLY CRITICALLY AFFECT AN APPLICATION, PROVIDING THERE ARE MORE THAN TWO IN THE CONFIGURATION.

- The printer controller MTBF is 'absorbed' in the printer subsystem (even though typically the controller has an MTBF five to six times as high as the printer itself).

- The back panel, mains, and channel are excluded (but should not be normal system MTBF calculations).

- For the sample configurations in B, it is assumed that each element of the configuration is critical to system operation (e.g., each terminal is needed and each disk is mandatory).

- Choosing (arbitrarily) the four-disk, eight-terminal configuration value as the base system, the impact of a redundant processor, disk, etc. is calculated (as opposed to an additional processor, disk, etc.).

- The assumptions made here are that, although identical elements will have identical MTBF, their fault occurrence does not coincide, and the redundant element will perform without fault during the response time of the engineer.

- The results speak for themselves and are as should be expected.

  - First, as configurations grow (desirable goal) user satisfaction is likely to fall (undesirable).

  - Second, efficiency in response to a fault has to improve dramatically to keep pace with simple field upgrades (e.g., the move from configuration B.1 to B.2 implies a drop in MTBF of 35%).

  - Third, the order of user desirability of redundant elements is the exact reverse of the vendors' view:

    - Printer.

    - Disk unit.

- Disk controller.

- Memory board.

- Processor board.

- This suggests that until disks become solid state and printers electronic, the redundant hardware approach will not be feasible for vendors serving the general-purpose business application marketplace, leaving Tandem a free hand in the high-cost, critical applications and network markets. Tandem computers employ fully redundant disk drives and controllers.

VII CENTRALISED CALL HANDLING AND ENGINEER DISPATCH

VII CENTRALISED CALL HANDLING AND ENGINEER DISPATCH

A. CONCEPT AND OBJECTIVES

- As part of the drive to optimise the use of the most scarce of all field engineering resources - the field engineer himself - and in line with the perpetual search for reduced response time, centralised call handling/engineer dispatch figures prominently and successfully amongst the new maintenance techniques.

- Until recently the function was executed on a manual basis and relied on the intimate knowledge each local field service manager had to have of client sites he was responsible for and the individual talents of each engineer reporting to him.

- Many factors enter into the decision of which call to handle first and which engineer to dispatch, including a wealth of detail on the client's configuration, fault history of that particular system, and which engineer normally handles the account. In addition, it is useful to know if the particular fault indicated has been seen elsewhere, how it was handled, and by whom.

- Computerising this data is of immense value to the dispatch operation, but runs the risk of removing the local field engineering manager from the decision loop. In so doing a lot of the instructive knowledge about the site is lost.

- On the other hand, centralized dispatch relieves the local manager from dealing with routine requirements (the vast majority of fault calls) and frees him to handle the really important managerial functions of planning, resources, budget control, and personnel management.

- Besides, the centralized dispatch function may be designed to call upon the service manager at appropriate moments in the service loop, whenever his judgement is required.

- Centralized call handling and engineer dispatch is an ideal first step towards remote assistance techniques of all kinds, and entails all the basic organisational changes and computerised support that the more intricate remote error reporting and remote diagnostic techniques require. Some of the advantages are listed in Exhibit VII-1.

B. APPLICATION

- Centralized call handling and engineer dispatch is applicable to all categories of equipment, from large mainframes to terminals, and extends to other markets also, such as word processing and white goods service (washing machines, driers, etc., that usually have white colours).

- Third-party maintenance (TPM) vendors, whose product is service, are typical candidates for such a system. Since most of them handle several lines of equipment from a variety of vendors, it is also feasible to allow each vendor search to access the call databank, and monitor the type of problems that arise. In this way, although in-field service is being handled by the TPM, the vendor himself can take responsibility for initiating the development of Field Change Orders (FCOs) or software changes on the basis of the fault trends developing in the field.

