DISTRIBUTED DATA PROCESSING SYSTEMS: APPLICATIONS, PERFORMANCE & ARCHITECTURE

INPUT

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INPUT provides planning information, analysis, and recommendations to companies 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 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.

Professional staff have, on average, nearly 20 years experience in the information processing industry. Most have held senior management positions in operations, marketing, or planning. This expertise enables INPUT ... y practical solutions to complex business probl...

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DISTRIBUTED DATA PROCESSING SYSTEMS

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1 INTRODUCTION

I INTRODUCTION

A. PURPOSE AND SCOPE

- This report is produced by INPUT as part of the Market Analysis Service (MAS) for the Computer Services Industry.

- The intent of the study was to ascertain the degree to which Distributed Data Processing (DDP) has been accepted and implemented within four major domestic industry sectors.

- It was INPUT's purpose to sample selected portions of the user environment for purposes of developing a clearer understanding of the extent to which DDP is being accepted as a working concept.

  - INPUT has conducted approximately 200 on-site interviews thus far in 1978 of DDP users in support of both custom and company funded research.

- The above information, when integrated with other related research performed by INPUT, serves as the basis for generating market projections through 1982.

- These projections are limited to determining the number of minicomputer and small business computer (SBC) systems that will be employed in DDP applications, and do not include special or general purpose intelligent terminals.

- Additional qualitative issues that INPUT worked to clarify as a result of this work included:

  - Determining how DDP is economically justified by users and their cost/performance results to date.

  - Defining the DDP decision making process and its impact upon the organizational structure.

  - Identifying those key forces that are either inhibiting or motivating the acceptance of DDP.

  - Defining the significant technical and marketing issues related to DDP.

  - Gaining an improved perspective of the complex competitive environment.

B. RESEARCH AND METHODOLOGY

- The research for this study was predicated upon two sets of questionnaires developed by INPUT and utilized during both telephone and on-site interviews with both users and vendors.

- Telephone screening methods were used to arrange the detailed on-site interviews with senior personnel who could speak with authority regarding DDP.

- The industry sectors that were selected included retail and wholesale distribution, banking and discrete manufacturing and process manufacturing. Each of these groups are known to have large EDP expenditures and are sensitive to leading edge concepts.

- Forty interviews were arranged with Fortune types of firms who were randomly selected and subsequently qualified as credible DDP respondents.

  - Half of these user interviews were conducted on-site by an INPUT senior staff member and resulted in sessions ranging up to four hours in length. The balance of the interviews were completed over the telephone.

- Eighteen vendors were surveyed and nine on-site interviews conducted by senior personnel.

- The focus of the interviews was to determine representative user and vendor attitudes and experience and not to construct a statistically valid sample. Accordingly, other market related information developed by INPUT, or available in the public domain, was used in constructing DDP market estimates and forecasts.

- Definitions of DDP and other terms used in this report are contained in the Appendix.

- Client inquiries and comments are invited.

II EXECUTIVE SUMMARY

II EXECUTIVE SUMMARY

A. MAJOR CONCLUSIONS

1. DDP IN PERSPECTIVE

- Although DDP appears to have been employed by a selected number of end users for ten or more years, it has been only over the last two to three years that wide spread implementation has begun.

- Accordingly, the concept's acceptance has been largely limited to the Fortune class of industrial companies or major firms in banking, insurance and retailing.

- Exceptions to the preceding are to be found in two areas, including:

  - Computer services vendors are increasingly offering small users access to DDP networks, thus affording them an opportunity to reap the benefits of distributed processing with limited investment in time and resources; e.g., Shared Medical has successfully marketed DDP services, and ADP's recent ONSITE product announcement represents an aggressive commitment to this market.

  - Managements of some companies in the $100-500 million annual sales range have adopted DDP methods as part of an operating strategy to

initiate or sustain relatively rapid rates of growth. Case studies on several of these companies are included in the body of this report.

- INPUT has concluded that, based upon our research to date, the banking, process and discrete manufacturing sectors will continue to lead the way in adopting DDP techniques.

- Other sectors, with the exception of insurance and retailing, appear to be laggards in moving toward DDP.

- The concept's adoption has been evolutionary, with recent acceleration occasioned in part by the sharp price/performance improvements in intelligence based products including programmable terminals, microcomputers and minicomputers.

- INPUT forecasts the data processing hardware market as increasing from about $10 billion in 1977 to $20 billion in 1982. As shown in Exhibit II-1, the percentage of those systems operated within a DDP environment will increase from 15% to 30% during that time period.

