SOFTWARE MAINTENANCE

INPUT

ABOUT INPUT

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

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UNITED STATES, West Coast
2471 East Bayshore Road
Suite 600
Palo Alto, California 94303
(415) 493-1600
Telex 171407

UNITED STATES, East Coast
Park 80 Plaza West-1
Saddle Brook, New Jersey 07662
(201) 368-9471

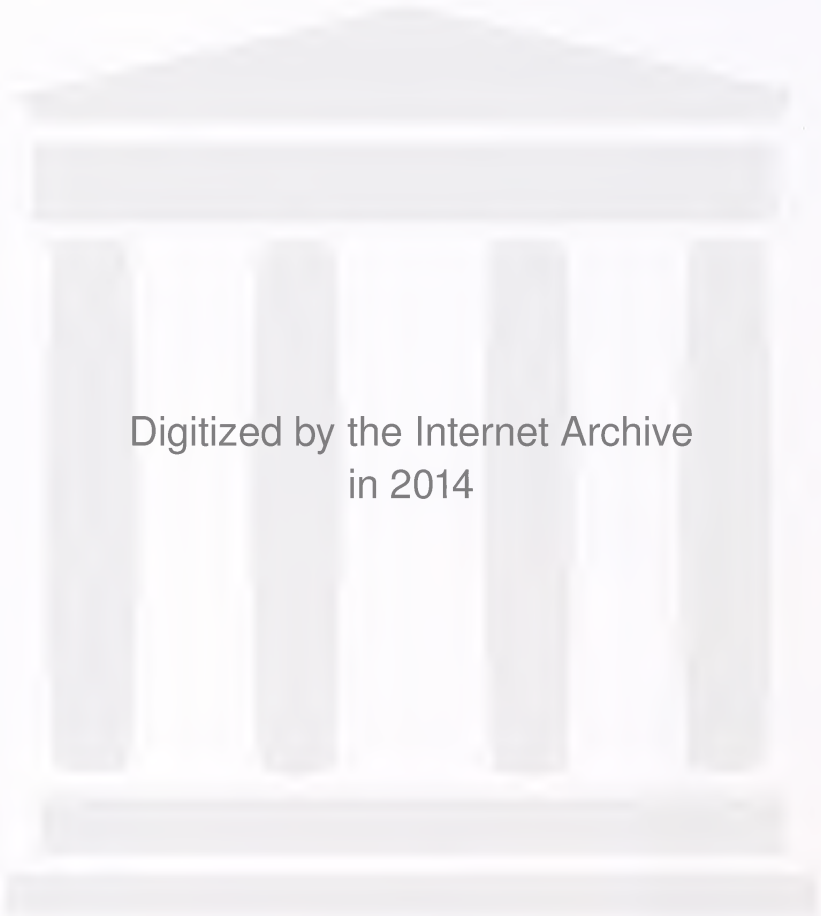
UNITED KINGDOM
INPUT Europe
Empire House
414 Chiswick High Road

[illegible]vice Company, Ltd.
[illegible]No. 12-7 Kita Aoyama
[illegible]u

[illegible]-9 Merriwa Street
[illegible]on N.S.W. 2072

SOFTWARE MAINTENANCE

OCTOBER 1979



SOFTWARE MAINTENANCE

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1 INTRODUCTION

I INTRODUCTION

A. SCOPE

- This report is produced by INPUT as part of the Field Service Planning Information Program.

- This is the first major issue report under this subscription service and deals with the current state and expected future of software maintenance within field service organizations. It was selected because of high client interest.

- Before the research was started, INPUT clients were asked to suggest specific issues and areas of interest to be incorporated into this study. The majority of these issues were incorporated into the research.

B. METHODOLOGY

- Research carried out for this report includes a series of 26 interviews with major vendors of data processing equipment.

  - These interviews were conducted with the principal executive responsible for software maintenance.

- Of the 26 interviews conducted, seven were in-depth on-site interviews and 19 were phone interviews.

- On-site interviews lasted up to two hours in length and phone interviews about one hour.

- Because of the nature of the information provided, INPUT agreed to keep the names of the companies interviewed confidential. However, the types of companies interviewed are presented in Appendix B in terms of 1978 annual revenues and types of products.

- Copies of the questionnaires used are presented in Appendix A.

- Inquiries and comments on the information presented are invited from our clients.

II EXECUTIVE SUMMARY

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A. MAJOR FINDINGS

1. SOFTWARE MAINTENANCE ORGANIZATIONS

- The dominant organization structure among the companies interviewed is geographic and mirrors the structure of the total field service organization.

  - Eighty-one percent of the companies interviewed use this form of organization to position their software maintenance personnel.

  - These are not self-contained units. They rely on back-up support from other organizational elements when a software problem cannot be resolved at the local level.

  - This back-up assistance is usually provided by a remote support center dedicated to aiding the field organization, or a separate support element which provides on-call support, but has other line responsibilities.

- The principal software maintenance executive occupies a high position within the total field service organization.

- Almost one-half of the companies interviewed had the principal software maintenance executive reporting directly to the vice president with overall responsibilities for field service operations.

- Only 8% of the companies interviewed had the principal software maintenance executive two levels below the vice president.

- All companies who had instituted organizational changes within the last 18 months had elevated the reporting level of the principal software maintenance executive.

- The majority of the software maintenance personnel are located at field sites.

  - The companies interviewed had software maintenance organizations that ranged in size from 17 to 2,600 people and, on the average, had a majority of their software personnel located at field sites.

  - Twenty of 24 companies interviewed had 83% of their software maintenance personnel located at field sites.

- Although it was only possible to obtain information concerning the ratio of software maintenance personnel to the total field service organization from 11 companies, this information is nontheless revealing:

  - The software maintenance personnel represented, on average, 27% of the total field service organization. The range was from 5% to 50%.

- Expected growth in the size of the field service organization is significant.

  - The expected growth of the software maintenance organization for 1980 ranged from 8% to 71%.

  - Small organizations (under 100 people) expected the largest growth in staff size.

- Even organizations with a current staff of 300 to 500 people are expecting more than a 50% (on average) increase.

2. SOFTWARE MAINTENANCE PROCESS

- There was almost universal support of system software products (operating systems, compilers, etc.) among the companies interviewed. Over 59% of the companies interviewed provided software maintenance for applications software, but this was limited to software products developed by the company.

- Information about the number of software maintenance calls and the method for handling them was very limited among the companies interviewed. It was not that companies were reluctant to provide this information, but rather that many of the companies did not have this information available.

  - Of the five companies who were able to provide information in this area, the number of software maintenance calls ranged from 1,500 to 6,000 over the last 12 months.

- It was possible to obtain information about the methods used for handling software maintenance calls from 21 of the companies interviewed.

  - On an average basis, these companies handled 71% of their software maintenance calls by phone and 29% by on-site calls. The preference of almost all companies is to handle software maintenance calls by phone because of the decreased costs.

- Although it was possible to obtain cost estimates from only two of the companies interviewed about the cost of on-site versus phone software maintenance calls, the difference in costs were great.

  - Software maintenance calls handled by phone had estimated costs of only $25 to $75, while on-site calls, considering labor costs only, ranged from $200 to $500.

- The variability in the types of remote software diagnostics among the companies interviewed was significant.

  - Forty-two percent (11 of 26) of the companies interviewed provided no software diagnostic programs and software maintenance personnel were required to operate from program dumps and listings.

  - Thirty percent of the companies were already operating with a remote diagnostic capability. Two of these companies had established data communications links to the user sites. The rest used voice communications only.

3. SOFTWARE MAINTENANCE PRICING

- Fifty-eight percent (15 of 26) of the companies interviewed had established separate pricing structures for software and hardware maintenance.

  - Five of these companies priced exclusively on fixed price contracts bundled into the purchase price of the software. The other companies price in combination with other pricing techniques, usually time and materials.

  - Time and materials charges ranged from $250 to $400 per day, exclusive of travel costs.

- Only two companies made any major changes in pricing structure during the last 18 months. Both did it to establish separate pricing for software maintenance in order to treat it as a separate profit center.

- The offering of software warranties was a common practice among the companies interviewed, with 65% of the companies interviewed providing a warranty either on a system or applications software product.

- Only three of the companies interviewed stated that they were currently operating software maintenance as a profit center within the field service organization. All other companies treated it as a cost center.

- Companies that were operating separate profit centers would provide very little information about their level of profitability and expected revenue growth rates. However, one company told INPUT that software maintenance currently was contributing 30% of total field service revenues and that they planned within the next five years to increase that level to 50%.

4. SOFTWARE MAINTENANCE PERSONNEL SELECTION AND TRAINING

- With significant growth expected in the size of software maintenance organizations, the preferred current sources for personnel are:

  - Hire and train new personnel.

  - Current users.

  - Recruit from competition.

- The latter two sources pose recruiting problems because hiring of current users could jeopordize an account and recruiting from competition forces companies to pay higher salaries.

- Companies did not foresee an major shifts in sources for personnel and plan to continue to rely on their current sources over the next five years.

- Eighty-eight percent (23 of 26) of the companies interviewed have established a formal training program for software maintenance personnel.