EXHIBIT VII-1

ADVANTAGES OF CALL/DISPATCH SYSTEMS

- Speed service response to end user, (usually immediate).
- Reduce site visits and associated costs.
- Improve engineer productivity.
- Improve engineer reporting.
- Monitor service call activity on a time dependent basis.
- Provide on-line system reports by site, engineer, district, and product.
- Automate escalation procedures.
- Provide statistical summaries for management audit.
- Provide individual FE activity logs for performance review.
- Provide service call volume trends by product for personnel planning, education needs.
- Provide data to end users to substantiate a change in type of maintenance contract in use.
- Provide billing data for T&M contracts.

- In addition to the cost and deployment efficiences that can be achieved, a natural side benefit is a precise and complete error statistics/reporting system, that avoids much of the form filing that engineers typically detest.

- Although most call handling/dispatch centres are designed to handle national calls only, it is not unlikely that several countries could be handled by a single centre, particularly in Europe where the intercountry distances are relatively small. This is particularly true of start-up operations of small vendors.

- Another possibility is the application of centralised call/dispatch to multiple product lines of a single vendor whose markets are not confined to computer products (e.g., office equipment, communications products, instrumentation, and computers, as in the case of IBM, Honeywell, Exxon, and others).

- The distribution of application of centralized call/dispatch is important, where possible, due to the heavy overheads that its initial setup implies, which should be shared by as large a base of installed systems as possible.

C. CALL HANDLING/DISPATCH OPERATION

- The establishment of an automated call handling/dispatch service requires the setting up of a complex data communications/database application using a sizable computer and storage facility. One of the key aspects in Europe is availability of adequate PTT lines and communications equipment (without which the operation can quickly come to a halt).

- Next, a staff of trained, professional call service desk persons is required, who in many ways are the key to the operation since they have to screen the calls. In a centralized customer service organisation, the scope of the calls is extensive and detailed.

- The in-field engineers need to train themselves in the new procedures, which involve a modification of their normal reporting lines: their service manager will have a lot less contact with them, and a large part of their instructions will come from a 'low level' service desk person.

- In addition, their reporting habits frequently need changing since they must now estimate times of arrival and repair knowing that the computer has a clock running on them. Any bad habits (time keeping, call reporting) will rapidly be exposed.

- On the positive side, paperwork can be kept to a minimum and the call centre can act as a super secretary for the busy, mobile engineer.

- A sample of the dispatch information flow is shown in Exhibit VII-2. As can be seen, time limits (or 'ticklers') are set at every decision stage, critical or no. This is important because this is exactly the commodity that is being tracked: time.

- It is obvious from Exhibit VII-2, it is necessary to be able to process a high volume of slow transactions, running simultaneously and supported by history/ back-up data that can be quite voluminous for each transaction.