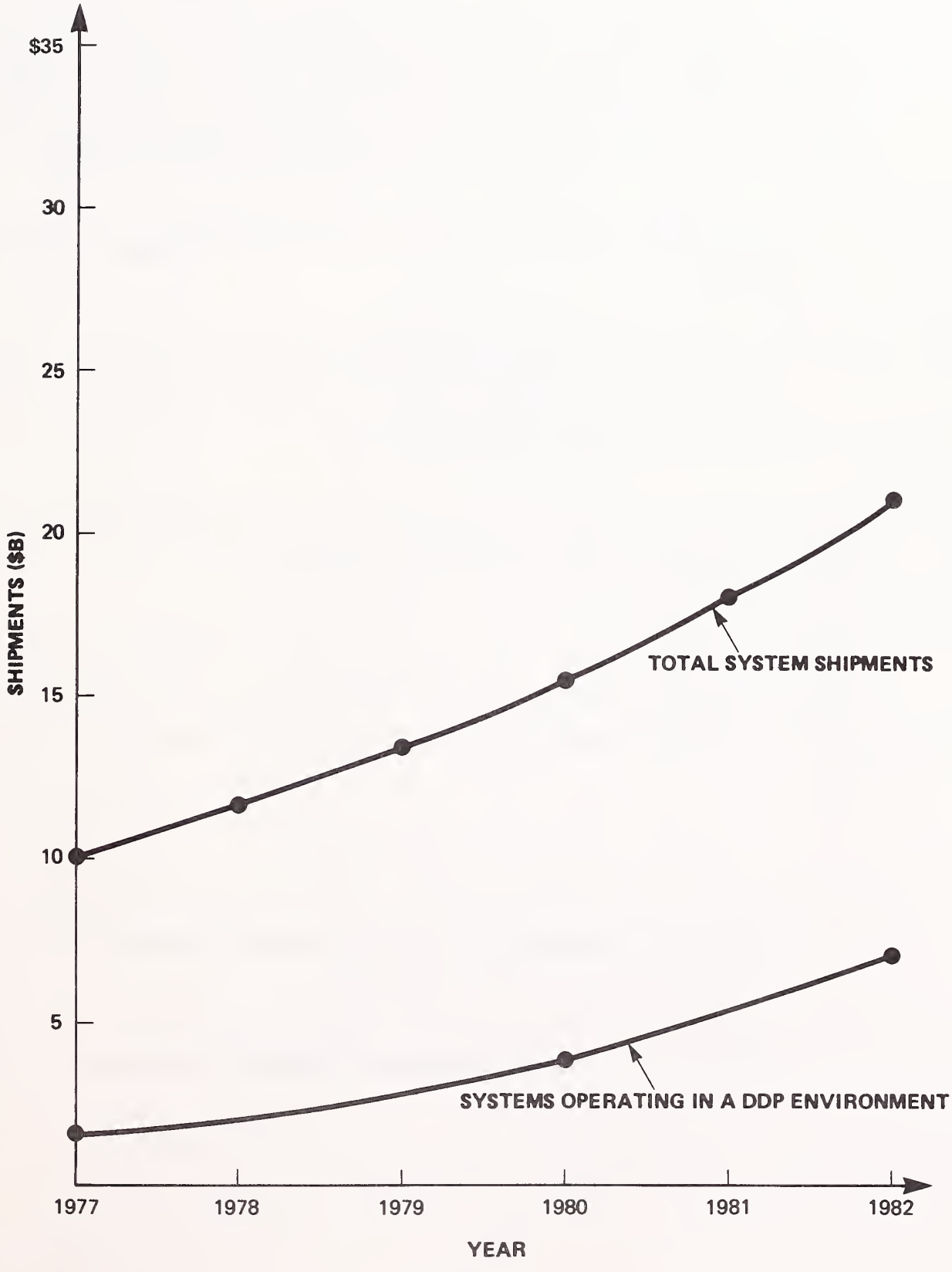
  - INPUT forecasts that the rate of price/performance improvements in both minicomputer and mainframe classes of machines will continue at average annual rates of 15% and 25% respectively through the mid-eighties, representing cost/performance improvement factors of 4 and 9 respectively over a ten year period.

  - Accordingly, hardware costs will assume a lower level of relative importance vis-a-vis the costs associated with both applications and network software, minicomputers, operating personnel, systems design and implementation, and network communication costs.

- The current lack of communications expertise by users, particularly within smaller companies, is a major deterrent to the wider acceptance of DDP.

EXHIBIT II--1

ALL U.S. COMPUTER SYSTEM SHIPMENTS
AND SYSTEMS OPERATING IN A DDP ENVIRONMENT (1977–1982)



- Over the long-term, AT&T's recently introduced Advanced Communications Service (if permitted to be offered by the Federal Communications Commission) would go a long way in alleviating these and other difficulties; e.g., a lack of hardware and protocol standards.

- Large mainframe users continue to be dissatisfied with the lack of equipment standards among vendors and the software and documentation difficulties encountered in initially attempting to work with minicomputers. However, this has not prevented companies from transitioning to DDP by either:

  - Reluctantly selecting a single vendor and adopting the vendor's standards or,

  - Developing their own system from the "ground up" after convincing themselves that suppliers could not (or would not) satisfy their performance and service requirements.

- Users believe that no single vendor currently offers complete DDP capabilities including hardware, software and telecommunications.

- INPUT's survey of users reveals a singular lack among many of the more recent converts to DDP of hard quantitative measures substantiating the concept's anticipated cost/performance benefits. We attribute this in part to the:

  - Pilot status of many of these installations.

  - The greater than expected difficulties and costs encountered in implementing distributed processing systems.

  - A general lack of post-auditing procedures within corporations.

- Nonetheless, the survey concluded that DDP does solve more problems than it creates and that its acceptance among users is growing, although not at the rate that vendors' pronouncements or some media puffery suggests.

2. DRIVING FORCES

- Key factors that are contributing to increased distributed data processing implementation include:

  - A desire to slow the rate of mainframe utilization and subsequent upgrade.

  - Its use as an aid in facilitating the decentralization of an operating entity while maintaining centralized EDP control.

  - Remote user dissatisfaction with the timeliness of centralized reporting.

  - The inherent difficulties of accurately entering and manipulating data at computer centers that are physically removed from their remote source.

  - Dramatic increases in the cost/performance capabilities of computers coupled with increasing integration of intelligence within various peripheral products.

  - DDP's use as a market strategy tool by users in order to become more responsive operationally to dynamic market opportunities.

  - Being able to build redundancy and fail safe features into critical operations at costs that are affordable.

  - The potentially favorable financial impact (balance sheet and profit and loss) resulting from reducing inventories, increasing accounts receivable

turnover, improving cash management and reducing personnel requirements.

- Another driving force not to be overlooked is the momentum generated by a variety of vendors (most recently IBM with its Series/1 minicomputer) in serving to attract more user attention to distributed processing.

3. MARKET OUTLOOK AND PROJECTIONS (1978-1982)

- INPUT estimates the growth of DDP through the forecast period will primarily impact the shipments of minicomputers and small business computing (SBC) systems. Forecasts in this report therefore include only these systems. They do not include large host computer systems or special/general purpose intelligent terminals.

- In 1977, INPUT estimates that 70,000-75,000 minicomputer and SBC systems were shipped into all industry sectors of the United States market and that less than 10% of this total was actually shipped into a DDP applications environment.

  - Accordingly, the 1977 domestic market for minicomputer and SBC systems in a dedicated DDP environment was approximately $250 million of the total shipments of $2.5 billion.