  - This formal training was conducted for employees immediately after starting work and ranged in length from 5 days to 110 days.

- The two major elements of the formal training programs are in the areas of procedures and operations and technical product training. Over half of the companies offered training in both areas.

- Within the last 18 months, two of the companies added (as part of their training program) a segment on human communications and interface skills.

- Sixteen of the companies interviewed provided ongoing training for software maintenance personnel. This training was conducted at both branches and corporate headquarters.

- Surprisingly, none of the companies felt a need to use outside training firms for course development or instruction.

- Apparently, formal training programs have had very little effect on compensation and retention of software maintenance personnel.

  - Only one company provided salary increases at the end of the formal training program and these ranged from 7% to 12%.

  - The other companies had salary increases tied directly to semi-annual or annual review cycles.

  - Only four companies indicated that there was movement from the field service organization to other organizations within the company after completion of the formal training program.

- Training costs appear to be running between $200 and $325 per student day.

  - The majority of the companies expected that their training budgets would increase for next year. Anticipated increases ranged between 10% to 25%, with an average increase of 19%.

- The major reasons for increased training costs (other than inflation) were increased hiring of new personnel, development of new course material, particularly in remote diagnostics and firmware, and distribution of more training to branch locations.

5. FUTURE TRENDS IN SOFTWARE MAINTENANCE

- The three major issues that appear to have the greatest impact on future software maintenance policies and procedures are:

  - Remote diagnostics.

  - Distributed data processing.

  - Personnel availability.

- Remote diagnostics appears to be the most significant issue because of the effect it can have on personnel qualifications, maintenance organizations structures, and procedures for accomplishing software maintenance.

  - If remote diagnostics is implemented for the accomplishment of a significant part of the diagnostic segment of software maintenance, it will be possible to support users direct from this location or with a less qualified staff in the field locations. This could significantly reduce software maintenance costs for personnel.

  - However, these reductions in cost must be traded off against the required costs for the development and operation of a remote diagnostic capability.

- Distributed data processing is the second most significant issue facing software maintenance organizations. In other studies conducted during the last year, INPUT estimated that this segment of the market will be at least a $6 billion market by 1982.

- It will significantly increase the number of user sites that must be maintained over a larger geographic area.

- Many of the users will be unsophisticated and will probably require a greater level of support by software maintenance organizations.

- These two factors alone will require field service management to conduct a critical evaluation of the traditional methods of providing software maintenance. Simply providing "more of the same" will not get the job done.

- Personnel availability will be a continuing problem, both in recruiting and training of new personnel. With the increased demands on software maintenance organizations for additional personnel, less skilled personnel will have to be recruited and in turn will require more training. During the next five years, the majority of the companies interviewed indicated that they expected changes to occur in each of the following areas:

  - Personnel qualifications.

  - Organization.

  - Training.

  - Diagnostic tools.

  - Price of software maintenance.

- Personnel qualifications, organization, training, and diagnostics tools were all interrelated factors.

  - The driving force appears to be remote diagnostics, which would permit software maintenance organizations to operate from a central core of highly trained specialists, with less qualified personnel in the field.

- This implies a more centralized organization structure, with a possible reduction in the number of levels in the organization.

- It would also require different types of training and a major revision in training curriculum.

- In addition, companies are planning on offering more applications software which would require some different personnel qualifications and training.

- Thirty-eight percent (10 of 26) of the companies interviewed expected the price of software maintenance to increase over the next five years.

  - For competitive reasons, they declined to quantify the amount of these increases. Only two of the companies expected the price of software maintenance to decrease as the result of increased software reliability and improved diagnostic capability.

- It is also expected that the majority of the companies will price software maintenance separately from hardware maintenance.

- There was almost universal agreement that the importance of software maintenance will increase over the next five years. The primary reasons for this growth in importance are:

  - The expected increase in the reliability of the hardware will result in more visibility in software maintenance.

  - The differentiating characteristic in future sales situations will be software, not hardware.

  - Users are becoming more sophisticated, and associated with this will be a greater demand for improved software maintenance.

- At the same time, introduction of a growing number of DDP systems will require an interface with a new class of first time end users who will require additional software maintenance support.

- Software maintenance organizations will have an opportunity to improve the reliability of software products during the development stage. Their experience base provides a unique perspective into the review of the design of the new software products to assist in improved reliability.

B. RECOMMENDATIONS

- Companies should conduct a critical evaluation of their software maintenance policies and procedures to ensure that they are prepared to meet the increased demands that will be placed on their organizations in terms of both performance and profitability.

  - For those companies that are not yet collecting detailed cost information on software maintenance operations, it should be initiated immediately.

  - The process is directly translatable in terms of cost control and increased profit.

- Companies should immediately consider the development or expansion of a remote diagnostic capability for software maintenance. This capability offers significant advantages over the traditional methods of software maintenance:

  - Personnel reduction and more centralization of the software maintenance organization.

  - Acceptability of less qualified and lower paid software maintenance personnel at field locations.

- Increased involvement of users in software maintenance procedures leading to a reduction in the number of on-site software maintenance calls.

- The possible use of hardware maintenance personnel to handle software maintenance calls at the field sites.

- Improved dissemination of software corrections and updates to user sites.

- Companies should examine their current training programs to determine if the traditional training techniques should be replaced with more self-paced, individual training techniques to reduce the cost and time to train new personnel.

- With the expected increase in the number of first time end users that will be present in the growing DDP environment, more "people oriented" training should be included in the training curriculum.

- Software maintenance organizations should become actively involved in the development of new software products within their companies to ensure that reliability considerations are being evaluated during the design process. Evaluation of the reliability of the software during this stage will reduce the requirements for software maintenance once the product is in the field.

III SOFTWARE MAINTENANCE ORGANIZATIONS

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A. DEFINITION OF SOFTWARE MAINTENANCE

- Within the scope of this study, software maintenance is comprised of the following major functions:

  - Diagnosis - Fault detection and debugging.

  - Correction - Installation of software fix or workaround solution. As a function of the severity of the fault, workaround solutions are provided if the system can continue to operate.

  - Control - Configuration management of the software products to ensure that the software products being used reflect the most current available software.

  - Dissemination - The transfer of information from the headquarters organization of software documentation (specifications, manuals, listings, software status reports, software program corrections, etc.).

  - Educational Support - Technical asistance to users by either on-site or phone in the use of the software products supplied with the system.

B. ORGANIZATION OF THE SOFTWARE MAINTENANCE FORCE

1. TYPES OF ORGANIZATIONS

- There are essentially three basic types of organizations that currently exist within the companies interviewed.

  - Geographic - This organization has the software maintenance force responsible for all activities within a geographic area and looks like the typical field service branch type structure.

  - Functional - This organization has the software maintenance force divided by functional discipline, e.g., system programmers, communication specialists, application/industry specialists. This type of organization is usually centrally located at headquarters or regional locations.

  - Product - This organization has the software maintenance force divided by specific product, e.g., operating system. This type of organization can be either centrally located or distributed among branch locations.

- Exhibit III-1 presents the preference among the companies interviewed.

  - Geographic organization is the clear preference, with 81% of the companies currently operating in this mode.

  - However, it should be recognized that geographic organizations are not always self-contained and often rely on additional support from both functional and product specialists who may not be located in their geographic area of responsibility. A more detailed examination of the types of internal interfaces is discussed in Chapter III-D.

EXHIBIT III-1

TYPES OF SOFTWARE MAINTENANCE ORGANIZATIONS
BY COMPANIES INTERVIEWED

TYPE OF ORGANIZATIONAL STRUCTURE	PERCENT OF COMPANIES	NUMBER OF COMPANIES
GEOGRAPHIC	81%	21
FUNCTIONAL	11	3
PRODUCT	8	2
TOTAL	100%	26

- The geographic organization structure offers two major advantages over other types of organization structures.

  - It provides for a straightforward delineation of area of responsiblity.

  - It is complementary with the overall field service organization and permits local management control over all field personnel resources at the branch level.

2. REPORTING LEVELS

- One measure of the importance of the software maintenance function is the reporting level and title of the principal software executive within the company.

- For purposes of this study, all management titles were grouped into three basic levels.

  - Manager.

  - Director.

  - Vice President.

  The division of these titles among companies interviewed is presented in Exhibit III-2.

- None of the companies interviewed had the principal software maintenance executive more than two levels below the principal executive with overall responsibility for field services.

EXHIBIT III-2

REPORTING LEVEL OF PRINCIPAL SOFTWARE MAINTENANCE EXECUTIVE BY COMPANIES INTERVIEWED

REPORTING LEVEL	PERCENT OF COMPANIES	NUMBER OF COMPANIES
VICE PRESIDENT	46%	12
DIRECTOR	46	12
MANAGER	8	2
TOTAL	100%	26

- This level of management attention is not a recent development. Only two of the companies interviewed had made a change in the reporting level in the last 18 months. In both cases it was to elevate the level of the principal software executive.

- The remainder of the companies interviewed had maintained their existing organization structure for greater than 18 months.

