Customer
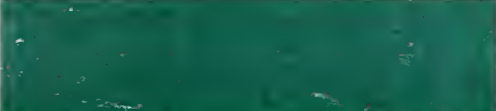# Service
Program
(CSP)

Automated
Service
Delivery

INPUT®

1943 Landings Drive, Mountain View, CA 94043. (415) 960-3990

AUTOMATED SERVICE DELIVERY

APRIL 1987

Customer Service Program (CSP)

Automated Service Delivery

AUTOMATED SERVICE DELIVERY

ABSTRACT

Customer Service organizations are currently faced with conflicting challenges from two sources:

- Users who want better service yet lower service prices.

- The parent organization which looks to service to provide increased service margin while at the same time wanting service to continue to remain competitive in the market.

As a result, service organizations have looked toward advanced technology to find ways to provide better service more efficiently (and profitably). Customer service organizations have successfully automated certain service management functions, such as call-handling, dispatching, and parts management, with sophisticated software systems. In addition, certain diagnostic and support implementation activities have been built into the computer systems themselves.

This report details the development of service automation technology by showing industrywide use, as well as specific case studies of leading service vendors and their service automation activities. The report concludes with the presentation of an "ideal" service management system that incorporates current technology.

This report contains 70 pages, including 17 exhibits.

F-T01-164

AUTOMATED SERVICE DELIVERY

CONTENTS

INPUT
FT01-164-1987

AUTOMATED SERVICE DELIVERY

EXHIBITS

INPUT

I INTRODUCTION

A. SCOPE

- This report deals with specific issues of high importance to customer service organizations, with the primary focus on the steadily increasing user demand for more and better service in an increasingly competitive marketplace. Service organizations will find themselves under greater pressure from both users and internal organization to increase and improve service and to maintain or even lower service prices while at the same time increase their revenue and profit contribution to the overall company goals.

- As a result, service organizations will need to uncover and exploit new revenue sources, both in the types of services provided (e.g., software support, unbundled training, systems integration) and in the types of customers (e.g., third-party maintenance). In addition, service organizations must continue to find ways to provide service more efficiently and effectively.

- One such way is to gain tighter control over the inherent costs associated with the delivery of service, primarily the movement of engineers and parts both in the field and at service locations. By optimizing the amount of time an engineer is actually engaged in service activities versus traveling or communicating with the service organization, the service organization optimizes the billable costs/service revenue ratio, thus increasing service margin. In addition, the correct inventory of necessary spares contributes

- 1 -

INPUT

more obvious benefits (e.g., reduced downtime, reduced travel time, increased user satisfaction).

• Customer service organizations in the computer industry have, not surprisingly, looked to increased automation as a method of gaining such increased control over costs. Software and turnkey systems have been developed to accomplish such service functions as dispatching/call handling, inventory management, and billing. Early systems were patterned after traditional manufacturing systems (one leading product, SERVICEMAN, was developed and sold by ASK Software, a leading vendor of manufacturing software systems) which emphasized "real time" control over resources (e.g., manpower, tools, parts). As these systems developed, integration of service functions became the key focus of these systems.

• Presently, service organizations require increased integration of service management functions (accounting, account histories, etc.) with service delivery functions (dispatching, product histories). In addition, more sophisticated applications are beginning to incorporate remote diagnostics into service management systems. Furthermore, "real time" information handling needs are now "too slow"; service organizations need to plan into the future, rather than remain largely "reactive."

• This report will analyze the development of automated service delivery activities within customer service organizations from simple dispatching and parts tracking systems to current fully-integrated service management systems. In addition, the report will analyze "user" (service organizations) needs for such systems, based on interviews with service management of leading manufacturer and third-party service organizations. When possible, case studies will detail specific application of in-house and "packaged" systems. Lastly, a series of recommendations will conclude the report, based on the development of an "ideal" model of a (not so) future service management system.

- 2 -

INPUT

B.   METHODOLOGY

- This report was prepared using a two-prong research effort:

  - Primary research was conducted in February 1987, involving focused interviewing of logistics managers or MIS officials at 16 manufacturer and third-party service organizations. The focus of these surveys was experiences with automated service, primarily field service management systems (FSMS) and remote support systems (RSS). The questionnaire used for this effort is contained in Appendix A. In addition, vendors of FSMS packages and portable terminals used in conjunction with FSMS applications were surveyed concerning their products.

  - Secondary research was performed, making use of INPUT's specialized library containing information on products, companies, and applications of customer services activities.

- As always, INPUT welcomes questions, suggestions, and comments about this report or any of INPUT's research products and/or services.

- 3 -

INPUT

II EXECUTIVE SUMMARY

• This executive summary is designed to help the busy reader quickly review the research findings of this report. Each main point is summarized as an exhibit and an accompanying script is given on the facing page. The format is designed to facilitate use of the executive summary as an in-house overhead presentation.

• The focus of this report is to demonstrate the importance of automated service systems as a way of improving service delivered to users while reducing the costs involved with service activities. Service organizations have traditionally used in-house and packaged software systems to automate dispatching, call handling, and parts management functions (replacing less efficient paper-based systems); increased pressure on service organizations to improve service and increase profitability while maintaining reasonable service prices has encouraged service organizations to increase service management and delivery automation. A further objective of service automation is the improved integration of these automation efforts.

• The following summary details the development of service automation efforts, up to current automation activities of leading manufacturer and third-party service organizations. The summary concludes with an "ideal" service automation system that integrates both service management and service delivery functions.

INPUT

A. THE DEVELOPMENT OF AUTOMATED SERVICE DELIVERY

- Early computer service management required the accumulation and storage of basic information concerning hardware maintenance activities and the dispatching and delivery of service to the company's user base. Service calls were telephoned in by the user, field engineers (FEs) were dispatched to the user site by phone or by radio, and all information about the process was accumulated and stored in a paper-based file management system.

- By the 1960s, most computer manufacturers had replaced their unwieldy paper-based systems with (by today's standards) primitive batch-processed computer systems. In the early 1970s, these systems were greatly improved with the addition of optical character recognition techniques, reducing the paper flow from the FE to service management.

- It was not until the mid-1970s that service management automation progressed to today's level, exemplified by systems developed by Western Union, Datapoint, and, most particularly, Texas Instruments that automated call handling, dispatching, parts tracking, and other service functionality on a real time basis. By this time, FE reports were coded for faster data entry, and later in the 1970s some companies experimented with handheld terminals that would improve FE communications.

- Currently, almost all field service organizations use some level of automated service management system, most in the form of in-house developed or packaged Field Service Management Software Systems (FSMS). In the next section, INPUT will examine current use of such systems.

- 6 -

INPUT

EXHIBIT II-1

INPUT®

DEVELOPMENT OF
AUTOMATED SERVICE DELIVERY

1960	1970	1980	1990	2000

PAST ⟶ PRESENT ⟶ FUTURE

PAST	PRESENT	FUTURE
PAPER-BASED PHONE OR RADIO	FSMS SOFTWARE	AI/EXPERT SYSTEMS
	REMOTE DIAGNOSTICS	REMOTE SUPPORT
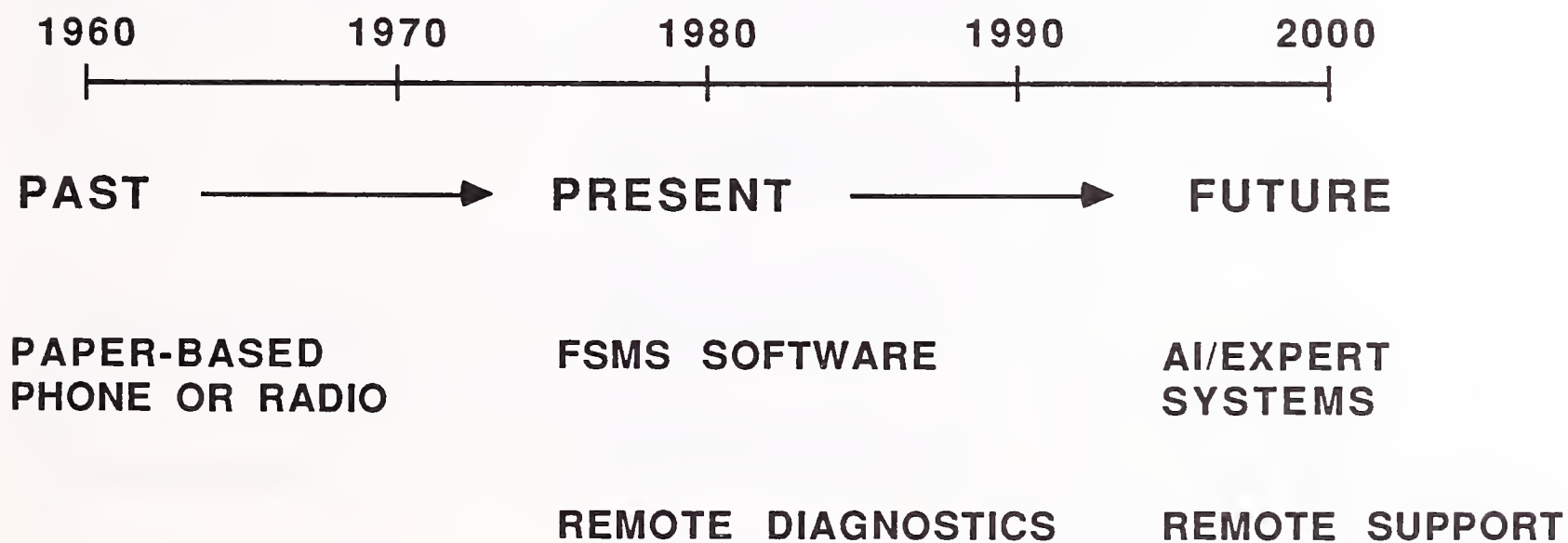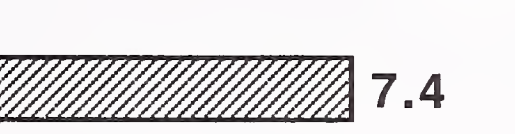
INPUT

B.   CURRENT FSMS FUNCTIONALITY

- In March 1987 INPUT surveyed 16 leading manufacturer-based and third-party service organizations concerning their current requirements for specific service management functions as well as whether that function is performed by their current system (either developed in-house or "packaged").

- Not surprisingly, most service organizations place the highest requirement on traditional service management informational needs--parts (inventory) management and dispatching (call handling). Accounting functions (specifically invoicing) were less of a requirement for service organizations surveyed, suggesting that they would prefer to leave those activities to accounting people within the larger organization.