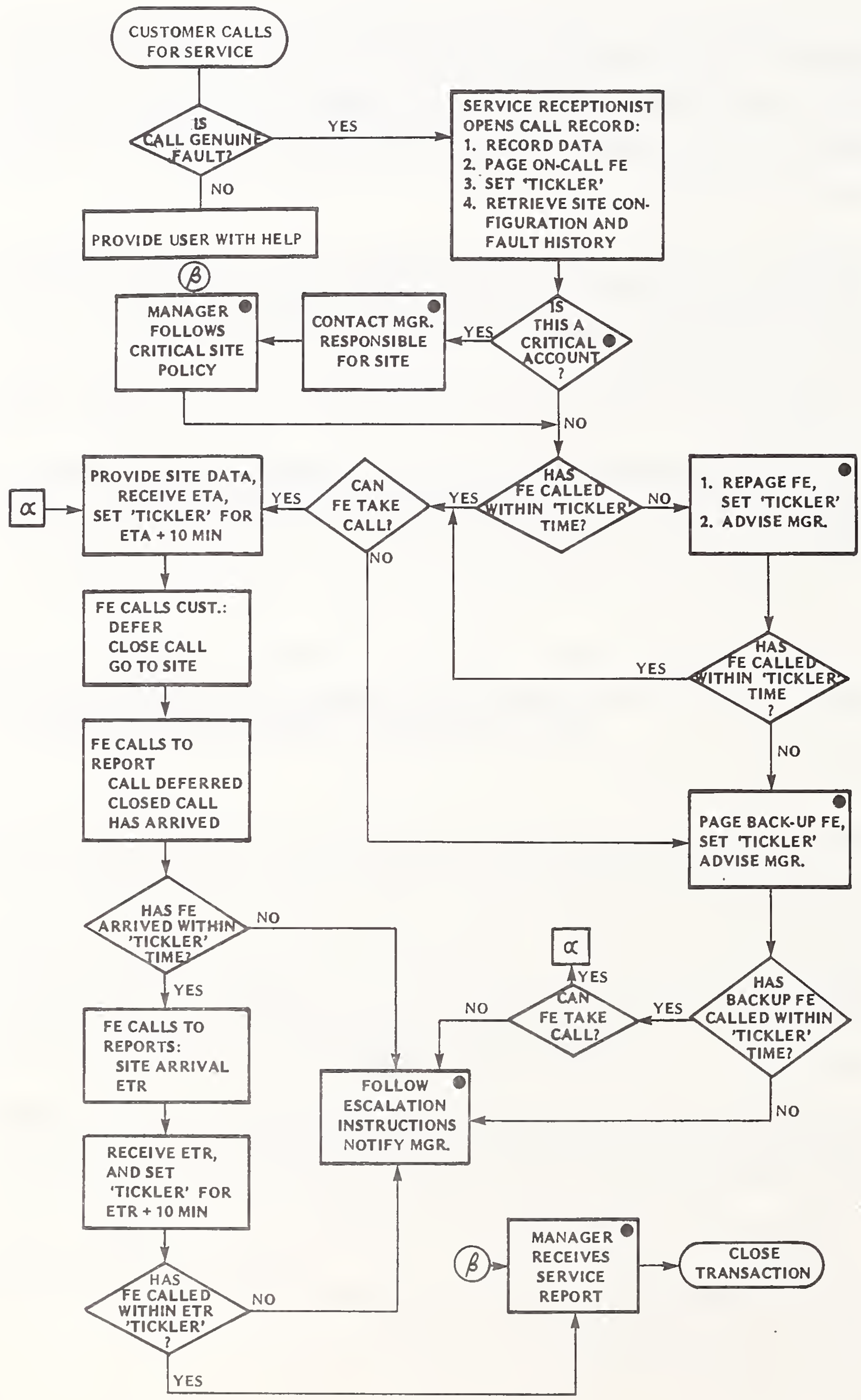
- This may not be within the scope of the vendor's own product line (although there is a natural tendency to use one's own computers for cost reasons).

- Essentially, the system is event-driven, starting with the customer call and terminating with the manager's report on the service call. It captures the initial call, controls the dispatch (which can also be assisted by a computer driven 'assignment list' detailing individual FEs to call on certain products or components or fault types) and tracks the progress of each call/FE.

- In parallel, summarised extracts can be made available, live, to the duty service manager, who can be 'programmed' into the monitoring sequence when time limits are exceeded or the site FE gets into difficulty.

EXHIBIT VII-2

DISPATCH INFORMATION FLOWCHART



ETA = Estimated time of arrival
ETR = Estimated time to repair
● = Activities which involve service manager

- Normally, all information related to a service transaction is date- and time-stamped for subsequent analysis and for addition to the history file.

- Optionally, each individual field engineer can have a personal activity file that records all his activities on call, for review later by himself or as supporting evidence for performance review by his manager.

- The form of the 'call' ranges from a telephone conversation to a radio page, which can also be initiated by the call/dispatch computer.

- The work file of the service desk receptionist is composed not only of incoming user calls, but also of reactivated 'alarms' on ongoing calls where the 'tickler' time has expired.

- The site arrival time can be used to generate an invoice if the customer file shows that a T&M agreement is in force. The file for each site can be used, if the vendor so desires, to show the client that he would benefit from a change in service contract, particularly when it entails an increase in vendor revenue.

- The activities identified with a black dot in Exhibit VII-2 show areas where it is normally advisable to involve the duty service manager. These include critical accounts and problem escalations.