3. LOCATION OF SOFTWARE MAINTENANCE PERSONNEL

- Of the companies interviewed, there is a heavy concentration of software maintenance personnel located at field sites. Exhibit III-3 provides a percentage distribution of the location of these personnel.

- Twenty of the 24 companies had 83% of their software maintenance personnel located at field sites.

  - These personnel were usually at branch levels and had considerable interface with their hardware counterparts and the end user.

  - The personnel located at the field sites were usually of a lower skill level than headquarters or remote site personnel, but interfaces were established to provide them with required support when they could not solve the problem.

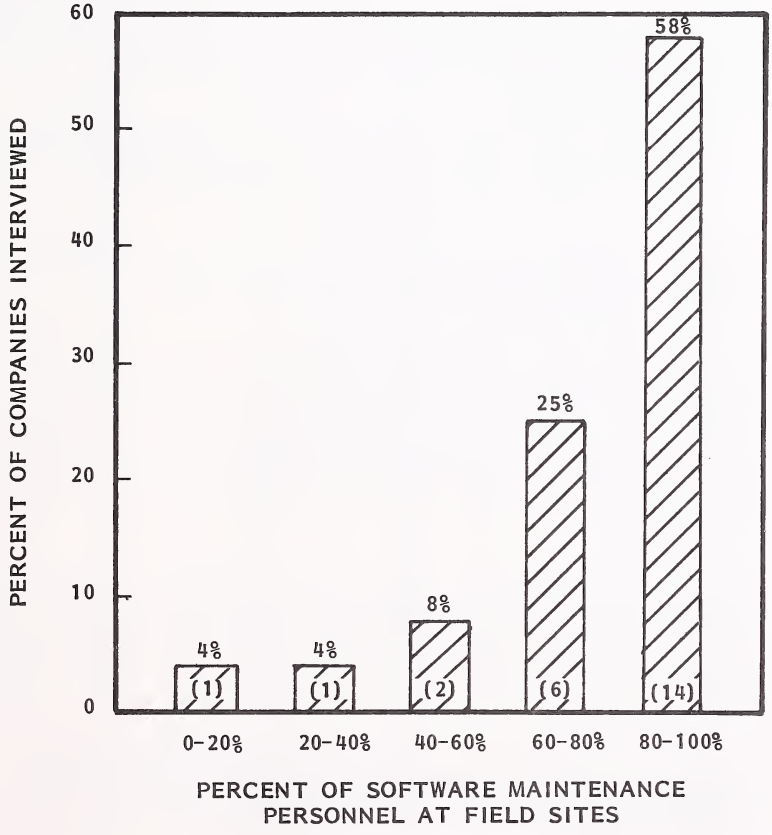
- Only two of the companies had less than 50% of their software maintenance personnel distributed among the various field locations.

  - One of these companies was in a start-up situation. Personnel now located at headquarters will be assigned to field locations within the next six months.

  - The other company with no personnel at field locations worked in a distributor relationship and provided no direct support to the end user.

EXHIBIT III-3

PERCENT OF SOFTWARE MAINTENANCE PERSONNEL
LOCATED AT FIELD SITES BY COMPANIES INTERVIEWED



(xx) = NUMBER OF COMPANIES

C. SIZE AND GROWTH OF SOFTWARE MAINTENANCE ORGANIZATIONS

- Of the twenty-six companies interviewed, their total software maintenance force ranged in size from 17 to 4,000 personnel as shown in Exhibit III-4. The average size was not calculated since the number of personnel is a function of the size of the installed base.

- However, eleven of the companies did provide information on total field service force and software maintenance force. This information is presented in Exhibit III-5.

  - The percent of software personnel to total field personnel ranged from a low of 5% to a high of 50%, with an average of 27%.

- Clearly, software maintenance is a significant part of the total field service organization and is expected to increase in importance.

- Of more significance than the size of these organizations is the expected growth rates. Nineteen of the 26 companies provided data in this area, and of this group, 18 expected to increase the size of their organization during the next year. Exhibit III-6 presents the growth rates by size of company for 15 of the companies.

- As can be seen from the exhibit, smaller organizations were expecting the largest increase in staff size with an average of 71%. Even larger organizations in the size of 100-500 were forecasting a 50% increase in size.

D. INVOLVEMENT OF ORGANIZATIONAL ELEMENTS IN SOFTWARE MAINTENANCE

- In order to determine what organizational elements were involved in software maintenance activities, three organizational elements were examined. These were:

EXHIBIT III-4

SIZE OF SOFTWARE MAINTENANCE ORGANIZATION BY COMPANIES INTERVIEWED

COMPANY	NUMBER OF PERSONNEL
1	17
2	19
3	20
4	21
5	29
6	30
7	30
8	40
9	46
10	100
11	115
12	120
13	150
14	200
15	200
16	320
17	375
18	400
19	450
20	1,350
21	2,600
22	4,000

EXHIBIT III-5

COMPARISON OF SIZE OF
SOFTWARE MAINTENANCE ORGANIZATION
TO TOTAL FIELD SERVICE ORGANIZATION
BY COMPANIES INTERVIEWED

SIZE OF FIELD SERVICE ORGANIZATION	PERCENT OF SOFTWARE MAINTENANCE PERSONNEL	NUMBER OF SOFTWARE MAINTENANCE PERSONNEL
65	26%	17
75	40	30
100	20	20
119	16	19
280	11	29
400	5	21
750	50	375
1,100	9	100
1,230	37	450
4,350	31	1,350
9,700	27	2,600

EXHIBIT III-6

EXPECTED GROWTH DURING NEXT TWELVE MONTHS
IN SOFTWARE MAINTENANCE ORGANIZATION
BY COMPANIES INTERVIEWED

SIZE OF CURRENT SOFTWARE MAINTENANCE ORGANIZATION	AVERAGE PERCENT OF PERSONNEL GROWTH	NUMBER OF COMPANIES
UNDER 50	71%	4
100-200	46	5
300-500	57	3
1,000-+	8	3

- Field Organization - This includes all personnel located at branch and district offices in the field.

- Separate Support Organization - This includes division or headquarter personnel who have, as part of their responsibility, the provision of staff level support to the field organization. They are a non-dedicated group who have other software responsibilities such as central software libraries, configuration management, software documentation, etc.

- Remote Support Center - This is a dedicated organization of highly qualified specialists located at either division or headquarters level. Their sole function is to provide software maintenance support either to the field organization or directly to the end user.

- Exhibit III-7 provides a percentage distribution of these organizational elements that existed within the companies interviewed.

  - Eighty-eight percent (23 companies) used some combination of two or more of these organizational elements in performing software maintenance functions.

  - In 30% (8 companies), which used all three organizational elements, the non-dedicated separate support organization only became involved when it was not possible to solve the problem with a combination of the other two organizational elements.

- The existence of some type of centrally located organization staffed with highly qualified specialists has been found to be the most efficient way of dealing with more complex software maintenance problems that cannot be handled directly by field personnel.

EXHIBIT III-7

INVOLVEMENT OF MULTIPLE ORGANIZATIONAL ELEMENTS IN SOFTWARE MAINTENANCE BY COMPANIES INTERVIEWED

ORGANIZATIONAL ELEMENT	PERCENT OF COMPANIES	NUMBER OF COMPANIES
FIELD ORGANIZATION ONLY	8%	2
FIELD AND SEPARATE SUPPORT ORGANIZATION	23	6
FIELD AND REMOTE SUPPORT CENTERS	35	9
FIELD, REMOTE AND SEPARATE SUPPORT ORGANIZATION	30	8
SEPARATE SUPPORT ORGANIZATION ONLY	4	1

- The one company shown in Exhibit III-7 which had only a headquarters based separate support organization sold its products only to distributors and had no first line software maintenance responsibility.

IV SOFTWARE MAINTENANCE PROCESS

IV SOFTWARE MAINTENANCE PROCESS

A. TYPES OF SOFTWARE PRODUCTS SUPPORTED

- There are two general classes of software supported by the software maintenance organizations.

  - System Products - This category of products includes operating systems, compilers, and other system utilities.

  - Applications Products

- Exhibit IV-1 presents the type of software products supported by the companies interviewed.

  - There was almost universal support of system products among the companies interviewed, with only one company not providing support of their system product. This was the result of the operating system being purchased from a software product vendor with whom the company had contracted for this on-going maintenance activity.

  - Over 50% of the companies maintained applications programs, but this was generally limited to applications the companies themselves had developed. Although software maintenance personnel would provide some consulting support for user developed applications, they did not assume maintenance responsibility.

EXHIBIT IV-1

TYPES OF SOFTWARE PRODUCT SUPPORTED
BY COMPANIES INTERVIEWED

TYPE OF SOFTWARE PRODUCT	PERCENT OF COMPANIES	NUMBER OF COMPANIES
SYSTEMS	50%	13
APPLICATIONS	4	1
BOTH	46	12

B. NUMBER OF SOFTWARE PRODUCTS SUPPORTED

- Exhibits IV-2 and IV-3 present the number of systems and applications products that are supported.

- As would be expected, there are a significantly larger number of applications products than system products that are supported.