- These same service organizations reported a low requirement for remote diagnostics within their service management system. Indeed, only 28% of the sample currently implements remote diagnostics through their system, while all of the systems manufacturers surveyed use some form of remote diagnostics separately.

- The separation of accounting and remote support functions highlights a weakness within today's service management activities since the lack of integration of these activities with other service automation activities leads to less efficient management and delivery of service.

- In the future, service organizations will face increased pressure to provide more efficient and effective service at reduced prices. To do so, service organizations will need to integrate all service functionality to optimize service efficiency.

INPUT

EXHIBIT II-2

FSMS USE

Service Function	Requirement*		% Receive
	1 2 3 4 5 6 7 8 9 10		
Parts Tracking	///////////// 8.1		83%
Dispatching	///////////// 7.4		78%
Accounting	///////// 6.3		56%
Remote Diagnostics	/////// 5.1		28%

Sample: 16 Service Organizations

C.   PRODUCTIVITY GAINS RESULTING FROM AUTOMATION

- Service automation activities improve not only the flow and availability of information, but also the actual delivery of maintenance and support to the user.   Certain vendors have already realized productivity gains by incorporating such advanced applications as artificial intelligence (AI) and expert sytems into their remote support offerings.

- AI and expert systems are advanced applications that mimic human reasoning by "interpreting" patterns existing in a data base (in this case, a problems data base) and by presenting "recommendations" based on the probability of these patterns occurring.   When incorporated with remote support, those applications can lead to the ability to recognize minor intermittent errors, report these errors, and recommend necessary steps to circumvent or correct the error.   What results is the ability to provide predictive support that allows scheduled replacement of a unit, rather than reactive support to correct catastrophic failure of a system.

- DEC, for example, has improved both hardware maintenance and software support delivery through the establishment of automated support centers, such as the one located in Colorado Springs (CO).   Data General has realized similar improvements in productivity with its own centralized software support centers.

INPUT

EXHIBIT II-3

INPUT®

PRODUCTIVITY IMPROVEMENTS FROM AUTOMATED SERVICE DELIVERY ACTIVITIES

Company	Support Implementation	Productivity Gain
IBM	Expert Systems for Peripherals	20-30% Reduction in Service Costs
DEC	Remote Support Center	85% of Software Problems Solved in 45 Minutes or Less
DG	Telephone Support for Software	20-25% Decrease in Service Incidents

INPUT

D.   THE FUTURE OF SERVICE AUTOMATION

- Service organizations are currently faced with building pressures from three major fronts:

    - Users who are requiring improved and increased services while pushing for lower service prices.

    - Larger (manufacturer) organizations, which push for increased profitability, particularly with slowed product sales growth.

    - The overall competitive environment, which reflects the importance of system availability as serviceability in the user's purchase decision.

- All of these pressures have forced service organizations to find ways to provide service and support more efficiently and effectively to their users. Service organizations have already successfully automated certain functions within service management (e.g., logistics management, dispatching, remote diagnostics), yet this increased pressure should encourage service organizations to continue their progress in service automation.

- The minimum functional requirements of such an effort are shown in Exhibit II-4, stressing the productivity gains available through the efficient integration of service automation capabilities. All of this technology is currently available and in use to some degree by service organizations. What is needed is the integrated application of these activities which will result in better informational flow and smoother delivery of support to the users.

INPUT

EXHIBIT II-4

INPUT®

THE "IDEAL" AUTOMATED SERVICE SYSTEM

- Complete Functionality - Logistics, Informational, Accounting

- Single, Accessible Data Base

- Integration of Remote Support Activities

- Use of AI and Expert Systems Software

INPUT

III DEVELOPMENT OF AUTOMATED SERVICE DELIVERY

A. EARLY DISPATCHING SYSTEMS

- In recognition of the inevitability of product failure, product manufacturers established entities designed to resolve problems for their customers' products. Given the need for prompt resolution of the inevitable problems, these entities were set up to be able to provide problem resolution at the user's site. Thus, these entities became known as "field service" organizations.

- It also became necessary to keep track and manage the activities of the service organization. Field service management was established to keep track of the people, tools, and parts required to perform service at users' sites. This also created the need to communicate (and keep track of such communications) between service management and the field service personnel.

- Basic informational (data) needs for the management included the following:

  - Call (from users) handling.

  - Dispatching (field service personnel).

  - Parts tracking and use.

  - Failure analysis.

- 15 -

- While call handling and dispatching was normally handled by telephone or radio, most informational processing was paper-based. The record of the call was handwritten, handled by the appropriate people, and then stored (filed) as a master file.

- By the mid-1960s, most service organizations had replaced their unwieldy, all-paper-based systems with primitive (by today's standards) automated systems built around batch-processed, keypunched data processing systems. The resulting improvements in data storage and handling were enormous, allowing accurate and readily usable records of equipment, customer histories, and service routines. Unfortunately, service reports (by the field engineer) were still handwritten, data entry was time consuming, and communications between field personnel and management were still primitive.

- By the 1970s, field personnel reporting (handwritten) techniques were replaced with optical character recognition (OCR) techniques which automated the process of taking down and entering information. This move reduced the time needed by the engineers to report their activities (although significantly limited the contents of their communications) and reduced the time necessary to enter the information into the computer. Still, communications between field engineer and service management were primitive, largely because they still relied on telephone- or radio-based communication, independent of the automated service management developments.

- By the mid-1970s, progress in the integration of communications and data handling activities was being made. Western Union and Datapoint had both developed service management systems into which engineer's calls were entered; however, the first company with a truly integrated automated service management system was Texas Instruments, which developed its system (FIS-1) in 1976.

- TI's system incorporated regional call handling and dispatching, resource allocation, staffing and performance modeling, and other MIS functions, built

- 16 -

around a TI 960 minicomputer that kept track of the activities of 100 field engineers working out of 38 service locations (1974 demographic data).

- TI continued to develop the system as its product and customer base grew, adding improved reporting capabilities that showed that while the cost per call increased (reflecting the costs of systems development), overall service profitability also increased as a result of reduced callbacks and improved efficiency while on-site.

- Perhaps the most significant improvement was the use of specialized handheld terminals by the field engineers (FEs), which replaced the use of handwritten reports or OCR coded forms. While the OCR forms were a great improvement over completely handwritten reporting forms, they often required an FE to memorize confusing codes. Frequently, the engineer put the wrong code, unintentially or even intentionally (FEs often put codes that they remembered, just to make sure that some code was entered), and would rarely be able to remember codes when questioned later about a specific call.

- An alternative to the coded methodology was automated call closing, where an FE would call by telephone a computer operator sitting at a data entry terminal, who would enter information from the FE at the time of call close. Since the data entry person was skilled at data entry, and since screens were frequently menu driven, data entry errors were reduced. Also, FEs could work from memory or informal notes without having to memorize or translate code (unfortunately, that task was placed on the data entry person). However, this methodology increased telephone costs and also slowed the entry of data into the system.

- By the late 1970s, improved computer design and manufacturing developments greatly reduced the size and increased the power of data entry terminals to the degree that intelligent terminals could be placed directly into the hands of the FEs. While the use of handheld terminals had a number of associated problems (they required FEs to remember codes due to the limited size of the

- 17 -

INPUT

display screen and placed the FE in a data entry role), data entry errors could now be caught at the source, and the terminals allowed the FE to communicate directly with the main data storage location. Eventually, a major benefit of the handheld terminal would appear—the ability to provide two-way communication between the FE and service management.

B.　CURRENT FIELD SERVICE MANAGEMENT SYSTEMS

- Currently, the basic functions of a field service management system are slanted toward traditional business needs:

    - Call handling.

    - Dispatching.

    - Parts tracking (including use).

    - Accounting and billing functions.

    - Limited informational capabilities (e.g., customer histories).

- As stated previously, the fundamental activity of call handling and dispatching has been a cornerstone of automated service delivery systems. Efficient service delivery requires the following activities to be performed in a timely manner:

    - Initial call fielding.

    - Identification of the equipment at the site.

    - Verification of the contract.

- 18 -

- Identification and recording of a problem.

- Routing of the call to the appropriate person/department.

- Calculating and communicating the appropriate response.

- Determination of the appropriate parts and repair time.

- Parts use.

- Call closing.

- The accomplishment of these tasks should be instantaneous and invisible to the customer. Given the increased requirement of users for virtually 100% system availability, increased downtime as a result of the call handling and dispatching function is unthinkable. As a result, the concept of real time informational processing became the goal of all FSMS activities.

- Typically, the size of the service organization, along with (to some degree) the organizational structure philosophy of the corporate entity, determines whether the call handling point be a centralized (national) toll-free number, a regional toll-free number, or a local (usually non-toll-free) number. Size or type of service organization does not always determine this structure. TRW and Sorbus, both TPMs similar in size, use centralized and regionalized systems respectively, with similar effectiveness. What is most important is that customers perceive fast response and resolution to their problem.

- With that priority in mind, the system should be capable of determining existing workloads and locations of available resources (FEs and spare parts) to assure prompt response and resolution of the problem. Again, the concept of real time arises since an FE or part location was rarely available immediately in a paper-based system.

INPUT

- Informational functions of FSMS systems smoothed the transition of service both internally and externally. Installation data helped determine expertise needed, configuration status, and potential problems that might result from compatibility problems (this unfortunately also led, in some cases, to "finger-pointing"). In addition, this data also fed equipment reliablity and usage reports. Contract verification data helped prioritize calls while also reducing problems with customers who would move products in and out of service coverage (some customers would only contract certain products and try to get the FE to service noncontracted equipment, even by switching boards and components).

- As suggested above, the call handling and dispatching functions of an FSMS system created additional strength of automated service delivery—that being informational capabilities. Analyzing FE, service office, or overall service staff efficiency became possible by analyzing call open and call close data. Parts use, inventory levels needed, and product serviceability reports are just a few analyses available.

- Furthermore, the accumulated information of problems and their resolutions became a useful tool in future problem identification and resolution, particularly to those organizations who took advantage of the real time benefits of handheld terminals. Although screen size limited the size of information transmitted, coded instructions could easily be transmitted (and monitored) to the FE from headquarters, regional support centers, or other FEs.

- Also part of the system's capabilities is its ability to automatically begin escalation procedures after a predetermined and reasonable period of time. Given the systems data base of historical information on mean-time-to-repair (MTTRepair) plus prescribed mean-time-to respond (MTTRespond) that is determined by system, parts availability, etc., the system should be able to easily assure both prompt response to all problems and reasonable resolution times.

INPUT

- In addition to the service-related functions discussed above, current FSMS systems also manage the business aspects of service, including cost reports, P&L analyses, billing, and other accounting functions. Again, the system should be able to easily repair such reports, given that all service data is collected and stored in a central data base that is shared and accessed by all functions of the FSMS system.