D. JOB STATUS AND SERVICE REPORTING

- During the service transaction, all the data associated with that particular job is available on-line to each operator either on demand or when system 'alarms' occur (tickler time exceeded).

- The availability of this information allows an informed response by anyone brought into the service transaction at any stage or its completion: <u>all</u> the data recorded can be absorbed, not just the summary provided by a particular participant. This has special relevance to managers being called into an escalating problem.

- Field engineer experience and availability can provide the basis of engineer dispatch and reflect illness, holiday, or any other incompatibility.

- The tickler is the service desk reminder that a decision point has been reached. It is not necessarily always an alarm and can be a simple reminder pad.

- Critical account lists, like the field engineer availability and skill lists, are dynamic and can be reviewed daily by engineering, sales, and general management.

- The system can be dynamically altered for management reasons. For example, if local management difficulties have developed, the regional manager may wish to have all second alarm situations automatically referred to him, either as a monitor of situation progress or as a monitor of how well a service manager is performing.

- Site arrival, job completion, and spare parts usage can be used for billing and inventory purposes. Absence of a spare or failure of the spare also provide valuable data for servicing the client and resolving disputes between client and vendor.

- The volume of traffic handled by the call/dispatch system can be a valuable guide for management, particularly in determining product release strategy (for hardware and software).

E. IMPACT ON FIELD SERVICE STRUCTURES

- The implications of the implementation of call/dispatch systems are enormous in human terms as well as in procedural terms.

- The field engineer/service desk person relationship is a key one particularly in field service organisations where the average field engineer's age is high. It can be difficult to strike the right balance in attitudes and respective authorities.

- The field engineer force should not perceive the call/dispatch system as an automated spying tool for management. This involves a flexible interpretation of the data by management and another delicate balance between being lax in discipline and overreacting to the data provided.

- There is no doubt that the service manager's own job content is dramatically changed, removing him from the role of super-engineer into that of a man/situation manager with significant administration tasks.

- Moreover, the local service manager can be put under pressure by the implementation of the call/dispatch system since it will highlight any operational insufficiencies and bottlenecks.

- However, if the field engineering staff can view the system as a combination of the procedures manual with an operator assisted electronic mail system, all will be well.

- The user himself is also put under some pressure in that he will be expected to know the level of his service entitlement, and be ready to take decisions on expenditures on the spot.

- In addition, he will be expected to have prepared his fault description carefully and be ready and able to discuss symptoms on the phone with an informed analyst, rather than providing generic statements.

VIII USERS' VIEW, 1981

VIII USERS' VIEW, 1981

A. INTRODUCTION

- The vendors' approach to maintenance, and the new techniques that are beginning to be applied have modified the European maintenance environment - from a vendor's standpoint.

- Many of the objectives of the new techniques are internal to the vendor - cost control/reduction, engineer productivity, etc. - but also aim at improving response/repair times and system availability for the end user.

- Can the impact of the new techniques be measured at the users' end? This section examines the users' view in 1981 and compares it to the data for 1980.

B. RESPONSE TIMES, 1980/1981 COMPARED

- Exhibit VIII-1 shows the users' view of the response times they are experiencing by category of equipment, comparing the data obtained by INPUT in 1980 with that for 1981.

EXHIBIT VIII-1

USERS' VIEWS OF RESPONSE TIME, 1980-1981, WESTERN EUROPE

EQUIPMENT CATEGORY	1980 (hours)		1981 (hours)		CHANGE (+/-)
	CURRENT	IDEAL	CURRENT	IDEAL	
• Large/Medium Mainframes	1.8	1.1	1.9	1.2	=
• Small Business Computers	4.5	2.2	4.7	2.2	=
• Minicomputers	6.7	3.1	6.3	2.6	+
• Plug Compatible Peripherals	7.2	3.1	5.1	3.2	++
• Terminals	6.7	3.4	11.5	4.1	-

- Within the limits of error for the size of the sample analysed no significant improvement (or deteriation) is discernible for large/medium mainframes and small business computers.