- It is expected that during the next five years there will be a significantly greater demand placed on software maintenance organizations to be responsible for applications programs. This will be the result of more data processing usage by small end user organizations who will not have an in-house EDP organization capable of developing or maintaining applications programs.

C. NUMBER OF SOFTWARE MAINTENANCE CALLS

- In order to determine the level of software maintenance activities, companies were queried as to the total number of software maintenance calls handled during the past twelve months. The results of this line of inquiry was very disappointing, since it was possible to obtain this information from only five of the 26 companies interviewed. It was not that companies were reluctant to provide this information, but rather the information simply was not tracked!

- For the five companies who were able to provide this information, Exhibit IV-4 provides a comparison of the size of the software maintenance organization with the number of maintenance calls processed during the last 12 months.

EXHIBIT IV-2

NUMBER OF APPLICATION SOFTWARE PRODUCTS
SUPPORTED BY COMPANIES INTERVIEWED

NUMBER OF APPLICATION SOFTWARE PRODUCTS	PERCENT OF COMPANIES	NUMBER OF COMPANIES
1-10	33%	4
11-20	18	2
21-30	-	-
31-40	8	1
41-50	8	4
51+	33	1

EXHIBIT IV-3

NUMBER OF SYSTEM SOFTWARE PRODUCTS
SUPPORTED BY COMPANIES INTERVIEWED

NUMBER OF SYSTEM SOFTWARE PRODUCTS	PERCENT OF COMPANIES	NUMBER OF COMPANIES
1-3	33%	7
4-6	24	5
7-9	24	5
10+	19	4

EXHIBIT IV-4

COMPARISON OF TOTAL NUMBER OF SOFTWARE MAINTENANCE CALLS AND SIZE OF SOFTWARE MAINTENANCE ORGANIZATION BY COMPANIES INTERVIEWED

COMPANY	SIZE OF SOFTWARE MAINTENANCE ORGANIZATION	TOTAL NUMBER OF SOFTWARE MAINTENANCE CALLS LAST 12 MONTHS	AVERAGE CALLS PER PERSON FOR 12 MONTHS
1	19	1,500	78.0
2	375	1,800	4.8
3	21	2,400	114.2
4	100	5,000	50.0
5	450	6,000	13.3

- As can be seen from this exhibit, there was a wide range in the number of software calls handled, and the number of calls handled per person; i.e., 4.8 to 78 calls per person (for the last 12 months).

- If a single shift, five day operation is used as a basis for comparison, the average number of software maintenance calls per day ranged from 5.7 to 23 per company.

- However, it was possible to obtain a further breakdown of these maintenance calls by on-site versus phone resolution. The results of this breakdown are presented in Exhibit IV-5.

  - Although it was not possible to obtain the quantitative information desired, 21 of the companies interviewed did provide estimates on the distribution of on-site versus phone software maintenance calls. This distribution is presented in Exhibit IV-6.

  - On the average, these companies handled 71% of their software maintenance calls by phone and 29% by on-site calls.

D. COST OF SOFTWARE MAINTENANCE CALLS

- As was the case with the number of software maintenance calls, very little information was obtained on the cost of software maintenance calls.

  - Only two companies had information they were willing to provide in this area. For a software maintenance call handled by phone, the estimated costs were from $25 to $75. For an on-site software maintenance call, considering labor costs only, the estimated costs were from $200 to $500.

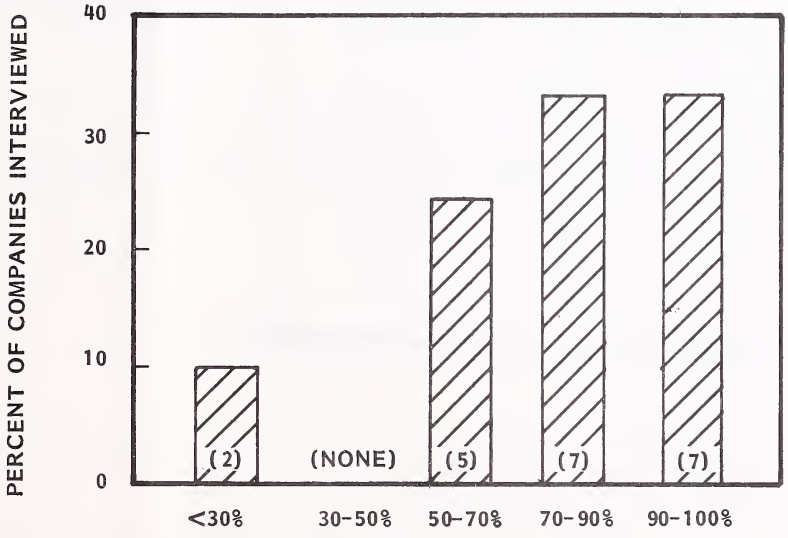
EXHIBIT IV-5

COMPARISON OF SOFTWARE MAINTENANCE
CALLS HANDLED VIA PHONE VERSUS
ON-SITE BY COMPANIES INTERVIEWED

COMPANY	TOTAL NUMBER OF SOFTWARE MAINTENANCE CALLS LAST 12 MONTHS	PERCENT VIA PHONE	PERCENT VIA ON-SITE
1	1,500	95%	5%
2	1,800	99	1
3	2,400	95	5
4	5,000	75	25
5	6,000	95	5

EXHIBIT IV-6

DISTRIBUTION OF SOFTWARE MAINTENANCE CALLS
HANDLED VIA PHONE BY COMPANIES INTERVIEWED



(XX) = NUMBER OF COMPANIES

- Although it was not possible to obtain the desired quantitative information, eighteen of the companies did provide comparative estimates on software versus hardware maintenance calls. The results are presented in Exhibit IV-7.

  - As can be seen, the majority of the companies providing information (61%) believed software maintenance calls were more expensive.

  - The average increase in cost of a software maintenance call was 37%. However, there was a wide range in the amount of the increased costs - from 15% to 100%.

  - The two companies that believed the costs for software maintenance calls were less than a hardware maintenance call handled most of them by telephone.

- Based on the information provided by the companies as part of this research, it appears that detailed cost information of software maintenance activities is not being captured and reviewed. INPUT believes this is a major planning deficiency.

E. CURRENT TYPES OF SOFTWARE DIAGNOSTICS

- Exhibit IV-8 provides a comparison of the various types of software diagnostics employed by the companies interviewed.

  - Probably the most significant finding was that 42% (11 of 26) of the companies interviewed provided no software diagnostic programs!

  - Software maintenance personnel were required to operate directly from program dumps and source listing. This type of diagnostic approach requires detailed program familiarity and is essentially a trial and error procedure.

EXHIBIT IV-7

COMPARISON OF COST BETWEEN HARDWARE
AND SOFTWARE MAINTENANCE CALLS
BY COMPANIES INTERVIEWED

COST OF SOFTWARE SERVICE RELATIVE TO HARDWARE SERVICE	PERCENT OF COMPANIES	NUMBER OF COMPANIES
SAME COST	28%	5
HIGHER COST	61	11
LOWER COST	11	2

EXHIBIT IV-8

TYPES OF SOFTWARE DIAGNOSTICS
PROVIDED BY COMPANIES INTERVIEWED

TYPE OF SOFTWARE DIAGNOSTICS	NUMBER OF COMPANIES PROVIDING
NONE	11
DUMP ANALYZER	8
REMOTE DIAGNOSTICS	6
STANDARD IBM UTILITIES	5
SPECIAL EDIT AND DEBUG	3
ON-LINE TRACER	1
PERFORMANCE MONITOR	1
SOFTWARE SIMULATOR	1

- Thirty percent (6 of 26) of the companies interviewed were already operating with a remote diagnostic capability. However, only two of these companies had an actual data communications capability for direct connection to the user site. The other companies relied on voice communications only.

- The other companies were using a wide range of standard diagnostic tools as indicated in Exhibit IV-8.

F. CURRENT TYPES OF SOFTWARE DOCUMENTATION

- For purposes of this study software documentation provided to both field service personnel and users consisted of three types:

  - Technical Documentation - This category of couments includes product technical description, technical and system specifications, software program specification, etc. These documents are created during or immediately after the product development stage and are generally used by field service personnel and end users for reference purposes.

  - User Documentation - This category of documentation consists of operator manuals, system procedure documents, user guides, etc. They are designed primarily for the use and maintenance of the software products.

  - Source Listings - This category of documentation is the instruction by instruction listing of the program and is essential for making software programming changes.

- Exhibits IV-9 and IV-10 provides a distribution of the various types of software documentation that is provided to the field sites and users by the companies interviewed.