- INPUT projects that in 1982 there will be approximately 225,000 total minicomputer and SBC systems shipped into the domestic market representing a 27% average annual growth rate (1977-1982). These systems are assumed to have an average value of $35,000.

  - In 1982, INPUT forecasts that approximately 20% of these systems will be utilized in a dedicated DDP environment which will yield a market value of $1.6 billion for this class of product.

- It is important to emphasize that, although these systems will represent over 85% of the total computer units shipped into DDP applications, large mainframes (DDP hosts) will actually account for over 70% of the total system value (exclusive of terminals). However, these large hosts will continue to perform non-DDP related applications for over 50% of their operating time.

- Exhibit II-2 summarizes DDP projections and offers the following major conclusions:

  - The retail and wholesale distribution sector represents the fastest growing DDP market segment through 1982.

  - 68% of unit shipments of minicomputer and SBC systems going into a dedicated DDP environment in 1982 will be in discrete and process manufacturing.

  - The relatively low unit shipments into banking of minicomputer and SBC systems is largely offset by heavy shipments of special purpose terminals which are excluded from the forecast.

  - The overall DDP market for SBC and minicomputer system shipments will grow at a 48% compound rate through 1982.

4. KEY USER ISSUES

- There is no "universal" definition of DDP. Users have implemented distributed processing in a manner that is structured to satisfy their individual requirements.

- A broad consensus of users believes that there are no viable data base management software (DBMS) systems available today to support host or remote (minicomputer) management and control requirements. Until such time as these products become available, their absence represents something of a deterrent to the adoption or expansion of DDP within user organizations.

EXHIBIT II--2

MINICOMPUTER AND SBC SYSTEM SHIPMENTS INTO A DDP ENVIRONMENT (U.S. - BY INDUSTRY)

	1977		1982		
INDUSTRY	TOTAL SYSTEM SHIP-MENTS(K)	DDP UNITS (K)	TOTAL SYSTEM SHIP-MENTS(K)	DDP UNITS (K)	DDP AAGR (%)
DISCRETE MANUFACTURING	24	2.60	58	16.0	44
DISTRIBUTION (RETAIL AND WHOLESALE)	7	0.55	32	6.5	63
BANKING	2	0.40	8	3.0	49
PROCESS MANUFACTURING	18	1.80	53	14.5	51
OTHER	21	1.20	74	6.0	40
TOTAL	72	6.55	225	46.0	48%

AAGR = AVERAGE ANNUAL GROWTH RATE

- IBM's System Network Architecture (SNA) is the principal network approach under consideration or being actively implemented by users. Competing network structures were rarely encountered.

- Users are projecting that an increasing percentage of their hardware budget will be spent for DDP equipment through 1982.

- Not surprisingly, there appears to be a close correlation between geographically dispersed organization structures and a predilection to adopt DDP methods.

- A decision to adopt DDP frequently evolves over a long period of time and the decision making process (including vendor selection) does not differ significantly from other EDP selection methods.

- Users with limited experience in dealing with minicomputers found that program development and debugging took longer than expected and attributed these problems to software limitations and inadequate documentation.

- Users continously emphasized the need to engage in detailed planning in implementing their DDP programs. Several expressed disappointment in having selected the lowest bidder in hardware procurement, particularly when dealing with relatively new products offered by smaller vendors.

- Additional risk areas that users expose themselves to in considering the smaller vendors of DDP equipment are the field maintenance, documentation and support areas.

- Smoother and more error free DDP operations have resulted from:

  - Added efforts to train remote site user personnel properly.

  - Using equipment that is technically transparent to users.

- Remote pilot installations have required anywhere from 3-12 months to become operational and have almost uniformly been underestimated in terms of the amount of actual difficulty encountered in getting up and running. Management may require as much as one year of operating data from pilot installations prior to activating additional remote sites.

- Remote site operating environments, particularly in retail stores and warehouses, have frequently proven to be more hostile to DP equipment than initially anticipated by the user or the vendor.

- Some users expressed dissatisfaction with telephone company communications services, citing:

  - Reliability (particularly in rural areas).

  - High tariffs and,

  - A lack of equipment standards from one operating company to another as reasons for their examining alternate network solutions.

- No new or unusual applications were uncovered as a result of DDP; rather, traditional EDP applications are being reimplemented in a DDP environment.

- Respondents were not well prepared to discuss the relative percentage of applications processing being done at the node versus the host. There were very few instances where applications were being completely processed at the node.

- The primary means of transferring data to the host was via remote batch mode.

- Seventy percent of the respondents currently used RCS vendors.

- Half of the current users believed there would be no change in their use of such services over the short term.

- The remaining users expected, in varying degrees, a decrease in RCS expenditures.

- It should be noted that all of the respondents were large users. INPUT believes that the market for "on-site hardware" provided by RCS vendors to smaller users is very promising, because the RCS vendor offers the smaller user some of the benefits of DDP without the initial investment and complexity of having to install it themselves.

- Only 25% of the surveyed respondents were using or planning to use value added networks (VANS).

- Although distributed processing may appear to offer greater local control and management of the data entry and processing functions, it does not suggest increased DP autonomy at the remote site. Centralized control of equipment procurement and systems development will continue to be carried out at corporate or divisional headquarters.

- Over the longer term, the degree of remote site autonomy will be directly related to management's organizational philosophy; i.e., centralized versus decentralized control.

- Only 10% of respondents relied totally on vendor supplied applications software. Fifty percent of all respondents used applications software that was exclusively developed in-house.

  - COBOL is the predominant software language followed in descending order by PL/I, ASSEMBLER, BASIC and FORTRAN.

  - Approximately 50% of all respondents were using a DBMS with IMS as the predominant installed product.

- Forty-five percent of the respondents expected to be developing their own network software.

- Office automation was generally regarded as being a positive driving force vis-a-vis DDP and potentially helpful in the future in justifying the cost of node equipment.

- The communications implications of DDP from both a technical and cost point of view will continue to be the single most pivotal issue controlling the rate of acceptance of the DDP concept.