- This leads to the final requirement of current FSMS systems--that the system be completely integrated. Furthermore, the system's central data base will be accessed, directly or indirectly, by three sources of new data--the FE, service management, and (indirectly) the customer. Exhibit III-1 summarizes informational flow to and from each of these sources and the FSMS system.

- Breaking down this informational flow, Exhibit III-2 shows the interaction between the FE and the system. The FE opens the call by arriving on-site, verifies contract confirmation (while the system should perform contract confirmation prior to FE dispatch, it is still necessary for the FE to assure that the specific failed product and part are indeed covered by contract), determines parts needed/used, and closes call. The system may provide the FE with product information, customer history, some level of service instructions, and other informational needs (e.g., messaging).

- Exhibit III-3 shows the informational flow between the service management and the system. For the most part, information flows to service management in the form of accounting information, efficiency reports, parts use, etc. On occasion, management might supply the system with updated or new information on products.

- A more indirect interaction and flow of information between the customer and the system is shown in Exhibit III-4. The FSMS system automatically bills contract customers on a predetermined basis and has the capabilities to bill noncontract (T&M) customers for both labor and parts use. The customer

- 21 -

INPUT

EXHIBIT III-1

FLOW OF SERVICE INFORMATION

INPUT
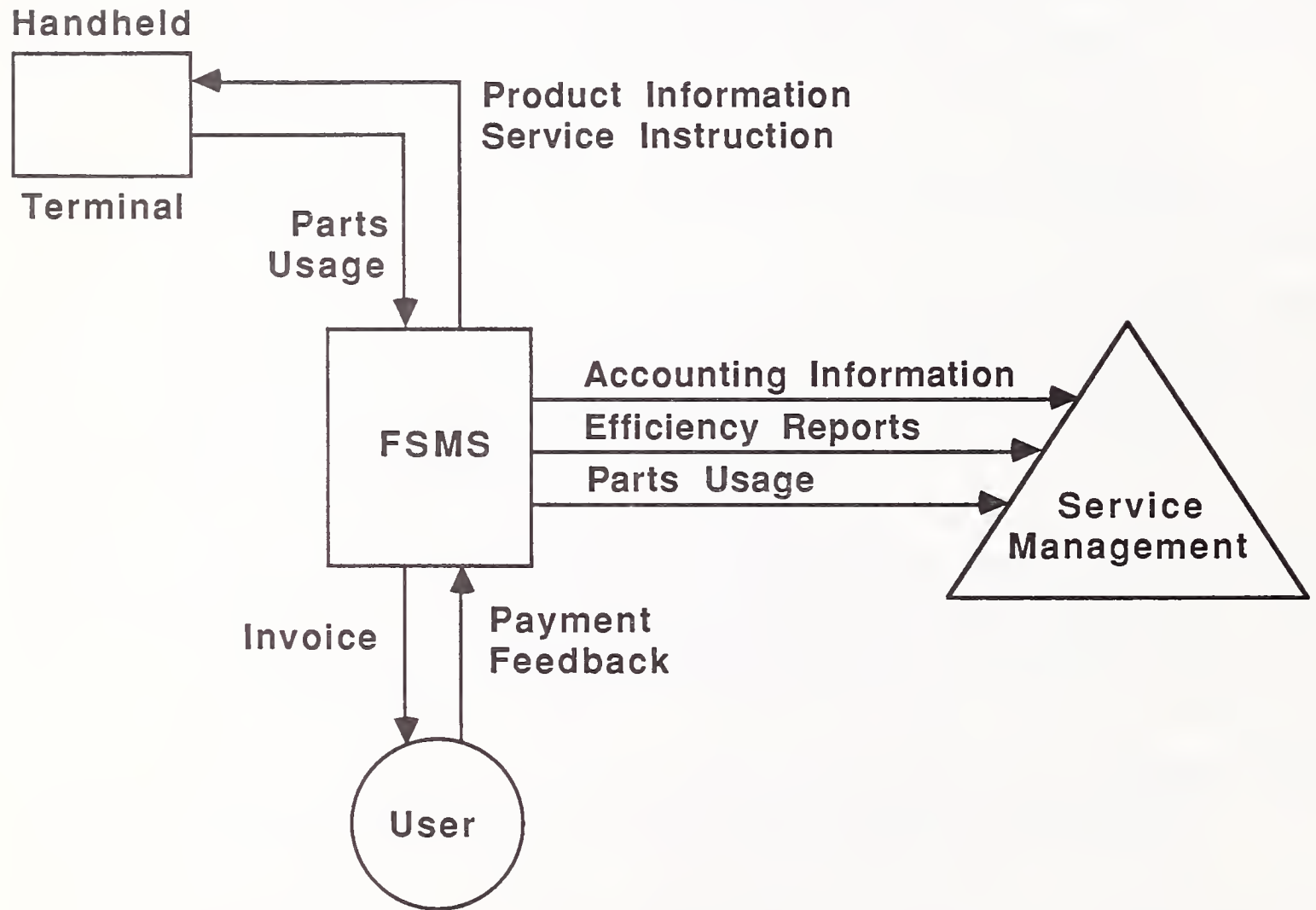
EXHIBIT III-2

INFORMATION FLOW: FE TO/FROM FSMS

```
                   ┌──────────────────┐◄────────────┐
                   │                  │             │
                   │       FE         │             │
                   │                  │             │   Customer History
                   └────────┬─────────┘             │   Product Information
                            │                       │   Service Instruction
   Call  Open               │                       │   Messaging
   Contract  Confirm        │                       │
   Response  Time           │                       │
   Repair  Time             │                       │
   Parts  Usage             │                       │
   Call  Close              ▼                       │
          ┌─────────────────────────────────────────────────┐
          │                                                  │
          │        Field  Service  Management                │
          │                 System                           │
          │                                                  │
          └─────────────────────────────────────────────────┘
```
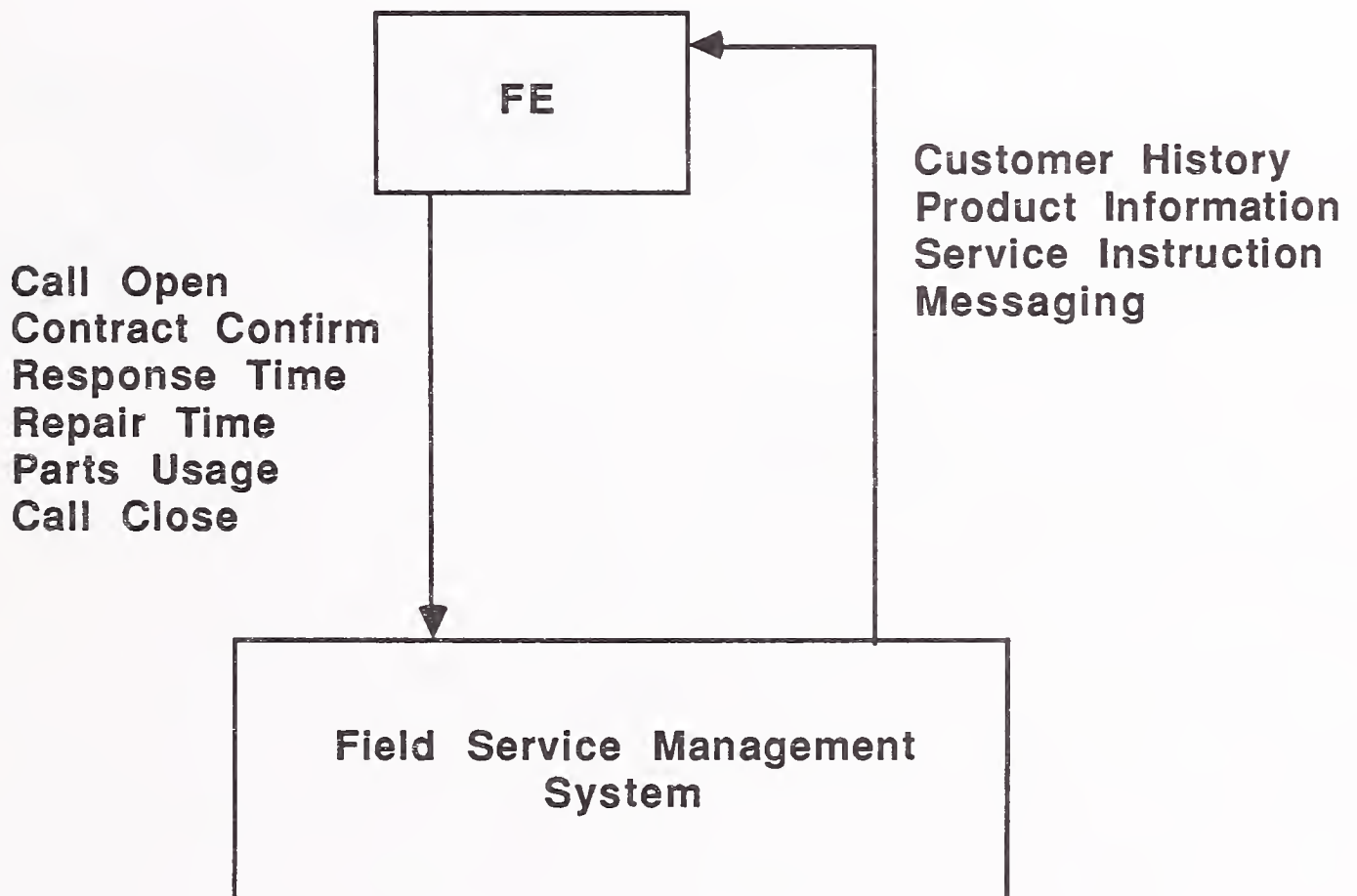
INPUT