EXHIBIT IV-9

TYPES OF SOFTWARE DOCUMENTATION
PROVIDED FIELD PERSONNEL
BY COMPANIES INTERVIEWED

TYPE OF DOCUMENTATION	PERCENT OF COMPANIES	NUMBER OF COMPANIES
TECHINCAL ONLY	8%	2
USER ONLY	15	4
USER AND TECHNICAL	19	5
USER AND SOURCE LISTINGS	8	2
USER, TECHNICAL AND SOURCE LISTINGS	50	13

EXHIBIT IV-10

TYPES OF SOFTWARE DOCUMENTATION
PROVIDED USERS BY COMPANIES INTERVIEWED

TYPE OF DOCUMENTATION	PERCENT OF COMPANIES	NUMBER OF COMPANIES
USER ONLY	46%	12
USER AND TECHNICAL	23	6
USER AND SOURCE LISTINGS	4	1
USER, TECHNICAL AND SOURCE LISTINGS	27	7

- Fifty percent of the field personnel receive all three types of documentation, while less than one-third of the users receive all types.

- The same type of trend is seen in technical specifications, with 77% of the field sites receiving them, but only half of the users receiving these documents.

- Source listings are the most closely controlled. Only 58% of the field sites and 31% of the users have access to this level of documentation.

- The release of source listings was particularly restricted among users because the companies did not wat "unofficial" patches made to software programs. This would create a possible loss of control in the software configuration leading to a more difficult maintenance problem.

- Companies that did release source listings limited the release to sophisticated EDP organizations within user companies.

G. DISSEMINATION OF SOFTWARE CORRECTIONS AND UPDATES

- Once a software fault has been detected and corrected at a user site, this information must be disseminated to all other user sites with alike installations. The reporting of this software fault to the field organization is as important as correcting the immediate problem at the single user site.

  - Among the companies interviewed, a central organization was maintained by all software maintenance organizations for this function.

  - This central organization was responsible for verification of the software fault, updating the master software library, and disseminating this information to both the field and user personnel.

- As a function of the criticality of the software fault, different mechanisms were used for the dissemination of this information.

- For critical problems, either telephone, TWX, or data communications were used to relay this information as soon as possible.

- For non-critical problems, the information was relayed through a series of standard publications or bulletins that were issued on a weekly or monthly basis.

- Exhibit IV-11 provides a distribution of how this information reaches the user sites.

  - For critical problems, the companies interviewed were evenly divided on how this information was disseminated. However, when the information was sent directly to the users, it was also relayed to the field organization at the same time.

  - It appears that central distribution of this information directly to the user sites offers certain efficiencies since it relieves the field organization of this responsibility. However, if the end users are unsophisticated, this may not be possible and should be decided on a case by case basis.

  - Most of the companies sent non-critical software information directly to the users via their periodic software publications. In these instances, the user has the option of whether to install the correction or update.

  - Usually non-critical software faults are incorporated into future releases of the software that are issued to users on a periodic basis.

  - For those companies that elected to disseminate the information to the field organization only, they were responsible for installing the correction during the next periodic visit to the user site.

EXHIBIT IV-11

METHODS OF DISSEMINATION OF
SOFTWARE CORRECTIONS AND UPDATES
BY COMPANIES INTERVIEWED

DISSEMINATION METHOD	CRITICAL PROBLEM		NON-CRITICAL PROBLEM	
	PERCENT OF COMPANIES	NUMBER OF COMPANIES	PERCENT OF COMPANIES	NUMBER OF COMPANIES
DIRECT TO USERS	50%	13	65%	18
FIELD ORGANIZATION	50%	13	35%	8

V SOFTWARE MAINTENANCE PRICING

V SOFTWARE MAINTENANCE PRICING

A. TYPES OF SOFTWARE MAINTENANCE PRICING

- There are basically three ways companies bill users for software maintenance:
  - Total Monthly Service Charge - This is a combined charge at a fixed rate for both hardware and software maintenance.
  - Separate Monthly Software Service Charge - This is a separate charge at a fixed rate for software maintenance only.
  - Time and Materials - This is a variable charge based on actual time spent in software maintenance and is usually an add-on to one of the two charges above.
- Exhibit V-1 provides a distribution of the various pricing techniques that were used by the companies interviewed.
  - As can be seen from this exhibit, 50% (12 companies) restrict themselves to a single pricing scheme, either on a time and materials or warranty basis.

EXHIBIT V-1

TYPES OF SOFTWARE MAINTENANCE
BILLING METHODS BY COMPANIES INTERVIEWED

TYPE OF BILLING METHOD	PERCENT OF COMPANIES	NUMBER OF COMPANIES
MONTHLY SERVICE CHARGE, HARDWARE AND SOFTWARE	29%	7
SEPARATE MONTHLY SERVICE CHARGE, SOFTWARE	21	5
SEPERATE MONTHLY SERVICE CHARGE, PLUS TIME AND MATERIAL	21	5
TIME AND MATERIAL ONLY	21	5
WARRANTY ONLY	8	2

- Of more interest is that 63% (15 companies) have unbundled their software maintenance pricing from the hardware. However, only five companies were using this technique exclusively.

- The remaining companies used separate software maintenance pricing in combination with time and materials charge.

- Companies used combinations of pricing schemes to handle various types of system installation and geographic locations.

- Current time and material charges ranged between $250 and $400 per day plus travel costs.

- As presented in Exhibit V-2, the various pricing techniques have been in place for a considerable period of time, and there was no indication of any recent changes among the majority of the companies interviewed.

- However, two of the companies interviewed did make changes in their pricing method during the last 18 months. The significance is that these changes in pricing method were toward establishing software maintenance as a separate profit center and to provide more flexibility to customers. The companies comments on these changes are important:

  - "Separate (software) contracts are being used to make it a profit center."

  - "We are unbundling the software."

  - "Will soon announce many different types of software maintenance contracts so user can have as much support as he wants."

EXHIBIT V-2

LENGTH OF USE OF CURRENT SOFTWARE MAINTENANCE
BILLING METHODS BY COMPANIES INTERVIEWED

USE OF BILLING METHOD	PERCENT OF COMPANIES	NUMBER OF COMPANIES
0-1 YEARS	12%	3
2-3 YEARS	44	11
4-5 YEARS	12	3
6-7 YEARS	12	3
8+ YEARS	20	5

B. USE OF SOFTWARE WARRANTY

- Sixty-five percent (17 of 26) companies provided some type of warranty on their software.

- These warranties ranged in time from 30 days to one year, but some of the companies interviewed indicated that these time periods were not strictly enforced.

- The companies are almost equally divided in their attitude toward providing warranties for either systems or applications programs, with 50% of the companies providing warranties.

- The use of software warranty as part of the pricing method seems to be primarily a function of the maturity of the software product and its associated reliability.

C. SOFTWARE MAINTENANCE - PROFIT VERSUS COST CENTER

- Companies were extremely reluctant to provide any significant data in this area, and INPUT does not believe the information collected during the interview program is necessarily reflective of what is actually happening.

- Of the 24 companies who did provide responses in this area, only three of the companies indicated that they were profit centers within their companies. All others indicated that they were treated as a cost center.

- Based on INPUT's study, "Maintenance Requirements for the Information Processing Industry - 1978-1983," 94% of the companies interviewed reported a 1978 pre-tax profit for maintenance services which ranged from 7.6% to 21.7% of maintenance revenues.

- Although software maintenance managers may view their organization only as a cost center, they are in fact contributing to the total profitability of maintenance revenue.

- The potential for profitability does exist within software maintenance organizations, as reflected in the following data provided by one of the companies interviewed:

  - Software maintenance provided a 30% contribution to profitability of total maintenance profits.

  - Within the next five years expect this to increase to a level of 50%.

VI SOFTWARE MAINTENANCE PERSONNEL SELECTION AND TRAINING

VI SOFTWARE MAINTENANCE PERSONNEL SELECTION AND TRAINING

A. SOURCES OF SOFTWARE MAINTENANCE PERSONNEL

- As indicated in Chapter III, companies were expected to increase the size of their software maintenance organizations significantly over the next five years. Within the next year, companies have forecast planned increases which range from 8% to 71%.

- Exhibit VI-1 presents the ranking of personnel sources that are currently used to meet staffing needs. Respondents were asked to rank each of the possible sources on a scale of 1 to 5, with 5 being the highest.

  - As can be seen from Exhibit VI-1 the top two sources for selecting personnel are:

    . Current users.

    . New Hires (trainees).

  - Users were particularly important because of the direct experience that they had had with the software in the same environment in which they would be responsible for maintaining it.

EXHIBIT VI-1

RATING OF CURRENT PERSONNEL
SOURCES BY COMPANIES INTERVIEWED

PERSONNEL SOURCE	WEIGHTED SCORE	NUMBER OF RESPONSES RANKED 5
USER	4.0	4
HIRE AND TRAIN	3.8	10
RECRUIT COMPETITOR	3.0	6
INSIDE COMPANY	2.3	1
TRADE SCHOOL	1.8	-
OTHER INDUSTRY	1.3	-
ARMED FORCES	1.1	-

- One of the main motivating factors for software personnel to leave the end user organization and join a data processing company was that there was more opportunity for career growth.

- Managers who relied on current users as their primary source of personnel were keenly aware of the danger this imposed on the account. The process by which this was accomplished was, in many cases, carefully coordinated with marketing personnel who had responsibility for the account.

- Typical comments about this method of personnel selection were:

  - "Eighty percent of our existing software maintenance organization has been recruited from end user organizations."

  - "End users are already trained and in-place."