5. THE DDP COMPETITIVE ENVIRONMENT

- The advent of DDP is serving increasingly to blur the lines of distinction between hardware, software and systems vendors while offering both opportunities and challenges to all of these suppliers.

- Four distinct classes of vendors have converged upon the DDP market and include:

  - Mainframes.

  - Minicomputers.

  - Remote computing services

  - Intelligent terminals.

  Taken together there are approximately 150 vendors addressing this market who have annual revenues exceeding $10 million.

- By leveraging their proven software, networking and communications expertise against a background of decreasing computer costs, RCS companies are uniquely capable of installing, operating and fully supporting turnkey DDP systems.

- However RCS vendor limitations may be found in:

  - Developing a credible maintenance operation.

  - Evolving a sales and marketing force capable of dealing with DDP systems.

  - Financial resources.

- Hardware vendors can no longer rely upon the traditional value added of packaging components and selling processing power. More effort is required in dealing with the pivotal value added components of software, communications and networking.

- One-third of the vendors sampled claimed that over 30% of their installed base of computers was employed in a DDP mode.

- The six most important industries targeted by vendors for DDP included:

  - Banking.

  - Manufacturing.

  - Government.

  - Insurance.

  - Distribution.

- Transportation.

- Vendors still perceive little impact from the IBM Series/1 but are increasingly concerned over more aggressive moves by IBM in DDP within the next two years.

- Most vendors are including office automation product offerings as part of their DDP strategy and have been increasingly committing themselves to developing compatibility with the IBM SNA/SDLC network architecture.

B. RECOMMENDATIONS

- Vendors must recognize that DDP is blurring the lines of distinction between hardware, software, RCS and telecommunications vendors. Accordingly, the following recommendations are relevant to all market participants.

- INPUT is convinced that DDP as a concept is gaining increased acceptance and vendors must include it as a factor in planning strategies.

- DDP is a fashionable buzz phrase that may be leveraged into selling volume quantities of minicomputers, intelligent terminals and ancillary services. However, the "price of admission" is to be able to offer value added products and services in software, communications and networking.

- Vendors who are attempting to forge a "rifle shot" marketing strategy would be well served to address the manufacturing, banking and retailing sectors.

- Consider that as DDP evolves it will offer excellent opportunities for smaller vendors to provide complete applications oriented solutions at DDP nodes on a turnkey basis.

- Structure a marketing strategy that recognizes what the users traditional concerns are:

  - Reliability.

  - Hardware and software compatibility.

  - Field maintenance.

  - Documentation and support.

- Develop and/or market a DBMS that will assuage user concerns regarding the loss of data control and that offers complete transparency to the unsophisticated operator.

- Regard each piece of intelligence based equipment as a potential node in a future network. This thinking should extend particularly to the office environment and encompass standalone SBC's, word processing, private automatic branch exhange (PABX) equipment and other forms of non-data communications.

- Aid the end user in solving his communications and networking problems either by:

  - Supporting IBM's ACF/SNA.

  - Providing interfaces with value added network services.

- Assist the user in concretely defining the cost/performance advantages of DDP.

- Consider the user's propensity for strong centralized control and target the DDP "sell" at the corporate DP manager.

- Evaluate joint venture relationships between computer services, hardware and telecommunications companies.

III USER DDP ATTITUDES AND MARKET CHARACTERISTICS

III USER DDP ATTITUDES AND MARKET CHARACTERISTICS

A. APPROACH

- The analyses and conclusions that follow were derived primarily from data collected during 40 user on-site and telephone interviews.

- Four basic industry sectors were selected and included:

  - Distribution (retail and wholesale - 10 interviews).

  - Discrete manufacturing (11 interviews).

  - Process manufacturing (10 interviews).

  - Finance (banks and savings and loan institutions - 9 interviews).

- Many of these questions were of an open ended nature and yielded highly qualitative types of responses. A number of these have been directly quoted or paraphrased (without attribution).

- Many of the results and conclusions closely paralleled other research work INPUT has recently performed on the subject of DDP. We have noted where there were conflicting results and intend to focus subsequent research for clarification.

B. DDP USER IMPACT

1. THE NEW ECONOMICS

a. Hardware

- The price/performance capabilities of large scale computer power has tripled approximately every six years since 1954. A $100 computing cost on the IBM/System 650 in 1954 equates to $1.23 on the 3033 in 1978 (even adjusted for operating systems overhead).

- In a period of 12 years (1964-1976) it became possible to purchase 40 times as much on-line disk storage for the same amount of money.

- The above statistics speak eloquently in explaining the phenomenon that has made DDP an economically viable alternative to more traditional data processing methods.

- Irrespective of the impressive improvement in hardware price/performance, expenditures for computer equipment continue to double approximately every six years. It would be naive to assume that in a DDP environment the overall trend in hardware expenditures will change significantly - the major differences will be in how these expenditures are distributed.

- Exhibit III-1 shows the past and projected distribution of EDP budgets for hardware. (These distributions are obviously approximate and vary tremendously, but the general trends as data processing moves toward a DDP environment are quite clear.) The following observations are important in understanding the impact of these trends:

  - The overall expenditures for "data processing" equipment are projected to double from 1976 to 1982 and in 1987 will be triple the level in 1976.

EXHIBIT III--1

HARDWARE BUDGET DISTRIBUTION

	1965	1976	1982	1987
CENTRAL PROCESSORS AND MEMORY	46%	31%	25%	20%
PERIPHERALS AND MASS STORAGE	36%	27%	27%	25%
DATA ENTRY*	18%**	13%	7%	***
MINICOMPUTER SYSTEMS	****	9%	16%	25%
TERMINALS AND DATA COMMUNICATIONS	****	20%	25%	30%

* STANDALONE
** INCLUDES SOME UNIT RECORD EQUIPMENT
*** ABSORBED UNDER TERMINALS
**** INSIGNIFICANT

Therefore, while central processors decrease by 35% as a percentage of budget between 1976 and 1987, actual expenditures will still double over the same timeframe.