EXHIBIT III-3

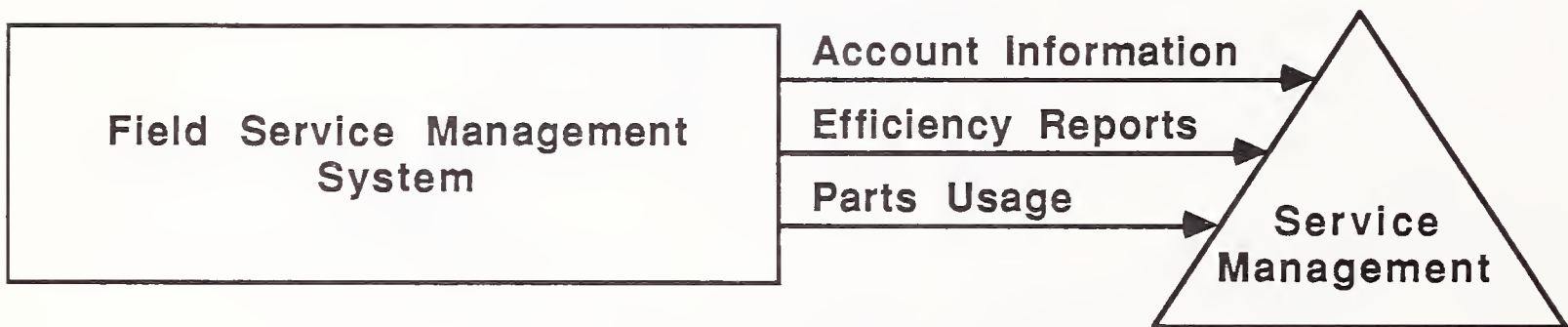# INFORMATION FLOW: FSMS TO MANAGEMENT

INPUT

EXHIBIT III-4

INFORMATION FLOW: FSMS TO CUSTOMER

INPUT
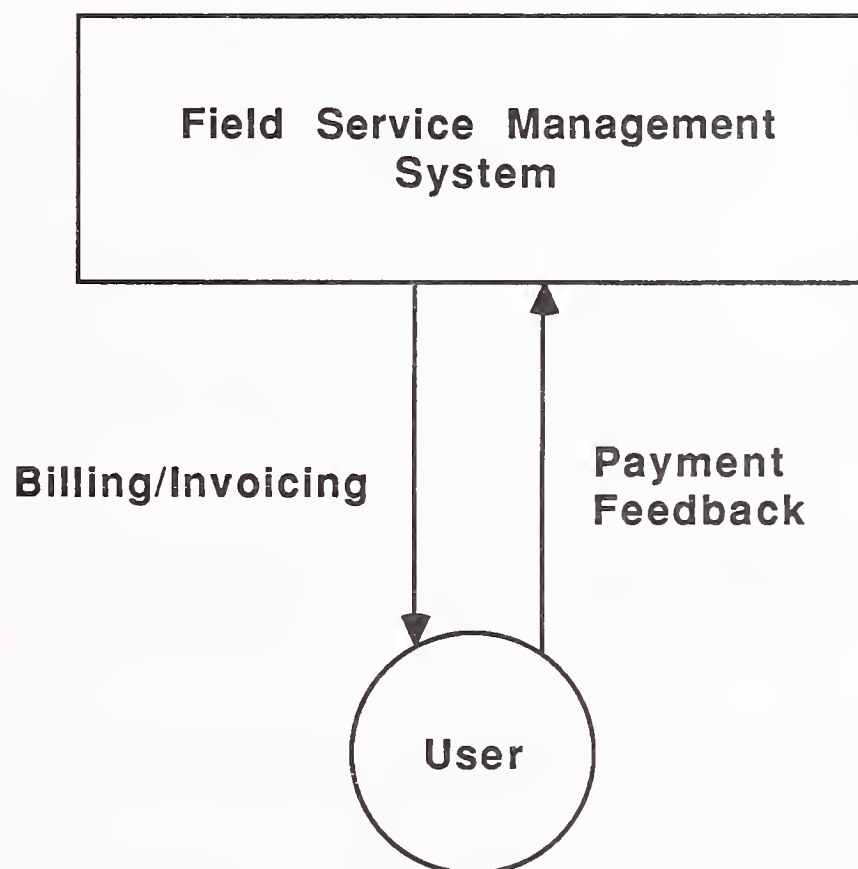
indirectly updates the data base by paying the bill. A rarely used aspect of the customer system interface is the systemized extraction of customer feedback through the system. Customers can be routinely queried concerning their satifaction with their product or service.

- Exhibit III-5 provides an overview of selected packaged FSMS software available to service organizations. This list is by no means exhaustive; rather, it fairly represents the most popular packages on the market.

- It should be noted that most larger service organizations have developed their own FSMS system in-house, as will be shown in Chapter IV. Exhibit III-6 presents the advantages and disadvantages of packaged FSMS software systems as compared to in-house systems. Perhaps the most sigificant benefit of in-house developed systems (other than the obvious advantage of customization) is the competitive edge perceived by service organizations toward their own system (TRW, for example, regularly offers tours of its facilities).

C.   HANDHELD TERMINALS

- As indicated above, the ability to communicate quickly and efficiently became a key objective in maximizing the amount of time that the FE is generating revenue. One way of meeting this objective was the adoption of state-of-the-art portable terminals. Not only have these terminals improved FE/management communications, but they also have improved the FE's ability to diagnose and effect repairs.

- Basically, a handheld terminal provides the following capabilities to an FE:

    - Small size, usually about the size of a cellular telephone.

    - Light weight, usually about a pound.

INPUT

EXHIBIT III-5

REPRESENTATIVE FSMS SOFTWARE PRODUCTS

Product	Vendor	Functions						# FE Support	# Install	Comments
		Account	Dispatch	Efficiency	Information	Parts	Diagnostics			
Field Watch	Data Group	●	●	●		●			23	Mainframe and mini-based
Service-TRAX	Combined Computer Resources	●	●	●		●		700+	5	Mini-based
SAFE	Sunmo Inc.	●	●	●		●	●		6	Mini- and Micro-based
Super Dispatch	Pacific Decision Sciences		●	●		●	●		3	
FSMS	Pacific Decision Sciences		●	●		●	●		2	
FSMS	Pinetree		●				●		NA	Primarily Handheld Terminal

INPUT

EXHIBIT III-5 (cont.)

REPRESENTATIVE FSMS SOFTWARE PRODUCTS

Product	Vendor	Functions						# FE Support	# Install	Comments
		Account	Dispatch	Efficiency	Information	Parts	Diagnostics			
Service Man	Ask Computer	●	●	●		●			30	Part of Mfr. SW Package
Alert System	Alert Computer Systems	●	●	●	●	●		800	35	Mainframe Mini Micro
Fastrak	Core Software		●	●	●	●		999		Optional Integration to Accounting

INPU

EXHIBIT III-6

ADVANTAGES/DISADVANTAGES OF
FSMS SOFTWARE

- Advantages of "Purchased" FSMS Software

    - Usually Cost-Effective

    - Faster, Easier Implementations

    - "Why Reinvent the Wheel?"

- Disadvantages of "Purchased" FSMS Software

    - Generic, "Rarely Fit All Needs"

    - Less Powerful

    - Usually Needs Some Level of Customization

    - Lose Competitive Edge

INPUT

- Compact, yet full-featured keyboard, usually with special function keys.

- Limited display with scrolling capabilities.

- Internal memory with plug-in memory expansion capabilities.

- Communications capabilities, either direct modem or acoustic-coupled.

- . Future expansion capabilities, e.g., printers, wand readers, etc.

• As discussed previously in Section A of this chapter, handheld terminals have replaced paper-based and telephone/radio-based dispatching activities, with dramatic improvement in responsiveness and repair times. Furthermore, handheld terminals, along with other service developments (such as increased modularity of computer design), have helped increase in-field performance of the engineering staff, helping to reduce labor costs and increase service profitability. In addition, use of these terminals reduces other service costs, such as dispatching force needed, parts-needed return trips, and, to a limited degree, no-fault-found calls. In the near future, handheld terminals will have a more direct affect on service delivery by adding to their diagnostic capabilities.

• One of the first companies to realize the benefits of handheld terminals was IBM with its Digital Communications System. The system is built around four-inch by eight-inch, 28 ounce terminals that are linked by an 800 MHZ two-way radio network. This system replaced a more cumbersome process in which a user called a coordination center, which had to locate and page an available local field representative, who would have to find a phone to call the coordination center to take the call.

- 30 -

- Instead, service calls can be directly sent to the service representative along with any pertinent site, customer, or service information. Furthermore, the terminals can be used by service representatives to request additional information from support centers or even other service representatives in the field. Service representatives use the system to order needed parts and to report parts use, thus speeding parts tracking and inventory control. Field management can use the system to plan and coordinate meetings and can query service representatives about calls in progress and past calls.

- A number of companies have entered the handheld terminal market. Exhibit III-7 provides a representative sample of leading vendors and their products. Note that most provide similar functionality with similar dimensions (the main difference between these products and the IBM portable terminal is the physical orientation--IBM's width is eight inches, while the competitions' length is eight inches).

- Future terminals will add greater communications and diagnostic capabilities. For example, a few systems currently offer bar code reader capabilities; however, the very nature of computer boards and components prohibit the use of present "wand" readers that might touch the board or component. Future readers will be laser-based, allowing the FE to read the ID code without physically touching the part. Scanning will greatly reduce the time necessary to enter the part number into the terminal.

D.   REMOTE DIAGNOSTICS/SUPPORT

- Remote diagnostics is defined as the ability to gain access to a computer from a point physically distant from the computer in order to perform problem determination activities. Typically, remote diagnostic activities were limited to telephone (dial-up) diagnosis performed by technical support personnel at the computer vendor's regional (or in some cases national) remote support

- 31 -

INPUT

EXHIBIT III-7

REPRESENTATIVE HANDHELD TERMINAL PRODUCTS

Manufacturer	Price	Dimensions (L X W X H) and Weight	Message	Scroll	Reader	Print	Comments
Pinetree Computer System Inc.							
MSI Data	$450-2,000.	7"x4"x1.5" 18 ounces	●	●	●		Add-on Printer
IXO, Inc.	$460.00	7"x4"x1" 1 lb.	●	●			Optional Printer
GR Electronics	$995.00	8.5"x6"x1.75"		●			Add-on Modem, Add-on Bar-Reader, Add-on Printer
Termiflex							

INPUT

centers, usually as an aid to on-site service personnel while the FE was on-site and also usually in response to the FE's request for assistance.

- Early remote diagnostics was faced with opposition from a number of sources. Field engineers felt threatened by the new technology, fearing that automation would eventually replace their jobs. Many users were also confused and hesitant to allow remote diagnostics for a number of reasons:

  - Confusion over remote pricing, since some vendors offered discounts for use of remote diagnostics, others charged premiums for use of remote diagnostics, and still others essentially charged premiums by requiring users to purchase special modems and software to run the diagnostics. The users recognized that vendors stood to gain from remote diagnostics and could not see why users should have to pay for the implementation of the technology.

  - Fear about the security of data, even in cases where remote access stopped at the controller level of the user's system and even after vendors would offer to sign statements defining and limiting use and access to the system.

  - Concern about losing the "warm fuzzies" associated with on-site service visits. Although users would be shown the increased system availability benefits of remote diagnostics, they would still fear a decline in overall support if remote diagnostics was adopted.