  - "User recruiting reduces our relocation costs of home office personnel."

  - "We offer users more opportunity for growth in our company."

- The second source of high importance was to hire and train the personnel themselves. These people were almost always college graduates with undergraduate degrees in either computer sciences or electrical engineering.

- Although companies interviewed would have liked to get more of their personnel from college recruiting, internal competition for these people is severe, and they were more likely to be attracted to a product development assignment than a maintenance assignment. The same difficutlty was experienced with internal transfers within the same company.

- The third most important current source was to recruit from the competition, but this did pose several problems for the companies interviewed.

- They were forced to pay higher salaries (up to 20% more) to get these people to join their company.

- As one company indicated, there was the problem of "untraining" these people in the other company's maintenance procedures before they could become effective.

- To understand if there was only an indication of a significant switch in personnel sources over the next five years, managers were asked to rank the same sources for 1983. The results of their ranking are presented in Exhibit VI-2.

- As can be seen from this exhibit, companies will still rely primarily on the same sources that they currently are using. However, the interviews did indicate the following:

  - There will be a higher reliance on college recruiting because companies believe they will have stable software maintenance structures more firmly established. This will permit them to handle more entry level people into their organizations.

  - However, it is important to note that the companies interviewed were still planning to use graduates of four year college programs for entry level software maintenance personnel, and there were no plans to use graduates of two year programs.

B. SOFTWARE MAINTENANCE TRAINING

1. FORMAL TRAINING PROGRAM

- Eighty-eight percent (23 of 26) of the companies interviewed indicated that they had an established training program for software maintenance personnel. The training programs ranged in time from 5 days up to 110 and are discussed in more detail in Section 2 of this chapter.

EXHIBIT VI-2

RATING OF FUTURE (1983) PERSONNEL
SOURCES BY COMPANIES INTERVIEWED

PERSONNEL SOURCE	WEIGHTED SCORE	NUMBER OF RESPONSES RANKED 5
USER	4.0	6
HIRE AND TRAIN	4.0	15
RECRUIT COMPETITOR	2.7	4
INSIDE COMPANY	2.2	1
TRADE SCHOOL	1.8	-
OTHER INDUSTRY	1.3	-
ARMED FORCES	1.0	-

- Seventy-nine percent (19 of 24) of the companies interviewed required all new personnel to participate in their formal training programs.

- The primary reason for this mandatory attendance was to establish a common base of understanding of the required procedures for functioning within the existing software maintenance organization and to provide detailed technical product information.

- Of the three companies who did not offer their own internal formal training program, two of the three companies obtained training from other sources.

  - One PCM company simply sent their people to courses offered by IBM.

  - The second company sent their people to end user product familiarization courses which were simply general systems overviews. This company was very dissatisfied with this approach and is currently in the process of developing its own software maintenance course which is to be oriented specifically to entry level personnel.

  - The third company simply relied on hiring experienced personnel from end user organizations and indicated it was a "sink or swim situation" for the new personnel.

- With the increased demand for software maintenance personnel, it appears that companies will have to continue their formal training programs at a high level of activity.

2. TYPES OF TRAINING PROGRAMS

- There were basically two types of training programs offered to software maintenance personnel by the companies interviewed. These were:

- Procedures and operations.

- Technical product training.

- Over half of the companies provided training in both areas. There was much heavier emphasis on procedures and operations among companies hiring experienced personnel.

- These courses ranged in length from five to ten days and were usually conducted immediately after the new employee reported to work.

- The procedures and operations training was an orientation course which dealt with "how to do it" and contained the following types of elements:

  - Organization structure.

  - Reporting and forms.

  - Internal company interface, e.g., hardware maintenance personnel, marketing and sales, product development.

  - Software documentation and specification.

  - Detailed policy and procedures.

- The primary purpose of these courses is to provide an orientation on internal company functions and interfaces in dealing with various software maintenance situations. The goal is to establish a common knowledge about procedural issues for accomplishing the maintenance activities.

- The technical product training is designed to provide detailed technical information about the various products that are to be maintained.

- When there is training provided on applications programs, it is usually provided by a training department which is outside of the software maintenance organization.

- It is interesting to note that two of the companies have within the last 18 months, started to include as part of their training what they both referred to as "people training."

- This addition to their training program is for the purpose of improving the human communication and interface skills of these personnel. It is primarily designed to present to the end user the correct "image" of that company.

- These types of training deal with such factors as personal appearance, handling "stress" situations (unhappy customer), and the development of other people - oriented skills.

- INPUT expects that there will be increased emphasis placed by companies in this area for both software and hardware field service personnel. This will be particularly true as data processing capabilities move into non-sophisticated end user environments.

3. OTHER TYPES OF TRAINING

- In addition to the formal training program that is provided at the beginning of the employees tenure with field service, sixteen of the companies provided additional on-going training. Exhibit VI-3 provides a tabulation of the types of additional training that is provided.

  - Although on the job training only received four mentions, it is probably much more extensive than that because of the types of working relationships that are established in the field.

  - Three of the companies interviewed had developed courses at the branch level. These were advanced courses beyond the formal training

EXHIBIT VI-3

OTHER TYPES OF SOFTWARE MAINTENANCE
TRAINING PROVIDED BY COMPANIES INTERVIEWED

TYPE OF TRAINING	PERCENT OF COMPANIES	NUMBER OF COMPANIES
NONE	33%	10
ADDITIONAL TRAINING AT BRANCH LEVEL	32	9
ADDITIONAL TRAINING AT CORPORATE	16	5
ON THE JOB TRAINING	13	4
VIDEO TAPES AT BRANCH LEVEL	3	1
ADDITIONAL IBM COURSES	3	1

NOTE: SOME COMPANIES PROVIDED MORE THAN ONE FORM OF ADDITIONAL TRAINING.

program and were directed to specific customer/product requirements of that branch.

- Only five of the companies have set up a formal mechanism for returning personnel to the headquarters or other training locations for additional training.

4. TESTING AND EVALUATION

- During the formal training program for software maintenance personnel, 70% (14 of 20) of the companies conducted formal testing of the students.

- The purpose of these testing sessions was to determine the students' progress and were not designed to eliminate students from the training program who were doing poorly.

- Several of the companies had developed fairly extensive evaluation schemes.

  - One company had been using a case study method where they set up in the laboratory environment, simulations of actual types of maintenance situations that had occurred. The student was required to interface with simulated end users in a field environment as part of the testing.

  - A second company had set up a testing program which was self-paced and allowed the student to attempt to solve a variety of software maintenance problems. This company believed this program was very effective, since it allowed personnel to move through a wide range of problems in a short period of time and be available for a field assignment very quickly.

5. TYPE OF INSTRUCTION

- Eleven percent (2 of 19) of the companies rely on lecture only for their formal training program. Their lecture-only training programs were limited to those

companies that offered only the five to ten day procedures and operations course.

- The majority relied on a combination of lecture, actual demonstrations, and "hands on" experience. About as much time was spent in a laboratory environment as it was in the classroom.

6. DEVELOPMENT SOURCE AND LOCATION OF TRAINING

- Of the twenty companies that provided information, all stated that all course material was developed by the company itself.

  - Over half of the companies relied on assistance from a company training group outside the field services organization.

  - Courses which dealt with detailed product information were developed for both internal and customer training.

  - Many of these product-oriented courses were augmented with additional information geared specifically for software maintenance personnel.

- None of the companies interviewed felt a need to use outside training development companies for course development or instruction.

- The average length of time companies had been offering a formal traininng program was four years with a range of from 1.5 to 10 years.

- Exhibit VI-4 provides a distribution of the locations where the training program was offered.

  - Company headquarters is clearly the dominant choice for conducting the formal training program because of the centralization of the necessary training resources.

EXHIBIT VI-4

LOCATION OF FORMAL SOFTWARE MAINTENANCE
TRAINING BY COMPANIES INTERVIEWED

LOCATION	PERCENT OF COMPANIES	NUMBER OF COMPANIES
CORPORATE HEADQUARTERS	59%	14
TRAINING CENTER	33	8
RESEARCH CENTER	4	1
BRANCH OFFICE	4	1

- However, some of the larger companies had established specific training centers for their formal training program. These were training centers that were used for all field service training and not just specifically for software maintenance training.

- One company conducted its training at a branch office level, which consisted of a five day procedures and operations course.

7. EFFECTS OF FORMAL TRAINING ON COMPENSATION AND RETENTION

- At the completion of the formal training program, only one of the companies interviewed indicated that personnel receive a salary increase.

- This company conducted a nine-week formal field services training program, with about one-third of the time dedicated to software maintenance training.

  - These salary increases ranged between 7-12%, based on the student's performance during the training program. It was not an "automatic" raise for all personnel attending the training program.

- The rest of the companies interviewed had salary increases tied directly to either semi-annual or annual salary review cycles. Successful completion of the formal training program was only one factor considered in determining the salary increase.

- Sixteen percent (4 of 25) of the companies interviewed indicated that there was a movement of personnel from the field service organization after the completion of the formal training program.