- The data for 1965 and 1976 are based on published and INPUT proprietary surveys of EDP budgets. The projections are based on analyses associated with this study and are consistent with user expectations for an increasing percentage of their hardware budgets directed at DDP related expenditures.

- Personnel costs include those normally associated with the centralized EDP budget (operators, programmers, analysts and DP management). These costs do not include secondary personnel costs (such as those associated with the development of program products) or tertiary personnel costs (such as those associated with the use of the information system).

- The only way personnel costs can rise astronomically in relation to the total cost of data processing is to include the tertiary costs in a DDP environment. These are people who make use of these systems in the course of their fundamental duties (accounting, engineering, management, instruction, etc.)

- Otherwise, personnel costs will remain relatively stable (between 40 to 50% of EDP expenditures -see Exhibit III-2). However, there is a danger of improper classification which would obscure data processing costs. This will be discussed later.

- The cost of data communications has been included under EDP costs. It is difficult to identify precisely, but the following from a definitional point of view offers clarification:

  - The data communications costs represent those spent with common carriers (including specialized carriers and value added networks -

EXHIBIT III--2

TOTAL EDP BUDGETS

	1965	1976	1982	1987
HARDWARE	48%	35%	30%	22%
OUTSIDE SERVICES AND PROGRAM PRODUCTS	4%	11%	14%	18%
PERSONNEL	48%	44%	42%	40%
DATA COMMUNICATIONS	*	10%	14%	20%

* INSIGNIFICANT

VANs) but does not include communications hardware owned by the user. (This is included under hardware costs.) They also do not include communications costs included in expenditures with computer services companies. (These are included under "outside services.")

- The category "minicomputer systems" includes associated peripherals, memory and terminals. The price of the minicomputer processor will become insignificant in such a system.

- Perhaps the most significant ramification of DDP (even though it is obvious) is that it is more difficult to control the cost of hardware which is distributed. In 1965, all computer hardware and data entry equipment was relatively easy to identify. By 1976, over 25% of the hardware (minicomputers and terminals) had migrated away from large centralized facilities. By 1987, over 50% will be removed from large central facilities.

b. Other Data Processing Costs

- There is no question that despite improved computer systems price/performance, the expenditures for such equipment has continued to rise. This is not necessarily bad - hopefully, more work is being accomplished.

- There is a popular misconception that data processing personnel costs are rising at an alarming rate. This may be true in terms of salary levels affected by inflation. However, this cannot be substantiated based on total EDP expenditures.

- The myth of astronomical personnel costs probably got started by hardware vendors who wanted to prompt the idea that hardware is inexpensive and people are expensive (true to a certain degree). However, certain computer "experts" have stated that within 20 years personnel costs will represent over 90% of the cost of data processing expenditures. This is untrue - there is no evidence that personnel costs have increased any more rapidly than total data processing costs.

- In fact, there is every indication that personnel costs as a percentage of total EDP budgets have been relatively stable at approximately 45% (see Exhibit III-2). INPUT projects these costs to decline slowly over the next decade. Some explanation of the exhibit is required.

  - One of the initial justifications of DDP is to cut communication costs, and this will be possible - especially in data entry and editing at the local level. However, so much of data processing is really communications that the overall expenditures for such services will continue to increase rapidly.

  - The substitution of communications for "hardware" is clearly indicated in Exhibit III-2. This is really an indication of electronic communications replacing paper flow. Electronic funds transfer and electronic mail are easily understood examples.

  - This relative increase in communication costs will result despite lowered costs of service because of the general availability of packet switching and satellite technologies. In fact, the lowered costs will be precisely what prompts the enormous growth of new applications.

- Another factor prompting the use of communications services will be the true "value added" potential of VANs to permit non-compatible computer systems and terminals to communicate with each other (whether to exchange data or information). Many compatibility problems are currently solved by converting from electronic to paper media and back to electronic - this is extremely expensive.

- As DDP develops, it will be found that practically all commercial data processing can be accomplished with minicomputers and intelligent terminals. The need for "number crunching" and access to large data bases will become increasingly difficult to justify as part of a private large scale system. This is reflected in substantially increased use of computer services as indicated in Exhibit III-2.

- In addition, the control of EDP personnel costs also dictates the purchase rather than development of software products and this contributes to the increased use of program products.

c. The Accounting And Control Problem

- As mentioned previously, DDP represents a challenge to management (DP, corporate and operating) to identify and control overall EDP expenditures.

- It will become increasingly easy to bury intelligent terminal and minicomputers in budgets as "machine tools" and/or "office equipment."

- It will be quite easy for an inventory clerk to become a computer operator or a personnel clerk to become a "programmer."

- There is certainly no one right way to budget and account for data processing expense in a DDP environment. However, the following will serve as useful guidelines:

- All EDP expense must first be identified and few companies can do that today.

- Before distributing processing, true costs must be known - it may be the last chance.

- DP management should become involved in "word processing" acquisitions and plans.

- All planning and control for data processing and communications should be combined under common management.

- All expenditures for outside services and equipment should be reviewed through a central organization.

- If all of the above are done, the actual accounting and distribution of expense assume less importance. However, unless understood, planned for and controlled, DDP will be extremely expensive without compensating performance improvements. Indeed, the research associated with this study strongly supports this contention.

C. ANALYSES OF SURVEY RESULTS

1. DDP NETWORK CHARACTERIZATION AND DESIGN

- INPUT's DDP research has served to underline the diverse perspectives that users have of the distributed processing concept; i.e., the lack of a "universal" definition of DDP. Users have implemented distributed processing in a manner that is structured to satisfy their individual requirements.

- Examination of Exhibit III-3 is informative in that its statistics offer some insights as to what current user perceptions are regarding DDP.

- Over 50% of respondents view DDP as a system configured around a central host operating with a centralized data base and enabling:

  - Data entry and output processing on programmable terminals.

  - Remote minicomputers to split applications processing with the host.

- Respondents in 70% of the sample regarded DDP network design as embodying a two level hierarchy of host and slave nodes. Only 12% of the sample were currently designing networks with autonomous nodes.