- The mainframe users still require a response in two hours. There is no visible impact of new maintenance techniques, even though this large machine category is one of the main areas targetted by the new techniques.

- The minicomputer category has been a major target for new techniques and some improvement is visible, within the margin for error of the sample. Interestingly, as the response time has improved so the users' requirements have narrowed from an ideal response time of 3.1 hours in 1980 to 2.6 hours in 1981.

- The main improvement has been in the plug compatible peripheral supplier category, which is where the greatest margin for improvement existed. The response time experienced by users has been reduced by slightly over two hours, bringing the peripheral response time down to the level of the minicomputer market.

- Plug compatible peripheral user requirements on response times have not changed.

- The only area of significant deterioration is the terminal market, where response times have considerably worsened. Vendors are gradually moving to a 'next day' response.

- User pressure cannot be great on the vendor or this would not be occurring (the terminal market is very competitive). In line with the worsening response, users' expectations have been relaxed, from 3.4 hours to 4.1 hours.

C. REPAIR TIMES, 1980/1981 COMPARED

- Exhibit VIII-2 shows the users' views of the repair times that they are experiencing, by category of equipment. Vendors should remember that users do not, normally, retain accurate records of their response/repair times and usually respond to questions on these subjects by averaging their most recent experiences.

- It is probable, therefore, that vendors' own, more accurate records will show different values to those shown in Exhibit VIII-2 (which in any case are a composite of all vendors' equipment). The important factor is the trend, not the absolute values even though these will not be far removed from the vendors' values.

- The mainframe users show a degradation in repair times in 1981 compared to 1980. Simultaneously, users have increased their repair time requirements to closer to one hour, compared to around one and a half hours in 1981. This is the worst result of all categories of system.

- Small business computer users have seen their stated requirements for 1980 realized in 1981. Immediately they have moved their 'ideal' requirements down to less than two hours. Evidence of this tendency of users to constantly ask for improving repair times can also be found in the minicomputers and plug compatible peripherals categories.

- Minicomputer users, in 1981, experienced an almost 50% drop in delays to repair faults, a dramatic improvement. Simultaneously they have begun asking for repair times more compatible with the mainframe systems that many of their minicomputers serve or are connected to.

EXHIBIT VIII-2

USERS' VIEWS OF REPAIR TIME, 1980-1981, WESTERN EUROPE

EQUIPMENT CATEGORY	1980 (hours)		1981 (hours)		CHANGE (+/-)
	CURRENT	IDEAL	CURRENT	IDEAL	
• Large/Medium Mainframes	2.7	1.6	3.4	1.1	-
• Small Business Computers	5.3	2.6	2.6	1.9	++
• Minicomputers	6.6	3.1	3.9	1.5	++
• Plug Compatible Peripherals	8.5	2.7	3.0	1.5	++
• Terminals	5.9	2.7	25.0	8.1	--

- Plug compatible peripheral vendors, in line with the important improvements achieved in response times, have also improved their repair times by a significant margin, dropping average repair times down from eight and a half hours in 1980 to three hours in 1981.

- The users' reaction to this has been to align their ideal repair time requirements on those of the minicomputers to which many plug compatible products are connected.

- The terminal category shows a sharp deterioration of the repair time experienced by users, going to a full day. Users' requirements have followed, increasing threefold from just under three hours to slightly over eight hours.

D. CONCLUSIONS

- The data in Exhibits VIII-1 and VIII-2 supports the view that European users have seen significant improvements in service response times and repair times in the last 12 months.

- The data also suggests that these improvements have occurred mainly as a result of the better call/dispatch techniques (which nearly all vendors have implemented) and better spares distribution.

- The order of magnitude improvements in repair times certainly cannot be attributed to remote diagnostics, which four vendors have implemented, and which apply, in any case, to a small proportion of the total products sold and to an even smaller proportion of the installed base.

- The conclusion that can be drawn is that users can expect better repair times in the future, as the remote assistance techniques are generalised and impact a broader spectrum of products.

- This suggests that vendors can reasonably expect good user acceptance of price increases, where related to performance improvements.