- This movement of personnel was attributed to a number of factors, but because of the limited response, no attempt was made to quantify the responses. Primary reasons given were exposure to other company organizations that looked more attractive and rewarding.

- Other organizations mentioned that personnel moved to:
  - Software development.
  - Sales.
  - Marketing.
  - Systems engineering.

C. CURRENT AND PLANNED TRAINING COSTS

- Companies were very reluctant to provide quantitative information about their current training costs. However, four companies did provide estimates of their cost per student day for current training.
  - These costs ranged from $200 to $325 with an average cost of $250 per day.
  - These costs included instructor time and student salary, but did not include any associated travel costs.
- Similarly, companies were reluctant to provide information about the total size of their current training budget. However, it was possible to obtain this information from four companies and this is presented in Exhibit VI-5.
- However, companies were more willing to provide information on their projected training costs for 1980, and why they were occurring.
- Of the 22 companies who provided information in this area, 73% (16 companies) were planning to increase their training budget for 1980.

EXHIBIT VI-5

CURRENT TRAINING BUDGET AND PERSONNEL
GROWTH BY COMPANIES INTERVIEWED

COMPANY	SIZE OF SOFTWARE MAINTENANCE ORGANIZATION	PERCENT PERSONNEL GROWTH, LAST 12 MONTHS	CURRENT TRAINING BUDGET
1	40	0	$ 6K
2	100	30%	$ 30K
3	30	(NO DATA)	$200K
4	115	80	$350K

- Of the 16 companies that were planning on budget increases, 10 provided data on the expected increase in their budgets.

  - These budget increases ranged from 10 to 25%, with an average planned increase for 1980 of 19%.

- Other than inflationary reasons, companies provided the following comments on why their budget will increase in 1980:

  - "There will be more systems to learn about."

  - "Will need more people as more systems are installed."

  - "Need to better the overall quality of field service personnel."

  - "Recently began program, so need large expansion to include all systems."

  - "Will need to train in remote diagnostic techniques."

  - "Will need to provide training on firmware."

  - "Will distribute classes to more locations."

  - "Will train hardware people to do first line software maintenance."

  - "Software maintenance will be made a profit center so more extensive training will be needed."

  - "Will train centrally, using CCTV and video tape."

  - "Will move training program from training department to field service."

- As can be seen from the preceding comments, companies have a wide range of reasons for increased training costs in 1980.

- The six companies that were expecting no increase or a decline in their training budget were basing their plan on the following reasons:

  - Both companies were completing the development of a remote diagnostic system for software maintenance.

  - Both companies were releasing improved system software that they believed would be more reliable and would require less training.

VII FUTURE TRENDS IN SOFTWARE MAINTENANCE

VII FUTURE TRENDS IN SOFTWARE MAINTENANCE

A. PERCEPTION OF MAJOR ISSUES

- As presented in Exhibit VII-1 INPUT identified a number of major issues that respondents were asked to rate in terms of how they would shape their software maintenance policies over the next five years. Their issues were rated on a scale of 1-5 with 5 being high. In the event more than one issue received a score of 5, respondents were asked to rank the 5s.

- As shown in Exhibit VII-1, the three issues in order of importance to software maintenance are:

  - Remote diagnostics.

  - Distributed data processing.

  - Personnel availability.

1. REMOTE DIAGNOSTICS

- Remote diagnostics appears to be the issue of most concern in shaping software maintenance policies. It has significant implications for personnel qualifications, maintenance organization structure, and procedures for accomplishing maintenance.

EXHIBIT VII-1

RATING OF FUTURE ISSUES
ON SOFTWARE MAINTENANCE POLICIES

FUTURE ISSUE	WEIGHTED SCORE	NUMBER OF RESPONSES RANKED 5
REMOTE DIAGNOSTICS	4.2	11
PERSONNEL AVAILABILITY	4.2	3
DISTRIBUTED DATA PROCESSING	4.0	4
USER INVOLVEMENT	3.0	0
FIRMWARE	2.9	1

- If remote diagnostics were implemented for the accomplishment of a significant part of the diagnostic segment of software maintenance, it will be possible to support users with a less qualified staff in the field locations. This, in turn, implies that it will be possible to reduce software maintenance costs at the personnel level. However, these reductions in cost must be traded off against increased communications cost for system operation and development and maintenance costs associated with the development and maintenance of a remote diagnostic center.

- The implementation of a remote diagnostics center would require changes in the organization of the field service force, both for structure and manning levels. Immediate access to the remote diagnostic center by the first line of software maintenance personnel could possibly eliminate or reduce the number of levels within the field service organization.

- It is possible with a remote diagnostic capability to involve the user directly in the diagnostic process without the assistance of field service personnel at the user location.

- The establishment of a communications network to support the remote diagnostic center would also provide the capability to directly transmit software corrections and updates over this network. This would permit very rapid response to critical maintenance problems.

- Companies who rated remote diagnostics of great importance provided the following types of amplifying comments:

  - "Will reduce the number of on-site calls."

  - "Will be able to reduce the number of field support personnel without reducing service."

- "Will be the way to good and effective software maintenance."

- "Must do, since enough qualified people will be impossible to find."

2. DISTRIBUTED DATA PROCESSING

- Distributed data processing was the second most important issue in shaping future software maintenance policies. In other studies conducted by INPUT during the last year, it has been estimated that by 1982 the data processing hardware market will have increased to $20 billion. Of this $20 billion market, 30% will be associated with DDP related systems.

- The importance of this market size to the demands placed on software maintenance organizations cannot be underestimated.

  - It will significantly increase the number of user sites that must be maintained over larger geographic areas.

  - Many of the users will be unsophisticated and will probably require a greater level of support by the software maintenance organization.

- These two factors alone will require field service management to conduct a critical evaluation of the traditional methods of providing software maintenance. Simply providing more of the same will not get the job done.

3. PERSONNEL AVAILABILITY

- Personnel availability was the third most important issue stated by the companies interviewed. Of primary concern was the ability of companies to locate and recruit personnel for the increased demands that will be placed on their organizations.

- While distributed data processing will place the highest demand, companies which are actively in the process of implementing remote diagnostic capabilities for software maintenance will be able to somewhat offset this demand.

4. USER INVOLVEMENT

- User involvement did not receive a high rating as a significant issue. However, three of the companies were planning their future software maintenance policies around heavier involvement of the user. They believed that this user involvement coupled with a remote diagnostic capability will permit them to reduce their costs.

B. EXPECTED CHANGES IN SOFTWARE MAINTENANCE

- Associated with the previous rating of important issues, companies were asked to select those areas in which software maintenance will change over the next five years.

- The results of this line of inquiry is summarized in Exhibit VII-2. While the majority (65 to 77%) of the companies interviewed did expect changes in all areas, there was not always unanimity of the type of change or why they would occur.

1. PERSONNEL QUALIFICATIONS

- Sixty-five percent (17 companies) expected changes to occur in this area. There were two trends that were apparent in this area.

  - The requirement for qualifications in the applications area was of concern. This was the result of company's plans to provide a wider range of software products beyond systems programs.

EXHIBIT VII-2

COMPARISON OF FACTORS EFFECTING
FUTURE SOFTWARE MAINTENANCE POLICIES

FUTURE	SIGNIFICANT CHANGE	
	PERCENT OF COMPANIES	NUMBER OF COMPANIES
DIAGNOSTIC TOOLS	77%	20
SOFTWARE MAINTENANCE PRICING	77	20
TRAINING	73	19
ORGANIZATION	69	18
PERSONNEL QUALIFICATIONS	65	17

- There was an indication that less qualified personnel could be used because of the implementation of a remote diagnostic capability. Although there would be a central core of highly qualified specialists located at the remote diagnostic center, the personnel at the field sites would be less qualified than the current field force.

2. ORGANIZATION

- Sixty-nine percent (18 companies) expected changes to occur in this area.

  - The dominant theme was to more centralization of the organization. Again, this is directly coupled to the implementation of a remote diagnostic capability.

  - There were also some conflicts in the placement of the software maintenance function within the overall field services organization. Two companies were planning on separating these functions into two separate line organizations, while two other companies were planning on just the reverse.

3. TRAINING

- Seventy-three percent (19 companies) expected changes to occur in this area.

  - With the availability of a remote diagnostic capability, the training for field personnel would be more difficult than current types of training. Although it was expected that the field sites would be able to operate with less qualified personnel, the current training curriculum would have to be modified to meet this new working environment.

  - The other change was in the area of applications software. Four of the companies were planning to expand their training into this area because of new product offerings that would be provided to first time end users.

4. DIAGNOSTIC TOOLS

- Seventy-seven percent (20 companies) expected changes to occur in this area.

  - As previously discussed, remote diagnostics was of major importance in improving the efficiency of the software maintenance organization.

  - It was expected that remote diagnostics would be the main diagnostic tool and would relieve the field personnel from performing this function.

5. PRICE OF SOFTWARE MAINTENANCE

- Seventy-seven percent (20 companies) expected changes to occur in this area. The issues raised by software maintenance managers in this area were somewhat contradictory.