- The current perspective did not support DDP as a network of computers with distributed data bases. It is INPUT's belief that this may result in large part from the lack of credible DBMS product offerings.

- The banking industry appeared to be particularly sensitive to off-loading communications functions from the host as well as maintaining a centralized data base.

EXHIBIT III--3

DDP CHARACTERIZATION *
(40 RESPONDENTS)

	DISTRI-BUTION	DISC. MFG.	PROCESS MFG.	BANKING	TOTAL
1. CENTRAL HOST WITH					
a) COMMUNICATIONS OFF-LOADED	2	1	0	7	10
b) PROGRAMMABLE TERMINALS	3	5	7	6	21
2. CENTRAL HOST WITH REMOTE MINIS					
a) APPLICATIONS SPLIT	6	8	6	4	24
b) 100% APPLICATIONS AT NODE	1	0	4	0	5
c) INTERACTIVE AT NODE	1	6	3	0	10
3. DATA BASES					
a) CENTRALIZED	6	4	7	9	26
b) DISTRIBUTED	2	6	1	0	9
4. NETWORK OF COMPUTERS					
a) DATA BASES/APPLICATIONS DISTRIBUTED	0	1	0	0	1
b) OTHER	1	0	0	0	1

* REFER TO QUESTION NO. 1 (APPENDIX)

- Banking's lack of interest in distributing data bases results from its strong orientation toward a centralized organization.

- Only the process industry respondents seemed relatively interested in complete delegation of applications processing at the nodes by means of on-site minicomputers. This probably relates to the high incidence of unique plant process control and laboratory automation functions to be found in this industry group.

- Approximately one-third of all respondents mentioned IBM's System Network Architecture (SNA) as the network approach being considered or actively used for its distributed processing system. However, 50% of the sample required IBM compatibility for their network architecture.

  - Bisync was the most frequently mentioned line discipline currently used with only limited reference made to SDLC.

  - X.25 (a communications protocol recommended by CCITT) was only referred to once and that in the context of an SNA implementation.

- Competing network architectures offered by non-IBM vendors were rarely encountered but did include Digital Equipment Corporation, Hewlett-Packard and NCR.

- AT&T's announcement regarding its Advanced Communications Service (ACS) was made after the research had been completed. INPUT thus could not determine user reaction to the announcement or product offering.

2. DDP SPENDING PLANS

- Fully 50% of the respondents polled expected an increasing share of their hardware expenditures over the next four years to go to DDP equipment (see Exhibit III-4).

EXHIBIT III--4

REPORTED CHANGE IN THE PROPORTION OF DOLLARS TO BE SPENT
FOR DISTRIBUTION HARDWARE FROM 1978 to 1982

NO. OF USERS WHO SAID THERE WOULD BE AN:	DISTRIBU-TION	DISCRETE MANU-FAC-TURING	PROCESS MANU-FAC-TURING	BANKING	TOTAL NUMBER	PERCENT
INCREASE	5	6	6	3	20	50.0%
DECREASE	0	1	1	2	4	10.0
NO CHANGE	4	0	2	3	9	22.5
DON'T KNOW	1	3	1	0	5	12.5
NO DATA	0	1	0	1	2	5.0
% OF RESPONDENTS	10	11	10	9	40	100.0%

- Another 22% expected no proportionate change from 1978-1982.

- However, it should be noted that most of the users that were interviewed had extremely limited visibility as to their hardware procurement plans beyond 1980.

- Exhibit III-5 and Exhibit III-6 present estimates of the current and 1982 projected percentages of hardware costs dedicated to DDP.

- The following observations may be made as a result of comparing this data:

  - Process manufacturing respondents currently and in 1982 expect to have sizable percentages of their hardware costs committed to DDP.

  - Banking and distribution respondents generally expect to have an increasing percentage of their hardware costs committed to DDP.

3. ORGANIZATIONAL STRUCTURE AND DDP IMPACT

- Respondents interviewed for this study were the senior data processing managers within the corporation or banking establishments that were contacted. They held titles that included Director of Management Information Services/Systems, Vice President or Data Processing Manager.

- In general, these respondents were one to two reporting levels below the President or Chief Operating Officer of the enterprise contacted.

- Management's organizational and control philosophies varied across a broad spectrum ranging from highly decentralized to highly centralized.

- It is difficult at this point to assess fully the impact that distributed processing is having (or will have) upon the relative importance of the traditional relationship that the data processing department has with the organization. In no case was the perceived importance of the DP department

EXHIBIT III--5

PERCENTAGE OF TOTAL USER HARDWARE COST EXPENDED FOR DISTRIBUTED PROCESSING - 1978 (NO. OF RESPONDENTS)

PERCENTAGE EXPENDED FOR DDP HARDWARE	DISTRI-BUTION	DISC. MFG.	PROCESS MFG.	BANKING	TOTAL	%
5 %	1	2	-	3	6	15.0 %
6-20 %	2	1	3	3	9	22.5
21-35 %	-	1	2	1	4	10.0
36-50 %	-	-	4	1	5	12.5
51-65 %	-	1	-	-	1	2.5
66-100%	2	-	-	-	2	5.0
DON'T KNOW	5	5	1	-	11	27.5
NO DATA	-	1	-	1	2	5.0
RESPONDENTS	10	11	10	9	40	100%

EXHIBIT III--6

PERCENTAGE OF TOTAL USER HARDWARE COST EXPENDED FOR DISTRIBUTED PROCESSING - 1982 (NO. OF RESPONDENTS)

PERCENTAGE EXPENDED FOR DDP HARDWARE 1982	DISTRI-BUTION	DISC. MFG.	PROCESS MFG.	BANKING	TOTAL	%
≤5 %	-	-	-	2	2	5.0 %
6-20 %	2	1	1	2	6	15.0
21-35 %	1	1	2	1	5	12.5
36-50 %	-	-	2	3	5	12.5
51-65 %	-	1	1	-	2	5.0
66-80 %	2	-	1	-	3	7.5
81-100%	-	-	-	-	0	-0-
DON'T KNOW	1	3	1	-	5	12.5
NO DATA	-	1	-	1	2	5.0
EXPECT INCREASE (PRO-PORTIONS WILL CHANGE BUT DK AMOUNT)	3	3	1	-	7	17.5
$ INCREASE BUT PROPOR-TIONS WILL NOT CHANGE	1	-	-	-	1	2.5
DECREASE	-	1	1	-	2	5.0
TOTAL RESPONDENTS	10	11	10	9	40	100%

DK = DON'T KNOW

believed to be diminished after DDP was implemented. However, one can always question the total objectivity of the respondents to such an issue.