- This conclusion must be qualified by the performance achieved by systems software, however, in particular the operating system. This is an area where vendors have yet to achieve the order-of-magnitude improvements that have been seen in hardware.

- European users have come to expect that each new release of operating systems comes with a list of functional restrictions, and it frequently occurs that other errors are discovered during the short (six months to one year) product life of the operating system.

- It is unlikely that this situation will change significantly over the next few years. Therefore vendor system availability calculations and plans should allow for the failure level of operating systems, rather than hardware alone as is still frequently the case.

- Significant rewards in maintenance price increases can be obtained, according to users, if the ideal repair times quoted in Exhibit VIII-3 are achieved.

- The percentages should be viewed alongside the actual average revenue generated by each equipment category, rather than at their face value. For example, a near 29% increase in terminal maintenance prices does not signify any great revenue increase (average vendor annual terminal maintenance change is approximately $250 per unit; i.e., an increase of $70 per annum). This would almost certainly not pay for the level of improved maintenance service requested by the users.

- Others, however, are significant. An increase of nearly 21% in medium mainframe maintenance prices is a major revenue improvement, as is 31% on minicomputer prices. The levels of improvement in repair times are attainable and the additional costs incurred by the vendor in providing the improved service should be more than offset by price increases of this magnitude.

EXHIBIT VIII-3

USERS' VIEWS OF ACCEPTABLE
MAINTENANCE PRICE INCREASE
FOR IDEAL REPAIR TIMES

EQUIPMENT CATEGORY	MAINTENANCE (Percent Increase)
Large Mainframes	10.86%
Medium Mainframes	20.94
Small Business Systems	15.00
Minicomputers	31.50
Peripherals	21.40
Terminals	28.64

- An 11% increase in large mainframes maintenance charges is less encouraging however, given the level of inflation in Europe. Nevertheless, with remote diagnostics playing an increasing part in reducing maintenance costs and repair times, perhaps even this level of price increase can be attractive.

- Obviously vendors should not interpret Exhibit VIII-3 as an encouragement by users to increase prices without improving repair time performances. Any such attempt could have serious consequences.

IX OTHER MAINTENANCE TECHNIQUES

IX OTHER MAINTENANCE TECHNIQUES

A. INTRODUCTION

- Not every product falls into the general category of equipment that can be serviced by traditional methods.
- This is particularly true of low-cost products, where the margins are very small in relation to the cost of a man/hour of field engineer time.
- These techniques then come into their own, including those presented in this section.

B. IBM 3101 - MAIL ORDER TERMINAL

- IBM sells the 3101, low-cost terminal by mass marketing techniques, such as mass mailing to known IBM and non-IBM computer users, newspapers/magazine advertising, and similar techniques. Volume discounts are applied (on more than 25 units).
- The device itself is delivered by mail without any field engineer involvement. The user receives three units: the logic unit, keyboard, and video.

- All units are provided with the necessary attachment cables and the mains cable. A booklet explains how the units are to be attached, and users must install and check out the terminal themselves.

- When a fault occurs, a test card establishes if the keyboard or logic unit is at fault. If the video is at fault, both the logic and video units must be returned with a completed repair authorisation form.

- The user pays for the transport to the IBM Repair Centre and IBM pays for the return postage after fixing the error. The unit comes with a warranty and IBM warns the user in writing when the warranty has expired. Thereafter the user pays for parts and labour to repair any faults.

- User reaction is difficult to measure at this stage since the installed base is still very small. In the U.S. the user reaction was less than enthusiastic, particularly about depot repair which is inconvenient.

C. DIGITAL SERVICE FRANCHISE

- With the advent of the general distribution of home computers, retailed through the major chains of hardware goods, the need arises to service these users.

- The usual service approach is to ask the user to return all or part of the failed computer through the mail and wait until the mail brings him the corrected system.

- The delay involved in obtaining such service is one thing. The expense involved is another. Also assumed is the ability of user, system, or both to diagnose the fault, intermittent or hard.