  - Ten of the companies expected the price for software maintenance to increase over the next five years, but were not willing to quantify the increases. Their price increases were the result of a number of factors other than inflation. The factors mentioned were increased personnel costs, use of value-added pricing structures, and unbundling from hardware maintenance pricing.

  - Two of the companies were planning on decreasing their current software maintenance prices. It was believed that these price reductions could be achieved because of the expected increase in the reliability of new software products and improved diagnostic capabilities.

C. IMPORTANCE OF SOFTWARE MAINTENANCE

- Software managers were asked whether software maintenance activities would increase or decrease in importance over the next five years. Although the personnel interviewed would be expected to be biased in their opinion, 96% (25 of 26) of the managers interviewed believed it would increase in importance. Even with this bias, their perception of software maintenance is important.

- Major reasons why they believed this increase in importance are:

  - The expected increase in the reliability of the hardware will result in more visibility in software maintenance.

  - The differentiating characteristic in future sales situations will not be the hardware, but rather the software as the cost for hardware maintenance on a per installation basis decreases.

- While there was an expectation of increased demands placed on the software maintenance organization in terms of both performance and cost, it was apparent that improved software reliability was of equal or greater importance.

  - The more use that a software product receives in the field, the more likely that software faults will be detected. As these software faults are corrected, the reliability of the product improves. Although it would have been possible to detect and correct many of these faults during the testing phase prior to product release, the demands of the marketplace and the cost of testing and associated post sales maintenance and support does not always permit it.

  - Users are becoming more sophisticated. Associated with this will be an increased demand for improved software maintenance.

- At the same time, the introduction of an increased number of DDP systems will require an interface with a new class of first time end users who will require additional software maintenance support.

- With the unbundling of software, there will be increased demands placed on software maintenance organizations to control costs. In some cases, there is an expectation that software maintenance will become a new or increased profit generator for the company.

- To deal with this software reliability issue, several of the companies interviewed use software maintenance management personnel during the development of new software products. The role played by these managers is one of design review and consultation.

- It is believed that this provides another perspective in reviewing the software product under development and provides a vehicle for detecting weakness in the reliability of the product and will receive increased emphasis.

APPENDIX A: COMPANY QUESTIONNAIRE

PRELIMINARY

A. Software Maintenance Organization

1. What is the current size of your field services organization? _____

2. Of this total organization what percent are dedicated to software maintenance? _____%

3. Which of the following best describes the organization of your software maintenance personnel?

   Geographic _____

   Functional _____

   Product _____

   Other _____

   Please describe _____

   _____

4. What is the title of the senior executive in your company responsible for software maintenance? _____

5. Has this changed within the last twelve months? ( ) Yes ( ) No
   If yes, why? _____

   _____

6. Of this software maintenance organization, please indicate percent located at field sites and percent located at headquarters/remote sites.

   Field sites _____%

   Hqs/Remote sites _____%

7. During the past twelve months has your software maintenance organization changed in size?

( ) Yes ( ) No

Percent Increase _____%

Percent Decrease _____%

Please comment: _____

_____

8. Which of the following organization elements are involved in software maintenance?

Field Organization _____

Separate Support Organization _____

Remote Support Centers _____

Other Organization Element (specify)

_____ _____

9. If more than one organization element is involved, please describe the relationship among these elements.

_____

_____

_____

_____

_____

B. Software Maintenance Support

1. What types of software maintenance is provided?

_____ Systems Software _____No. of products

_____ Applications Software _____ No. of products

2. During the past 12 months how many total maintenance calls did your field service organization handle? _____

3. Of those maintenance calls, how many were software related?

_____

4. Of the software maintenance calls, please indicate the percent handled by the following method:

_____ % Phone

_____ % Customer Site Call

Comments: _____

_____

5. What types of software diagnostic tools are provided to your field service personnel?

_____

_____

_____

_____

6. What types of software maintenance documents are provided to your field service personnel?

_____

_____

_____

_____

7. What types of software maintenance documents are provided to customer personnel?

_____

_____

_____

8. What is the role of the field service personnel in responding to a "software fault" call at the customer location?

_____

_____

_____

_____

9. What is the cost to your organization of a typical software maintenance call? $ _____.

What is the range of costs for a maintenance call?
$ _____ to $ _____.

10. Is the diagnosis and repair of a "software fault" at a customer site different from a hardware fault in terms of cost?

( ) Same

( ) Increased cost _____%

( ) Decreased cost _____%

11. How are these "software faults" disseminating to other customer sites that have the same system installation?

_____

_____

_____

_____

12. Is the field service organization involved in this process?

( ) Yes ( ) No

If yes, what is their involvement? _____

_____

_____

_____

13. When your company releases new software, either updates to current products, or new products, what is the role of the following:

a. Field Service Organization _____

_____

b. Other company Organization _____

_____

c. User _____

_____

d. Is the field service organization involved in the installation and test of these products?

( ) Yes ( ) No

If yes, what is the level of involvement _____

_____

_____

C. Software Maintenance Billing

1. Which of the following billing methods do you use for software maintenance?

	Average Monthly Charge
_____ Included in monthly/annual service charge.	_____
_____ Billed as a separate monthly/annual charge.	_____
_____ Billed as a Time & Material rate.	_____

2. How long has the current billing method been used? _____

3. If less than 18 months, when was it changed? _____

4. What were the reasons for the change? _____

_____

_____

5. Do you provide a software warranty?

   Applications S/W ( ) Yes ( ) No
   System S/W ( ) Yes ( ) No

   If yes, for either type software, could you please provide us with a copy.

6. In your company do you consider maintenance as a:

   ( ) Profit Center
   ( ) Cost Center

7. If you operate as a profit center, what were your total estimated maintenance revenues in 1978 _____ % S/W related _____

   1979 _____ % S/W related _____

8. Over the next five years at what annual rate do you expect your maintenance revenues to increase _____%

9. What will be the primary contributors to this increased revenue?

   _____

   _____

   _____

D. Field Service Personnel Selection and Training

1. Please rate the importance of the following sources in obtaining personnel for your field services organization (5 = highest number of personnel, 1 = lowest number of personnel) for 1979 and your projection for 1983.

FACTOR	RATING (1979)	RATING (1983)
a) Hire and train yourself		
b) Recruit from competition		
c) Recruit from other industries		
d) Trained discharged armed forces personnel		
e) Recruit from other functions within your company (e.g., manufacturing, engineering)		
f) Trade Schools		
g) Other (describe)		

2. Do you have a formal training program for field service personnel in software maintenance?

( ) Yes ( ) No

If yes:

Course Title	Number Of Training Days	Class Size	Cost Per Student Day	Frequency Offered	Type Of Course	Formal Testing	Where Developed	How Long Offered	Where Offered Hq.,Branch

If no, what methods are used for software maintenance training? _____

_____

_____

3. Are all field service personnel required to take these courses?

( ) Yes ( ) No. If no, what are the criteria for selecting personnel to attend these courses? _____

_____

_____

4. What other types of software maintenance training is offered?

_____

_____

_____

5. At completion of software maintenance training are field service personnel given a salary increase?

( ) Yes ( ) No Average Percent Increase _____%

6. As the result of providing software maintenance training have you seen a trend for field service personnel to move to other organizations within the company?

( ) Yes ( ) No.

7. What do you estimate will be your total cost in 1979 for software maintenance training? $ _____.

8. Do you believe your software maintenance training costs will increase in 1980?

( ) Yes ( ) No If yes, by what percent _____%

9 What are the major reasons for this increase in software maintenance training costs?

_____

_____

_____

E. Future of Software Maintenance

1. Please rate the following (1 = low, 5 = high) in terms of their importance in shaping your maintenance policies over the next five years.

Factor	Rate	Rank 5's	Comment
Remote Diagnostics			
Firmware			
Distributed Data Processing			
User Involvement			
Personnel Availability			
Other Technology Changes (specify) _____			
_____			

2. Do you believe there will be significant changes in any of the following areas over the next five years in terms of software maintenance in your company?

Area	Yes	No	Type of Change
Personnel Qualifications			
Organization			
Training			
Diagnostic Tools			
Price/Software Maintenance			

3. Over the next five years do you believe that within your company software maintenance activities will increase/decrease in importance?

Why? _____

_____

_____

APPENDIX B: TYPES OF COMPANIES INTERVIEWED

EXHIBIT B-1

TYPES OF COMPANIES INTERVIEWED AND 1978 REVENUES

COMPANY	TYPE OF PRODUCT			1978 REVENUES				
	MAINFRAME	MINI	SMALL BUSINESS	>$100M	$100-500M	$500-1B	$1B-2B	<$2B
1		X	X		X			
2		X		X				
3.		X	X		X			
4	X	X	X				X	
5	X	X	X					X
6	X	X	X					X
7		X	X		X			
8		X	X		X			
9	X	X	X		X			X
10		X	X	X				
11		X		X				
12		X		X				
13			X	X				
14		X						X
15		X	X			X		
16		X	X	X				
17		X	X	X				
18	X	X	X				X	
19	X	X	X					X
20	X					X		
21		X	X	X				
22	X				X			
23		X				X		
24		X			X			
25		X			X			
26		X	X				X	