- There appears to be a close correlation between a decentralized and geographically dispersed organizational structure and the predilection to adopt distributed processing methods.

- The paraphrased comments appearing in Exhibit III-7 are representative of the cross section of replies received in response to this issue.

4. THE DDP DECISION MAKING PROCESS

- There is little evidence that suggests that the DDP decision making process differs significantly from centralized processing analyses, justification and procurement methods. Not surprisingly, there is more user involvement in the analyses, planning and specification phases.

- Management involvement in the decision to adopt distributed processing runs the gamut from the Board of Directors down to the user organizations themselves. In general, the concept seems to be studied by a technical team with recommendations forwarded to a committee usually composed of senior DP, financial and user management. Their recommendations are frequently forwarded to the Chief Operating Officer or Board of Directors for final approval. (See Exhibit III-8.)

- It is important to emphasize that a decision to adopt DDP frequently evolves over an extended period of time. The driving forces behind this evolution often result from:

  - A lack of user satisfaction with the delays and inaccuracies of centralized EDP.

  - A desire to reduce the rate of mainframe capacity utilization and decrease the incidence of upgrades.

EXHIBIT III-7

REPRESENTATIVE COMMENTS REGARDING THE IMPACT OF DDP UPON THE DATA PROCESSING RELATIONSHIP TO THE ORGANIZATION

BANKING

- "Requirements come from above for marketing and users. We set the strategy and how we will implement."
- "The level of DP/MIS importance has been raised to the level of Senior Vice President of Operations and Information Systems."
- "The President and the Board of Directors back the Data Processing Manager in pioneering ultra-reliable distributed systems."

DISCRETE MANUFACTURING

- "Causes a major reorganizational realignment. The network becomes a management tool to control the business and adapt to changing market conditions."
- "No impact really, just part of a five-year plan."
- "Distributed Data Processing is really just a special case of the centralized system. The impact that it has on our users is that it confuses the heck out of them. If properly implemented, the distributed system will require central discipline that has not been available in most companies now."

- "It has caused chaos. It is causing a considerable degree of re-evaluation and awareness. People should be trying to be aware of what DDP is, what it is doing and what it means, because if people go off and do whatever they want to do, it will be a total catastrophe. We are trying to get hold of it before it gets out of control."

DISTRIBUTION

- "We shifted DP from a department reporting to the Controller to the President's staff in order to have greater visibility."

- "No impact. We are really a decentralized organization and DDP fits into our needs very nicely. We have 26 profit centers with a common set of policies. We grew from $90 million to $200 million in sales in three years under our new management and we needed Distributed Data Processing to do it."

- "DDP allowed the company to break up into several different organizations."

- "It will force some policy changes."

- "It has invoked minor operational and organizational considerations currently. It will have greater impact in the future."

- "Distributed Processing has made people more aware of controls and security."

- "The company is decentralized, so Distributed Data Processing is the natural way to go."

EXHIBIT III-7 (contd)

PROCESS MANUFACTURING

- "Network services was reorganized in 1978 with increased responsibility for software, long-range planning and plant support. We need to respond better to our users. Large capital expenditures for the host computer facility are becoming unacceptable."

- "When we put the plan together, we spent a lot of time selling it to many different people. We put on presentation after presentation to show the kind of service we could provide. By the time we began implementation, people were very familiar with strategies and very comfortable with them. Some of the systems we have turned out have been very high quality and we have received a lot of praise from the user in terms of what it is doing for him, and how much easier it is to use and how much more he is getting out of it. We couldn't do that in a mainframe environment."

EXHIBIT III--8

ORGANIZATIONAL INVOLVEMENT IN THE DDP DECISION PROCESS

	ALL INDUSTRY TOTAL	
	NO. OF RESP.	% OF RESP.
RECOMMENDED TO COMMITTEE, PROJECT TEAM, NO SINGLE INDIVIDUAL	8	20.5
PRESIDENT	3	7.7
SENIOR VP, VP OPERATIONS, VP	6	15.4
CORP DIRECTOR MIS/DP, VP/DP	10	25.6
VP FINANCE, CHIEF FINANCIAL OFFICER	3	7.7
MANAGER MIS/DP	8	20.5
CONTROLLER/ADMINISTRATIVE SYSTEMS	2	5.1
USER MANAGEMENT, MFG DIVISION OPERATING DIVISION	6	15.4
OTHER (HOLDING CO., TECHNICAL STAFF, MIDDLE MANAGEMENT)	4	10.3
NO REAL DECISION - EVOLUTIONARY PROCESS	2	5.1
NUMBER OF RESPONDENTS	39	*

* TOTAL EXCEEDS 100% AS MORE THEN ONE TITLE WAS FREQUENTLY SELECTED.

- The financial justification for DDP usually results from some form of cost/benefit analysis where a variety of alternate DP options are examined including:

  - Regional DP centers.

  - On-line data entry.

  - A continuation of centralized processing (frequently involving some form of host expansion or upgrade).

- Exhibit III-9 offers some paraphrased comments describing the decision to adopt distributed processing.

- Exhibit III-10 indicates the management level at which the final product selection decision is made by industry.

- Approximately 50% of all respondents believed that the development cycle time for DDP was comparable to centralized processing with regard to the time required to:

  - Perform cost/performance trade-offs.

  - Define the system.

  - Perform vendor analyses and selection.

  - Perform program development, integration and debugging.

  However, some interesting contrary observations were also uncovered that are worthy of note.

- The nature of distributed processing makes audit trails more difficult to track and requires a longer (but absolutely essential) user training period.