- Now that the major retail chains are beginning to offer their names as the umbrella marketing organisations to these home computer products, surely they cannot allow their goodwill, integrity, and name to be associated with poor after-sales service.

- Either a retailer operated repair centre must come into being or a local franchised repair centre is needed. In the U.S. both are readily available.

- At present, the volume of repair work that exists to support such systems is not that great. Software houses that sell applications on these devices are also agreeing to become involved in assisting their users to obtain service when necessary. But as the volume builds, a local repair centre will emerge.

- The digital repair market goes a long way beyond the game computer, of course. Television, video recorders, home entertainment of all natures also has such a digital repair need, along with appliance controls (increasingly digital), such as intelligent thermostats.

- It may be possible for vendors to offer 'no repair' products at the very low product end when such local digital repair centres come into being, with increased satisfaction for vendor and user alike.

D. DEPOT MAINTENANCE

- This calls for users to bring their faulty systems, terminal boards, and other equipment to central maintenance points where spares and engineers are concentrated.

- No site visits are made by the engineer, so that unproductive time is cut to minimum, and travel costs are eliminated. In addition since spares of all kinds are almost always available, the chances of having to wait for spares in order to effect repair are virtually nil.

- This approach is only applicable to systems, subsystems, and components that are easily transportable and which are easily diagnosed as faulty.

- End user products such as terminals are suited to this approach, as are home computers and subsystems such as floppy disks.

- Depot maintenance is also effective for vendors supporting an OEM network, where a degree of self-reliance is called for, knowledge of the products supported usually goes one or two levels beyond the average user knowledge.

- This is necessary for the OEM who frequently prefers to keep the first level contact with his clients to himself.

- Depot maintenance also calls for the ability to diagnose and repair down to at least board level, and chip level where possible.

- As a result depot maintenance is found either as a part of the internal support infrastructure of vendors' own field forces or as the initial national support provided by product vendors making an initial entry into a given country market.

- Depot maintenance is also effective for low-end products sold by mass marketing or retail chains to end users such as the home computer. Providing the location of the depot is well centred with regard to the user population, little user resistance is encountered.

E. PRODUCTIVITY TOOLS/EXERCISERS

- As a halfway house between remote diagnostics and self-test capabilities, a host of exercisor products are available that run a microcoded test sequence for specific products to assist the field engineer in obtaining a complete diagnostic.

- These exercisors are portable and are more complete in function than the self-test boards that can be incorporated into subsystems, since they do not rely on a minimum level of functional ability of the unit to be diagnosed.

- Status monitors similarly offer multiple applications, acting either as multi-point monitors, as front panels for computers, as an alarm monitor for process control or security applications, and as a production flow monitor.

- Integrated circuits are very difficult to diagnose even when parts of the IC are still functioning. But when an IC fails, the engineer has a very complex system to analyse.

- Single-point analysis of an IC is usually accomplished with an oscilloscope, an expensive piece of equipment. Logic probes are far less expensive and just as efficient for IC trouble-shooting, providing complex timing measurements are not needed.

- Logic probes have the ability to diagnose logic states, sense and store pulses in much the same way as signal tracers are used in audio and RF circuits. Entire logic trees can be followed enabling faults to be isolated.

- They operate as circuit powered digital instruments, comparing pin voltage, path voltage, or node voltage at the probe tip to reference thresholds for the logic family being tested.

- The availability of such productivity tools has occurred just as the highly skilled engineer is being abandoned in favour of board or subsystem replacement.

- These tools are therefore in future more likely to be found at the repair centre or depot maintenance locations.

APPENDIX A: DEFINITIONS

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- CENTRE OF EXCELLENCE: the concentration at specific locations of the most highly trained and experienced support staff for a given product, hardware or software. Used for customer support and for vendor's own field staff.

- DISTRIBUTED DATA PROCESSING: the deployment of programmable intelligence to the site where the particular data processing function is performed. Computers and terminals are interconncted through a telecommunications network adapted to individual user needs.

- ENGINEERING CHANGE NOTICE: notice of improvements or corrections in a product after it has been released to production or has been installed at the user's site.