- Eventually, increased user requirement for 100% system availability coupled with a realization by users that remote diagnostics activities could help vendors hold down service prices overcame user opposition to remote diagnostics. Users saw improvements in MTTRepair, reductions in no-fault-found calls and return trips for parts, and increases in overall system availability. Furthermore, remote diagnostics became almost invisible to users, since newer systems would arrive with the technology already built-in.

- 33 -

INPUT

- Vendors also saw tremendous benefits in the implementation of remote diagnostics, all at a time when service costs are coming under increased observation. The technology had evolved to a point that implementation costs no longer prohibited the use in systems other than the large mainframes. Furthermore, remote diagnostics reduced the labor-intensiveness of providing hardware support by reducing the number of on-site calls necessary.

- Remote diagnostics also relieved service organizations of personnel shortages. Prior to remote technology, service organizations had to compete for trained field support personnel. This competition was increased as the third-party maintenance industry took off in the late 1970s and early 1980s. Increased use of remote diagnostics along with increased use of modular computer design allowed service organizations to use engineers with less experience, increasing the available supply of service personnel and reducing the overall service salary level.

- Almost all computer manufacturers have incorporated remote diagnostic capabilities into their new computer systems; however, industry giant IBM is thought to be the first to incorporate remote diagnostics into its service dispatching system. In 1978, IBM introduced the first remote support center for the 8100 (small) Information System, and in 1979 furthered its involvement with the 4300 family of minicomputers.

- Currently, IBM's newest mainframe product, the 3090 family, utilizes a separate diagnostics and support processor (the 3092 Processor Control) that monitors all key aspects of the 3090's operation, including power, cooling, circuits, and all field replaceable units (FRUs), such as thermal conduction modules (TCMs), boards, cards, and cables. Error and system status information is stored on a pair of dedicated 3370 disk drives that can be accessed remotely from regional support centers. Support tecnicians at the support centers can instruct the system to perform additional diagnostic routines, if necessary. The system can also create a log of all problems, as well as reports on all "unrecoverable" failures.

INPUT

- Another company that has advanced the use of remote diagnostic (and support) technology is Stratus Computer, Inc., a manufacturer of fault-tolerant computer systems. Stratus' strategy slightly differs from standard industry philosophy of service by emphasizing user involvement in service, augmented by heavy reliance on remote support (Stratus dubs this approach RAU, short for "remote support," "automatic dial-out," and "user-service-ability"). Stratus operates two Customer Assistance Centers (CACs) domestically which are connected to customer sites and each other via a dial-up Remote Support Network (RSN). These support centers (which are not manned around-the clock; off-hour coverage is handled by paged personnel), can receive support communication automatical from the system or by customer-instigated communication. CAC personnel then can perform remote diagnostics, downline transmit files with new code (for software problems), or respond to electronic mail-transmitted requests for support of a less urgent basis.

- Another strength of Stratus' system is call management, which is handled through the RSN and logged at each CAC. Depending on the problem (as diagnosed remotely), either a replacement part is shipped overnight or a Stratus engineer is dispatched to provide on-site support. Since Stratus systems are designed using redundant architecture, immediate response times are almost always unnecessary.

- A further benefit of Stratus' support strategy is that the reduced cost of providing support is transferred to the user. Users can opt for any of three service packages at various prices:

  - Users who agree to perform most routine part replacements pay 3.5% of list price per year.

  - Users who agree to swap out "easy" parts (PCBs, terminals, etc.) but leave more complex parts (disks, tapes, power supplies, etc.) to Stratus

- 35 -

INPUT

pay 6.5% of list. Stratus reports that 90% of all Stratus users opt for this "co-active" service arrangement.

- Users who prefer to avoid participation in support can opt for traditional vendor-supplied maintenance at 10.5% of list.

- The use of remote support has already shown tangible improvements. IBM, for example, has found that 84% of incoming calls for software support are now capable of being handled over the telephone rather than on-site and that most of these are solved in less than 30 minutes. Data General, another company that has successfully incorporated remote support into its high-end mini-computer line, reports 20-25% decreases in service incidents while solving 75% of problems over the phone. Data General lists additional benefits of remote support:

  - Reduced direct labor costs as more expensive on-site FEs have been replaced with remote support center technicians.

  - Improved response times to customers, many of whose problems can be solved instantly by the system or over the phone.

  - Better management of spares with better accessibility since FEs are now freed from having to carry all possible spares with them.

  - Better time management of service staff through reduction of no-fault-found and spare-part-needed calls.

  - Decreased cost of outfitting FEs, not only with spares, but also with diagnostic and service tools and equipment.

  - Reduced training costs, allowing more focused training on specific systems and routines.

- 36 -

INPU

# IV USER REQUIREMENTS FOR AUTOMATED SERVICE DELIVERY

A.   OVERVIEW

- In this chapter, the results of detailed interviews with the service organizations from both manufacturers and independent third-party maintenance companies are analyzed. The focus of this sample is weighted toward larger service organizations (the smallest respondent was Total Technical Services, an $18 million TPM), accounting for the preponderance of in-house developed systems in the sample. However, the functional needs of these larger service organizations are no different than smaller organizations, other than the scale of their resource management requirements and their ability to allocate costs. Hence, the sample reflects the needs of all service organizations. The report will attempt to comment on any differences where size or type of service organizations might cause some variance.

- Exhibit IV-1 graphically demonstrates the overwhelming preponderance of in-house developed systems, used by 14 out of the 16 service organizations surveyed (88%). The reasons behind this include:

    - The size and scope of the information handling needs.

    - The ability to customize the system to each company's precise needs.

    - The importance of the system as a "competitive edge."

- 37 -

INPUT

EXHIBIT IV-1

SOURCE OF FSMS

**Purchased from
Software Vendor**

12%

**Developed
In-House
88%**

Sample = 16

INP
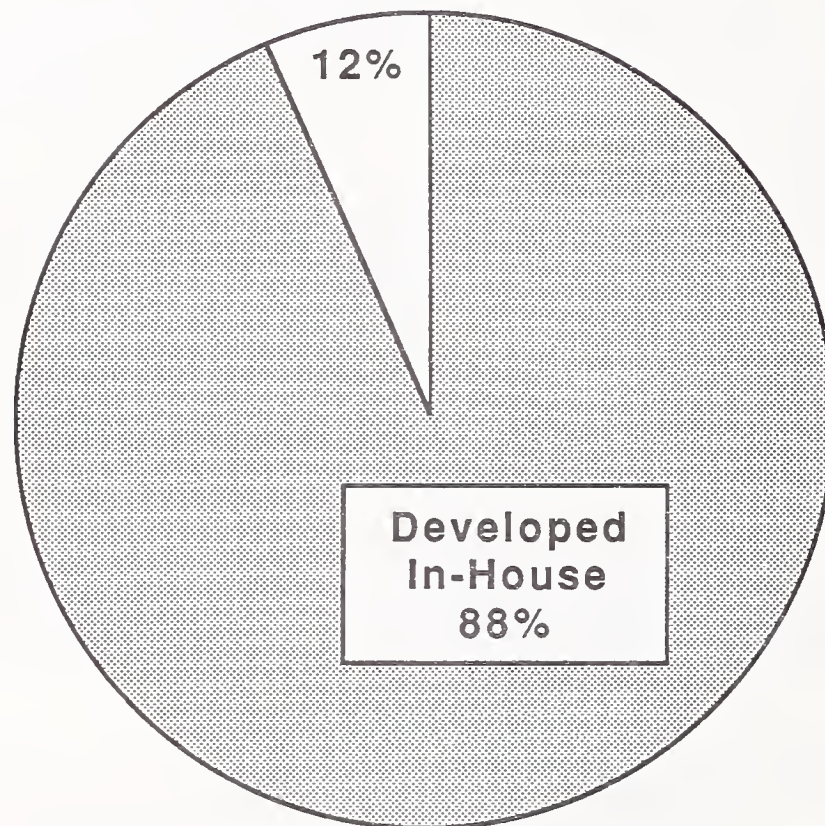
- Smaller service organizations would be much more likely to use "packaged" software solutions. First of all, their information handling needs (in terms of customers and FEs) would be smaller in scale to the size of their company. In addition, their financial resources usually would be insufficient to warrant in-house development of such a system, making the packaged system a more economical solution (a typical comment--"Why reinvent the wheel?").

- As smaller service organizations' needs grow, packaged systems usually allow some level of customization as most packages available are modular in nature. When a service organization wants to add a new function (e.g., accounting), all they need to do is add that module.

- Exhibit IV-2 demonstrates that most FSMS systems are located at centralized locations, which is understandable due to the fact that most users of the information provided by the system would be at the headquarters level.

- Not surprisingly, almost all service organizations place the highest requirement on traditional service management functions, as shown in Exhibit IV-3, specifically parts tracking, dispatching, and informational (e.g., customer histories). Also not surprisingly, most service organizations' systems satisfy these functional requirements.

- What is surprising is the low requirement that service organizations place on accounting functions, such as billing. This low requirement was supported by the fact that only 56% of the responding service organizations receive accounting support from their system. This low use of accounting functions is confusing, given the large (89%) number of organizations that use their system to maintain customer histories. What this suggests is that service organizations prefer to leave accounting and billing functions outside of their responsibility.