- ENGINEERING CHANGE ORDER (ECO): instructions including bill of material and parts required to effect the engineering change.

- FIELD CHANGE ORDER (FCO): see ECO.

- FIELD ENGINEER (FE): individual who responds to a user's call for service and repairs a device or system. FE is used interchangeably with customer engineer, serviceperson, maintenance person, etc.

- FIRST-LINE MANAGER (FLM): individual at the first or lowest level of management in the field organisation, usually at the branch level.

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

- MEAN TIME TO REPAIR: the elapsed time between a field engineer's arrival at the user's site and the repaired device's return to full operation.

- MEAN TIME BETWEEN FAILURES (MTBF): the elapsed time between reported failures on a device or system.

- REMOTE ASSISTANCE: techniques such as remote preventive maintenance, remote diagnostics, remote error reporting, and remote technical assistance.

- REMOTE DIAGNOSTICS (RD): diagnostics run by the vendor from a remote location without the intervention of the user's operator; diagnostics run by an on-site field engineer tied to a central support center, or by a user tied to a central support center. It can usually isolate a fault to the lowest exchangeable units. Also termed telediagnostics.

- REMOTE SUPPORT: sometimes used by some vendors as a term to describe full system diagnosis (i.e., hardware and software) as opposed to remote diagnostics used for hardware only.

- REMOTE TECHNICAL ASSISTANCE: the provision of symptom matching, to in-field engineers through a telephone network. This is usually a dial-in service to a computerised data bank of known errors matched with the symptoms they produce.

- SYSTEM SUPPORT CENTER (SSC): a central technical support facility staffed by highly skilled field engineers and accessed over a national hotline number. A system support center is available to both users and field engineers for the analysis of problems in hardware, software, or a combination of the two.

- USER SELF-MAINTENANCE (USM): some involvement by individual users in the installation, diagnosis, and repair of their own installed equipment.

APPENDIX B: VENDOR QUESTIONNAIRE

VENDOR QUESTIONNAIRE

COMPANY:

CONTACT:

TITLE:

TELEPHONE:

1. Over the past two years have you implemented new maintenance techniques?

   ____

2. When was this service begun? ______________________

3. Please give a brief description of the new technique:

   ____

   ____

   ____

   ____

4. What was the objective of introducing the technique?

   ____

5. Has that objective been achieved? ______________________

6. Has the technique reduced or increased field service costs?

____

7. By what percentage? ______________________

8. What is the breakdown of cost of a call

BEFORE	AFTER
______	______
______	______
______	______
______	______

9. How has the technique been marketed to users?

____

10. Do they know it exists? ______________________

11. Has the technique had any impact on your competitiveness?

____

12. How have users reacted to your technique?

____

____

13. How have engineers reacted to your technique?

____

____

14. How has the new technique impacted system availability?

____

15. Has the new technique contributed to profitability?

____

16. Did the new technique require organisational changes in your company?

____

17. If so, what were they? ______________________________

____

18. Have you experienced any major failures with the new technique?

____

19. If so, what were they? ______________________________

____

20. Do you do a cost analysis of new techniques prior to implementation?

____

____

21. How is the cost effectiveness of new techniques monitored? __________

____

22. What authority, in general, do you have in deciding to implement new maintenance techniques?

____

____

23. Who has the final say so? ______________________________

____

24. Are you aware of any new techniques that competition has implemented?

____

____

25. Are you likely to implement this or other techniques in the near future?

____

____

THANK YOU FOR YOUR TIME

26. What are your views on remote diagnostics, status of its implementations, effectiveness, etc.?

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APPENDIX C: RELATED INPUT REPORTS

APPENDIX C: RELATED INPUT REPORTS

TITLE	PUBLICATION DATE
European Field Service Annual Report 1980	July 1980
Centralized Dispatch and Voicebank	July 1980
Remote Diagnostics in Western Europe	October 1980
Opportunities in User Self Maintenance	August 1980
Marketing Field Services in Western Europe	December 1980

Contact: Dave Lyons, Director, Field Service Program, at London (01) 439-4442.