INPUT

EXHIBIT IV-2

LOCATION OF FSM SYSTEM

Regionalized
6%

Decentralized
6%

Centralized
88%

Sample = 16

INPU
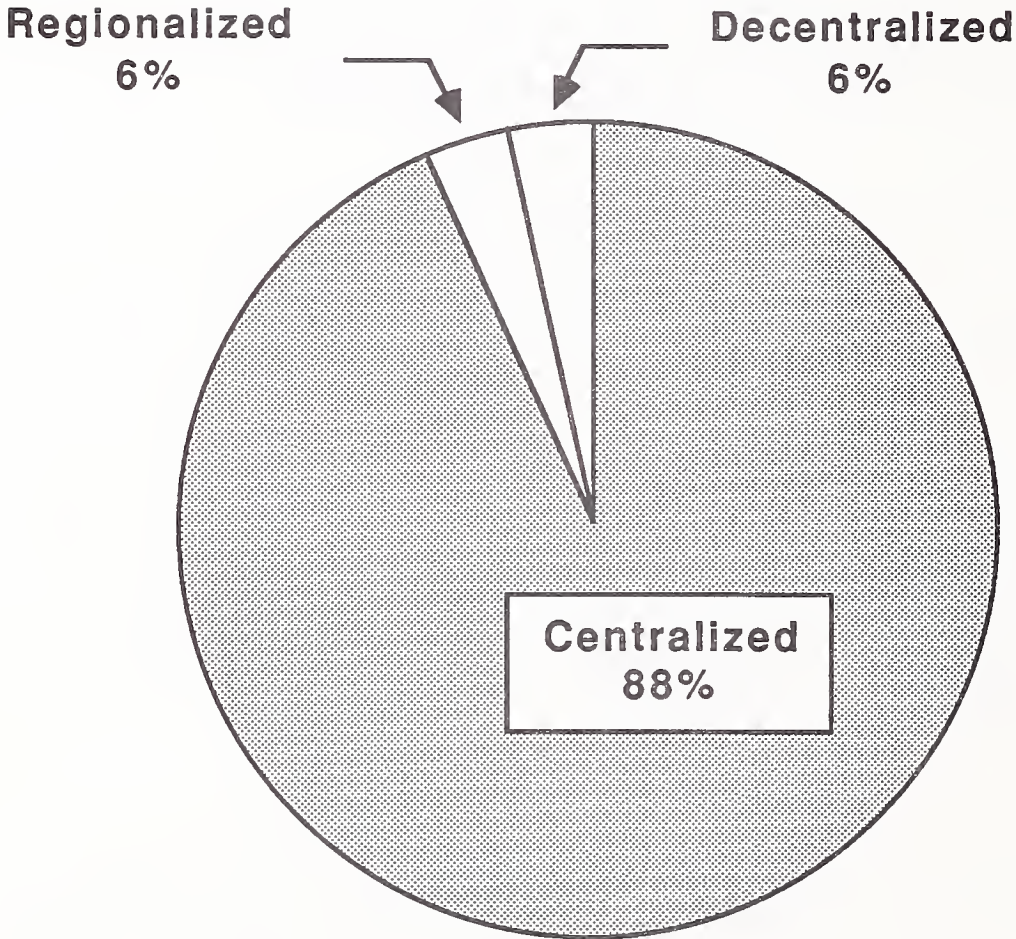
EXHIBIT IV-3

FSMS FEATURE PRIORITIES

Rank	Service Function	Requirement*	% Receive
1	Parts Tracking	8.1	83
2	Dispatching	7.4	78
3	Informational	6.8	89/72[1]
4	Accounting	6.3	56
5	Manpower Studies	6.1	72
6	Service Implementation	5.2	28
7	Diagnostics	5.1	28

Requirement scale: 1 2 3 4 5 6 7 8 9 10

* Requirement rating 1=low 10=high

1. Customer History / Product Information

Sample: 16 Service Organizations

INPUT

- The sample also placed low requirement on manpower studies; however, almost three-quarters of the respondents reported that they received some form of manpower report from their system.

- The results of this question reflects the limited integration of service management functionality present in today's systems. While most systems provided logistic support (dispatching, call handling, parts tracking, and inventory control), only half (56%) incorporated accounting and almost none (28%) provided remote support capabilities. These functions undoubtedly are automated in all of these companies (assuming, of course, that the company has remote support capabilities); the important point is that the use of multiple systems (and presumably multiple data bases) does not maximize efficiency.

B.   CASE STUDIES

- In the following section, INPUT will present case studies of selected service organizations and their experiences and needs concerning automated service delivery. The six companies were selected on the basis of the uniqueness or extent of their automation.

I.   AMDAHL CORPORATION

- Amdahl is a leading vendor of IBM plug-compatible mainframes and related products, having installed its first system (470 V/6) in 1975. In 1986, Amdahl sales were $966 million, with an estimated $200 million coming from customer services. Amdahl employs 750 hardware and software support engineers in the U.S.

- Service is delivered to Amdahl contract customers around-the-clock, seven days a week. While Amdahl does not contractually guarantee response times,

INPUT

INPUT studies demonstrate that Amdahl users report reponse times of one hour or less. Much of Amdahl's success is attributed to remote support delivered through Amdahl's worldwide remote support network called Amdahl Diagnostic Assistance Network (AMDAC). AMDAC provides hardware and software support to users of all Amdahl equipment. In addition, Amdahl systems have a built-in console processor that facilitates on-site diagnosis of system problems.

- Amdahl currently runs its current (in-house developed) system on an Amdahl 5890 system located at a central location. The system does not provide dispatching and call handling (a separate manual system satisfies that need) but does provide parts tracking, customer and product histories, invoicing and accounting capabilities, manpower efficiency reports, messaging, and training instructions to the remote support technician.

- Amdahl uses a separate system running on a 5890 to automate remote support and hopes to link all systems within the next two years. Amdahl's long-range goal is to have a single integrated, closed-loop system that tracks and stores service information, accessible by the FE through data collection terminals with intelligence at a higher level than current handheld terminals. As with many companies, Amdahl's goal is to move from "reactive" maintenance to "predictive" support.

- It should be noted that Amdahl's selection of parts handling as a starting point for service automation is not surprising given the extremely high cost of replacement parts of its systems. Amdahl also makes use of overnight express companies for the distribution (and, in effect, storage) of these high-priced spare parts. It becomes most critical for a company like Amdahl to assure the most effective use and storage of these critical spares.

- 43 -

INPUT

2.   DATA GENERAL CORPORATION

- Data General (DG) maufacturers a wide range of products in the small
  systems market, ranging from low-end laptop micros up to high-end super-
  minicomputers (such as the new MV/20000). Total revenue for 1986 was $1.3
  billion (up 2% over 1985), with service revenues of $399.7 million (up 22%).
  Weak sales forced DG to make a number of organizational moves, including
  layoffs and consolidation of a number of product and support groups. Field
  engineering was not left untouched, as all North American hardware and
  software phone support was consolidated at the Norcross (GA) facility. Depot
  repair and logistics functions were also consolidated at the Fountain (CO)
  location.

- As might be expected from a company with a wide range of products, DG
  offers support services to its users in a wide range of offerings. Customers
  can receive on-site support (dispatched from DG's centralized facility in
  Georgia) with their choice of 9- through 24-hour coverage, remote support (on
  newer high-end systems), depot service (from DG's new Colorado facility), and
  time-and-material service. DG provides on-site software support to users
  under contract in addition to telephone access to software problems data
  bases.

- DG currently uses two separate service automation systems, both of which
  were developed in-house. The first, Customer Dispatch System (CDS), handles
  all call handling and dispatching functions as well as messaging, product
  information, manpower efficiency reports, invoicing, and P&L reports. A
  second companion program, FACTS, handles all field accounting of spare parts
  use and location. There is no link currently between the two systems;
  however, DG hopes to integrate the two systems within the next two years.

- DG also hopes to add a problems data base accessible by the field engineer
  within the next few months. Currently, a different system provides
  computer-aided instruction (CAI) to the field support staff to assist with

- 44 -

INPU

training. In addition, DG is implementing a new contracts module to the system within the next month.

- DG, along with most other service organizations, sees the growing importance of gaining tighter controls over the costs involved with delivering service to its customer base. DG recognizes the decline in the labor content of service and the increase in the costs of parts. However, DG also emphasizes the dispatching and call handling functions within its systems, since that is the first part of service that a user sees.

- In the future, DG hopes to implement a real time system that provides machine-to-machine interface. The system will collect information about performance, analyze data, identify exceptions, and report these exceptions to the service organization. Along with this emphasis on predictive service, DG sees the future system to provide more preventive support with fault isolation capabilities as well as fault discovery.

3.   DATASERV COMPUTER MAINTENANCE

- Dataserv Computer Maintenance, a division of Dataserv, Inc., is a $50 million third-party maintenance (TPM) that specializes in the maintenance of large IBM systems, as well as the sale of spares and refurbishment services. Atlanta-based Bell South Corporation, a regional Bell operating company, recently announced plans to acquire Dataserv Computer Maintenance division's parent for a reported $96.5 million in stock.

- Dataserv offers service out of 32 cities in the U.S., dispatching an estimated 350-400 engineers on-site to customers' locations (70% of Dataserv's customers receive on-site maintenance service). Dataserv dispatches these engineers from a centrally located (Edan Prairie, MN) dispatch center, using a purchased system from Soft Solutions (Minnetonka, MN). The system, called Field Facts, can support up to 500 engineers; nonetheless, Dataserv felt it necessary to modify the system for its own use. The system currently runs on Dataserv's IBM System 36 minicomputer.

INPUT

- The system now provides dispatching and call management, messaging, part management, site histories, product information, invoicing and other accounting functions, and manpower efficiency reports. A separate accounting system provides P&L reports.

- As a TPM, remote support functionality is currently not a high priority at Dataserv. Instead, Dataserv places the highest requirement on more traditional service management functions, such as dispatching, parts tracking, and accounting. Dataserv hopes to integrate the P&L function into its system in the near future.

- Dataserv is typical of medium size TPMs. It has a growing need to efficiently track resources (manpower, spares), yet insufficient resources (money) to develop a system completely in-house. As a result, a service organization such as Dataserv's (or First Data Resources, which chose a packaged system (Super Service) from Pacific Data Science Corporation (Los Angeles, CA) to supplement one purchased from McDonnell Douglas called Sitrack System) looks to an existing solution to their automation need. And as the complexity of resource handling needs grows, the service organization can either add additional functionality (if the product is modular in design), customize the package through additional programming (either in-house or in conjunction with the software vendor), or replace the package completely with their own in-house solution.

4. DIGITAL EQUIPMENT CORPORATION

- Digital Equipment Corporation (DEC) is a manufacturer of a wide range of small systems, ranging from microcomputers to clustered superminicomputers (such as the new VAX 8XXX series) that compete with traditional mainframes. While many companies have struggled in the recent slump in the computer industry, DEC has flourished with total revenue growth of 13.5% (1986 revenues were $7.6 billion, up from $6.9 billion), while service revenue

- 46 -

grew to $2.6 billion (up 22% over 1985). DEC has relied on developments in its VAX lines, as well as IBM's difficulties in the small systems market (where DEC's compatibility within its own product line is seen as a major advantage).

- DEC consolidated hardware and software support functions by combining Software Products Services with the Field Service division. This consolidation is shown in the Customer Support Center (CSC), opened in Colorado in April of 1986. The center (one of 14 worldwide) is responsible for remedial and advisory support for both hardware and software customers throughout the U.S. During 1986, the CSC fielded over one million calls from 56,000 customer contacts.

- The CSC runs three shifts per day (two shifts on weekends) providing around-the-clock coverage from 130 hardware specialists, 300 software specialists, and 110 customer response representatives. Services provided to DEC customers include system problem analysis, preventive hardware services, advisory software services, remote software remedial support, network monitoring and support, DEC support remote delivery, and Digital Software Information Network (a problems data base), also known as DSIN.

- The CSC also provides a wide range of services to internal DEC service employees, such as remote hardware support to FEs, technical backup to hardware engineers and software support specialists in the field and at DEC support locations, remote sales support, Software Performance Report (SPR) screening, and library screening.

- DEC's development of automated service delivery is also demonstrated in its use of remote diagnostics and support delivery. All VAX systems can run diagnostics through the VAX Integrity Monitoring System (VAXSIM), which allows predictive maintenance by monitoring system performance, catching and storing intermittent and more critical system interruptions and signalling before threshhold levels occur. All VAX users receive this support (in fact, a user pays a 15% surcharge to not run remote support).

- 47 -

INPUT

- DEC has also developed an artificial intelligence (AI) tool for tracking and interpreting failure data called Standard Package for Error Accounting and Reporting (SPEAR). This tool provides an analysis of the system based on a data base of potential problems and their indicators and provides to the support staff three potential problems, ordered by the degree of likelihood. Again, the basis of this system is to provide fault identification prior to catastrophic failure, allowing scheduled replacement of the problem hardware or software.

- DEC also utilizes a problems data base known as STARS, which contains over 11,000 technical articles about DEC hardware and software products, accessible by DEC support personnel, and, at a reduced level, to users through DISEN.

- The goal of service automation at DEC is to provide "predictive" service and support to a customer base that is demanding less downtime on increasingly complicated systems (and networks of systems). Parts are becoming increasingly expensive, and with rapidly decreasing product life cycles (in the past, product life cycles were 3-5 years, now, they are 18 months, and soon they will be 12 months or less), the need to control costs is an extremely high priority. This priority is further illustrated by the change in cost structure at DEC:

  - In 1980, labor (and associated overhead) represented 49% of all costs, with the remaining 51% coming from materials (and their associated overhead).

  - In 1985, labor shrank to 40%, while materials grew to 60%.

  - By 1990, labor is expected to shrink to 33%, while materials will grow to 67%.

INPUT

5.   STRATUS COMPUTER, INC.

- Stratus is a manufacturer of fault-tolerant computer systems, attractive to those with extremely high-system availability requirements. The basic design involves multiple processors and self-run diagnostic routines that identify potential and real-system errors and automatically switch to a back-up device, hence achieving fault tolerance.

- Stratus has been shipping products since 1982 and has grown to become a $125 million company in 1986, second only to Tandem in the fault-tolerant market. It should be noted that IBM markets a Stratus system as its System/88.

- Obviously, the degree of fault-tolerance at Stratus affects the service delivery for users. Stratus offers three low-cost service offerings made possible by the system's basic design and the degree of remote support implemented by Stratus. Users can opt for various levels of "co-active" support at contract prices that range from 3.5% to 10.5% of system purchase price, depending on the amount of customer and vendor involvement.

- Even though fault-tolerance lessens the burden on the support organization, at least in terms of response and repair times, Stratus recognizes the need to efficiently manage resources, particularly those that involve spare parts. Stratus developed its own system in-house that handles dispatching and call handling, spare parts tracking, customer and product histories, and customer billing. Stratus hopes to add a customer-accessible problems data base within the next two to three months.

- Remote support and implementation are highlighted in the system, running on all systems locally yet controlled from Stratus' central location. Stratus placed the highest priorities on remote support, parts tracking, and product information data bases.

INPUT

- Stratus is moving toward systems-run support implementation, with the systems becoming increasingly involved in failure identification, isolation, and correction. Stratus also sees the role of the user increasing in the support of their own systems. Users will become increasingly involved in the replacement of boards and subassemblies. The role of the FE will then evolve to that of a "coordinator," handling the customers needs by assuring that the proper parts and technical assistance are available.

6. SUN MICROSYSTEMS, INC.

- Sun Microsystems is a leading supplier of 32-bit workstations to the engineering, scientific, and technical markets. In June 1986, Sun established Customer Service as a separate division, doubling the number of on-site field support staff (from 50 to 100) and increasing the number of sales and support locations by 12.

- Each support location maintains a certain level of spares; however, the central service location in Milpitas (CA) acts as the national parts depot. The company currently uses ASK Computer's MANMAN/SERVICEMAN service management software system running on a HP 3000 located at the Milpitas location. SERVICEMAN provides call handling and dispatching, parts tracking and inventory, and customer and product histories. SERVICEMAN can run as a standalone product (Sun uses it as such); however, the program was designed to run best as an integral part of ASK's MANMAN integrated manufacturing software system. Therefore, such functions as billing (which requires interface with MANMAN/OMAR) and accounting (which requires interface with MANMAN/GL) are not handled by SERVICEMAN.

- Thus, Sun's level of satisfaction with SERVICEMAN is diminished by the perceived lack of "completeness" of functionality. As a result, Sun is currently developing a system in-house that will provide a more complete FSMS solution to its needs. A primary focus of the system will be to better manage the "business" aspects of service, specifically P&L control, invoicing,

- 50 -

INPU

and accounting reporting. Furthermore, Sun recognizes that its needs are increased as they expand their service coverage.

- In the long term, Sun hopes to increase the automation of service delivery by building on its development of local and remote diagnostics. One specific long-range goal is to implement use of remote (handheld) terminals for call-close purposes.

INPUT

V CONCLUSIONS AND RECOMMENDATIONS

A. THE "IDEAL" SYSTEM

- When building a "wish list" of features and functionality desireable in a "perfect" automated service system, it would be too easy to fall victim to "gee whiz" technology and "pie-in-the-sky" goal-setting. Instead, it is the objective of this section to present in principle a system that is available today without stretching the limits of currently available technology, keeping in mind the basic strategic thrust of providing service efficiently and effectively in such a manner that meets or exceeds customer needs while still satisfying corporate profit goals. Exhibit V-1 summarizes such a system.

1. FIELD SERVICE MANAGEMENT SYSTEMS

- Currently available software/turnkey systems designed to automate basic service management are extremely capable already. Most large organizations prefer to use their own in-house developed systems; however, packaged and in-house systems are relatively similar in design and functionality:

    - Almost all systems provide dispatching and call management capabilities with problem escalation and parts usage/tracking functionality.

    - Almost all systems provide some level of accounting capability, such as billing, efficiency reporting, and P&L analysis.

- 53 -

INPUT

EXHIBIT V-1

FUTURE FSMS FUNCTIONALITY

- Accounting (Including Invoicing)

- Call Handling/Dispatching

- Efficiency Reports

- Information (e.g., Customer Histories)

- Parts Tracking

- Training Utilizing CD-ROM and CAI

- Remote Diagnostics

- Remote Service Implementation

INP

- Most provide some level of integration, allowing the use of one central data base that can provide a wide range of informational reporting capabilities, such as customer and product histories.

• Unfortunately, few systems, whether packaged or in-house developed, excel at integrating remote support activities. Less than half of the packaged software systems surveyed provided diagnostic capabilities (and most of these were relatively crude diagnostics, at that) and less than 30% of the in-house systems sampled provide any remote support integration (typically, these capabilities were managed through a separate system). Again, if the goal of automating service delivery is to cut down on expensive, labor-intensive activities, then the implementation and integration of remote support services with the service management process is a necessity.

• A likely service call scenario would then be as follows:

  - A system interruption occurs, and, depending on the level of remote support used, either the system begins servicing itself, or the system alerts either the user or a remote support center technician.

  - If the system itself cannot overcome or circumvent the problem, an on-site FE is dispatched automatically with information about the user, equipment, problem, parts necessary, and relevant service information.

  - Upon service completion, whether remotely performed or completed on-site by the FE, the call is closed out, automatically updating the FSMS central data base.

• A clear-cut benefit of this capability is that all service information and activities are tracked and stored in one location, increasing the number and scope of reports possible. For example, this type of system would not only be able to track system interruptions but also the number of interruptions handled by remote support versus on-site and the MTTRepairs resulting from both support methodologies.

INPUT

- An area of tremendous potential benefit to service and support is artficial intelligence (AI) and expert systems (ES). Basically, AI is a duplication of processes by which humans perceive and assimiliate data and use reasoning to process this data. For most purposes, this duplication is performed so that computers can make decisions based on reasoning. Expert systems are advanced applications of AI processes, usually involving software that permits inferences based on inquiries made to a central data base. In such applications, emphasis is placed on the machine's ability to recognize and identify patterns and make decisions based on those pattern recognitions. Exhibits V-2 and V-3 summarize the benefits of AI and expert systems.

- In service, AI and expert systems can be effectively used to supplement on-site and remote diagnostics. Such systems are already being used in similar, diagnosis-intensive industries (e.g., medicine, engineering, and science) and can easily incorporate currently available service histories contained in most FSMS systems.

- Although opponents of increased automation point to concerns from FEs who fear that such systems will replace human thought, the use of AI and expert systems will free human thought of more routine activities and concentrate on intrepreting the system's analyses. Specifically, use of such systems will free FEs from constant retraining on new equipment and allow the FE to concentrate more on customer interface skills.

- Many service organizations have already incorporated (or at least studied) the application of AI into their service strategy. IBM has reported productivity improvements of 20-30% in limited applications of expert systems in servicing peripheral products. Texas Instruments has been actively experimenting with AI applications for at least four years and hopes to be able to incorporate AI into its own FSMS system, Field Information System-II (FIS-II). General Electric offers an expert system for railroad locomotive maintenance and will soon release a similar system for jet engine maintenance. Tektronix offers a

- 56 -

INP

EXHIBIT V-2

ARTIFICIAL INTELLIGENCE

- Expert Systems

- Intelligent Computer-Aided Instruction

- Pattern Recognition

- Voice Recognition

- Robotics

INPUT

EXHIBIT V-3

EXPERT SYSTEMS

- Advanced AI Application

- Permit Inferences Based Upon DB Inquiries

- Employ Symbolic Representations

- Use Heuristics Search Methodology

- May Provide "Fall-Back" Problem Resolution

- Present Recommendations and Explain Why

less developed system for peripheral diagnostics that acts as a service tutorial, recommending specific service activities.

2.   HANDHELD TERMINALS

- While handheld terminals have been used specifically by service organizations for only a short time, the development of such tools has been aided by technological advances in microprocessor design that resulted in more computing and communications capabilities. The current products seem to be the best compromise between portability and functionality; however, future products will undoubtedly improve upon the size/functionality mix.

- Key improvements will be in the data entry aspects of the terminals. An obvious requirement of these terminals is to avoid having the FE spend significant amounts of time entering data into the terminal, which in effect equates to a highly skilled, highly paid engineer (functionally) replacing a data entry clerk. Previous terminal designs have avoided this by requiring coded responses and scrolling capabilities to lessen the amount of keyboard entry. Some systems have supplemented these with bar code, or wand reader expansion capabilities, yet the current technology which requires the reader to touch the coded part, assembly, or subassembly cannot be used for most service applications for fear of magnetic or other contamination concerns.

- Instead, advances in laser technology will allow FEs to use a wand reader to pick up part, board, subassembly, and assembly numbers with little fear of magnetic or dust contamination.

- Furthermore, future handheld terminals will improve their integration with the computer system's diagnostics function, improving problem determination activities. This ability will be further improved if the terminals incorporate artificial intelligence or expert systems capabilities.

INPUT

3.   REMOTE DIAGNOSTICS/SUPPORT

•   Remote diagnostics have provided the greatest amount of service advance-
     ment in the past few years. Most current systems have incorporated some
     level of diagnostic capability, and the more advanced systems have expanded
     the level of remote activities available to that of actual support implementa-
     tion. This capability is more common on the software side, with downline
     loading of software "fixes" the most economically accceptable of providing
     prompt problem resolution to the users.

•   On the hardware side, such remote support implementation is more commonly
     associated with multiprocessor and "fault-tolerant" systems, where a failed
     board, component, or even processor can be circumvented until replacement
     of the failed unit can be scheduled. In this fashion, support becomes less
     reactive as the scheduled replacement occurs prior to catastrophic system
     failure and at a time that least impacts the operations of the system.

•   Future remote support technology will certainly benefit from AI and expert
     systems applications as more companies follow the lead of IBM and Digital
     Equipment Corporation in developing automated tools to aid in the diagnosis
     and repair of computer systems.

- 60 -

INPUT

Appendix A: Questionnaire

1. Was your current service management system developed in-house or purchased from another source?

   a. in-house

   b. purchased from SW vendor _____ specify _____

   c. purchased from another source _____ specify _____

2. Does your system provide the following features:

   a. dispatching / call management   _____

   b. messaging   _____

   c. parts tracking / inventory   _____

   d. customer / site history   _____

   e. product information   _____

   f. billing / invoicing   _____

   g. other accounting functions   _____

   h. manpower efficiency reports   _____

   i. P & L analysis   _____

   j. diagnostics   _____

   k. training (service instructions)   _____

   l. support implementation   _____

3. If the system provides diagnostic capabilities, are they:

   a. user-run   _____

   b. FE-run   _____

   c. remotely-run   _____

   d. system-run   _____

4. Please describe the level of diagnostics performed _____

   _____

   _____

INPUT

5. Is your system centralized, regionally located and operated, or decentralized (at office level)?

    a. centralized   _____

    b. regional   _____

    c. decentralized   _____

6. Please rate your requirements for the following functions of an automated service management system (on a scale of 1-10, 10=highest):

	Requirement
a. dispatching	_____
b. parts tracking	_____
c. accounting (inc. billing)	_____
d. informational (e.g., site / product histories)	_____
e. training / service instruction	_____
f. manpower / office studies	_____
g. diagnostics	_____
h. service implementation	_____

7. How would you describe the "ideal-type" (future) service management system?

_____

_____

_____

_____

_____

- 62 -

INPUT

APPENDIX B: DEFINITIONS

- <u>APPLICATIONS SOFTWARE</u> - Software that performs processing to service user functions.

- <u>ARTIFICIAL INTELLIGENCE</u> - The academic discipline involving the study of the processes by which humans perceive and assimilate data (and use reasoning to process this data) for the purpose of duplicating these processes within computer systems. Also, this term refers to the computer systems that accomplish these duplicated processes.

- <u>BOC</u> - Bell Operating Company.

- <u>CONSULTING</u> - Includes analysis of user requirements and the development of a specific action plan to meet user service and support needs.

- <u>DISPATCHING</u> - The process of allocating service resources to solve a support-related problem.

- <u>DIVESTITURE</u> - The action, stemming from antitrust lawsuits by the Department of Justice, which led to the break-up of AT&T and its previously owned local operating companies.

- <u>DOCUMENTATION</u> - All manuals, newsletters, and text designed to serve as reference material for the ongoing operation or repair of hardware or software.

- 63 -

INPUT

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

- <u>EXPERT SYSTEMS APPLICATIONS</u> - Applications for expert systems--a computer system based on a data base created by human authorities on a particular subject. The computer system supporting this data base contains software that permits inferences based on inquiries against the information contained in the data base. Expert systems is often used synonymously with "knowledge-based systems," although this latter term is considered to be broader and to include expert systems within its scope.

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

- <u>ENGINEERING CHANGE ORDER (ECO)</u> - The followup to ECNs which include parts and a bill of material to effect the change in hardware.

- <u>ESCALATION</u> - The process of increasing the level of support when and if the field engineer cannot correct a hardware or software problem within a prescribed amount of time, usually two to four hours for hardware.

- <u>FIBER OPTICS</u> - A transmission medium which uses lightwaves.

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

  <u>FIELD SERVICE MANAGEMENT SYSTEM (FSMS)</u> - A specialized application program that automates some (if not all) of the following activities of a field service organization: call handling, dispatching, parts inventory and tracking,

INPUT

billing, efficiency reporting, and other functions. Ideally, the system accesses one data base from which each function can use and modify data.

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

- ISDN - Integrated Services Digital Network. A proposed standard for digital networks providing transport of voice, data, and image using a standard interface and twisted pair wiring.

- LADT - Local Area Data Transport. Data communications provided by the BOCs within local access transport areas (LATA).

- LARGE SYSTEM - Refers to traditional mainframes including at the low end IBM 4300-like machines and at the high end IBM 308X-like machines. Large systems have a maximum word length of 32 bits and a standard configuration price of $350,000 and higher.

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

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

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

- MICROCOMPUTER - A microprocessor-based single- or multi-user computer system typically priced less than $15,000. A typical configuration includes an 8- or 16-bit CPU, monitor, keyboard, two floppy disk drives, and all required cards and cables.

INPUT

- <u>MINICOMPUTER</u> - See Small System.

- <u>OPERATING SYSTEM SOFTWARE (SYSTEMS SOFTWARE)</u> - Software that enables the computer system to perform basic functions. Systems software, for the purposes of this report, does not include utilities or program development tools.

- <u>PBX</u> - Private Branch Exchange. A customer premises telephone switch.

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

- <u>PLANNING</u> - Includes the development of procedures, distribution, organization, and configuration of support services. For example, capacity planning, "installation" planning.

- <u>PLUG-COMPATIBLE MAINFRAME (PCM)</u> - Mainframe computers that are compatible with and can execute programs on an equivalent IBM mainframe. The two major PCM vendors at this time are Amdahl and National Advanced Systems.

- <u>PROFESSIONAL SERVICES</u> - A category services including system design, custom programming, consulting, education, and facilities management.

- <u>RBOC</u> - Regional Bell Operating Company. One of seven holding companies coordinating the activities of the BOCs.

- <u>REMOTE DIAGNOSTICS</u> - Gaining access to a computer from a point physically distant from the computer in order to perform problem determination activities.

- 66 -

- **REMOTE SUPPORT IMPLEMENTATION** - An extension of remote diagnostics where some level of support delivery is performed from a point physically distant from the computer. Currently, this capability is more common to software support where problems can be solved or circumvented through downline loading of new code (fixes).

- **RESELLER** - A marketing organization which buys long-distance capacity for others at wholesale rates, selling services at retail but discounted prices and profiting on the difference.

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

- **SMALL SYSTEM** - Refers to traditional minicomputer and superminicomputer systems ranging from a small multi-user, 16-bit system at the low end to sophisticated 32-bit machine at the high end.

- **SOFTWARE DEFINED NETWORK** - A private network which uses public network facilities and which is configurable on an as-needed basis by the user (see Virtual Private Network).

- **SOFTWARE ENGINEER (SE)** - The individual that responds (either on-site or via remote support) to a user's service call to repair or patch operating systems and/or applications software.

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

- **SUPERMINICOMPUTER** - See Small System.

INPUT

- <u>SYSTEMS INTEGRATION</u> - The action of a single service vendor's design, development, and implementation of a system or subsystem including integration of hardware, software, and communications facilities for a customer.

- <u>SYSTEM INTERRUPTION</u> - Any system downtime requiring an Initial Program Lod (IPL).

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

- <u>T-1</u> - Refers to a standard 1.544 megabit per second digital channel used between telephone company central offices and is now used for microwave, satellite, fiber optics, or other bypass applications.

- <u>THIRD-PARTY MAINTENANCE (TPM)</u> - Any service provider other than the original equipment vendor.

- <u>TRAINING</u> - All audio, visual, and computer-based documentation, materials, and live instruction designed to educate users and support personnel in the ongoing operation or repair of hardware and software.

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

- <u>VSAT</u> - Very Small Aperture Terminal. A small satellite dish system, usually using Ku-band frequencies.

- <u>VIRTUAL PRIVATE NETWORK</u> - A portion of a public network dedicated to a single user.

INPUT

APPENDIX C: RESPONDENT COMPANIES

- Amdahl Corporation.

- Data General Corporation.

- Dataserv Inc.

- First Data Resources.

- Gould.

- ITT/Servcom.

- Intelogic Trace.

- McDonnell Douglas Field Service Company.

- Memorex Corporation.

- National Advanced Systems.

- Stratus Computer, Inc.

- Sun Microsystems, Inc.

INPUT

- TRW Customer Service Division.

- Tandem Computer.

- Total Technical Services.

- Unisys Corporation.

INPUT

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

The company carries out continuous and in-depth research. Working closely with clients on important issues, INPUT's staff members analyze and interpret the research data, then develop recommendations and innovative ideas to meet clients' needs.

Clients receive reports, presentations, access to data on which analyses are based, and continuous consulting.

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

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

Offices

NORTH AMERICA

Headquarters
1943 Landings Drive
Mountain View, CA 94043
(415) 960-3990
Telex 171407

New York
Parsippany Place Corp. Center
Suite 201
959 Route 46 East
Parsippany, NJ 07054
(201) 299-6999
Telex 134630

Washington, D.C.
8298 C, Old Courthouse Rd.
Vienna, VA 22180
(703) 847-6870

EUROPE

United Kingdom
INPUT
41 Dover Street
London W1X 3RB
England
01-493-9335
Telex 27113

Italy
Nomos Sistema SRL
20124 Milano
Viale Vittorio Veneto 6
Italy
228140 and 225151
Telex 321137

Sweden
Athena Konsult AB
Box 22232
S-104 22 Stockholm
Sweden
08-542025
Telex 17041

ASIA

Japan
ODS Corporation
Dai-ni Kuyo Bldg.
5-10-2, Minami-Aoyama
Minato-ku,
Tokyo 107
Japan
(03) 400-7090
Telex 26487

INPUT®
Planning Services For Management