EXHIBIT III-9

REPRESENTATIVE COMMENTS RELATED TO THE DECISION TO ADOPT DDP

- "We just analyzed what had to be done and we studied the best ways to do it."
- "The technology was there that allowed us to do the things we couldn't do before."
- "Distributed Data Processing was an evolutionary process; there was no major decision. In a large corporation like ours, we don't think of it as DDP, just a way of life for us. We process centralized or in a distributed manner depending upon the application."
- "There has been no decision; the reason they have distributed machines is because they went out on their own and got them."
- "The decision to go to DDP was a very conscious decision. We conceived the plan, we sold it all the way to the top, to the Board of Directors, and they accepted it. We've talked to a lot of people whose idea of DDP was to take one application and try it out on the fly. We've had more experience over the years and even failures, so we know what we were getting ourselves into--more of a philosophy with us than anything else."
- "We presented a plan to the president and the executive committee. They gave us carte blanche. We published the specs for satellite and branch controllers. We did the competitive bidding and selected the contracts and negotiated the cost."

EXHIBIT III-9 (contd)

- "The decision process is done entirely within the division. We consult with the users for their requirements and we translate them into action plans."

- "We do our own thing. If it's under $5,000, we do it directly; if it's $50,000 we go to the president for approval."

- "We conduct cost benefit analyses. The executive advisory counsel reviews that analysis, and we need a three to five year pay back to adopt."

EXHIBIT III--10

WHO MADE THE FINAL PRODUCT SELECTION DECISION?

	DISTRI-BUTION	DISC. MFG.	PROCESS MFG.	BANKING	TOTAL NO.
PRESIDENT	1	-	-	1	2
SENIOR VICE PRESIDENT, VICE PRESIDENT	3	2	1	7	13
MIS DIRECTOR, CORP MIS	6	1	4	-	11
CORPORATE DIRECTOR DATA PROCESSING	1	2	1	1	5
DATA PROCESSING MANAGER	-	3	1	-	4
USER DEPARTMENT	-	1	2	-	3
TEAM OR COMMITTEE	-	2	1	-	3

NOTE: # OF RESPONSES SHOULD NOT EQUAL # OF RESPONDENTS DUE TO MULTIPLE ANSWERS

- The amount of time required to select DDP vendors varied widely as a function of:

  - Remote site geographical dispersion and the vendor's perceived ability by the user to provide field support.

  - The size of the competitive market; i.e., there are approximately 60-90 DDP vendors.

  - Whether an SNA or other network committment had been made.

  - Whether the respondent corporation was a dedicated vendor "shop" or not.

- Minicomputer program development and debugging took longer than expected. This was due to software limitations and documentation difficulties that traditional mainframe users encountered when using minicomputers and that they were unaccustomed to dealing with.

5. EXPECTED VS. REALIZED COST SAVINGS

- DDP is widely regarded as being a cost effective data processing alternative to more traditional methods. All major companies interviewed reported that they had conducted a variety of cost analyses to substantiate the migration to DDP.

- Almost half of the respondents claimed actual cost savings. (See Exhibit III-11.)

- However, when respondents were questioned as to the extent of realized cost savings, actual payback periods, ROI or profit and loss impact, they were hard pressed to provide quantitative information. INPUT attributes this in part to the:

EXHIBIT III--11

EXPECTED VS. REALIZED COST SAVINGS IN IMPLEMENTING THE DDP SYSTEM

	DISTRI-BUTION	DISC. MFG.	PROCESS MFG.	BANKING	TOTAL NO.	%
NO SAVINGS ANTICIPATED OR REALIZED	-	1	-	-	1	2.5
SAVINGS ANTICIPATED AND NOT REALIZED	-	-	-	-	-	-
SAVINGS ANTICIPATED AND REALIZED	6	3	4	5	18	45.0
"PAPER SAVINGS ONLY"	-	1	-	-	1	2.5
UNDERESTIMATED COSTS-NO SAVINGS NOW	1	-	-	-	1	2.5
TRADEOFF/BREAK EVEN	1	-	-	1	2	5.0
TOO EARLY TO TELL-NOT FULLY IMPLEMENTED	1	2	2	-	5	12.5
DON'T KNOW	-	3	3	1	7	17.5
NO DATA	1	1	1	2	5	12.5
TOTAL RESPONDENTS	10	11	10	9	40	100%

- Pilot or test status of these installations.

- Greater than expected difficulties and costs encountered in implementing distributed processing systems.

- Traditional difficulties of accurately quantifying DP costs.

- Exhibit III-12 offers paraphrased user comments on the DDP cost savings issue.

6. ALLOCATION OF DDP COSTS

- The labor costs of non-EDP personnel who operated remote site DDP equipment were almost universally cost centered to the remote facility.

- Approximately two-thirds of the respondents had dedicated communications lines between the host and remote facility. Of the remainder, communications costs were either charged:

  - Directly against the remote DP budget or,

  - Cost centered to corporate communications with a pro rata charge back to the remote user.

- The cost of remote site equipment, in two-thirds of the cases, was charged directly to the remote site.

- In approximately 80% of the cases, users were also assessed a DP management overhead charge.

7. APPLICATIONS PROCESSED AT HOST AND NODES

- The major applications that were being processed either at the host or node installations included the usual mix of general business and industry peculiar

EXHIBIT III-12

REPRESENTATIVE COMMENTS RELATED TO DDP COST SAVINGS

BANKING

- "The hardware is replacing the existing system at half the cost and doing 40% more work (account growth)."
- "Reduced cost of $73/year/account in 1976 to 40% of that in 1978.
- "Haven't catalogued them yet."
- "Ran 42% more work at a 10% increase in cost."
- "All services in distributed processing have resulted in an increased profit for the services company - greater than 10% savings realized."
- "No savings that we have quantified, just better customer response."
- "On-line data entry - 3 year payback. Several factors make it cheaper when we convert: (1) The way we own current equipment; (2) our use of plug compatible hardware - 40% less."

PROCESS MANUFACTURING

- "Decrease in operations staff centrally and at the local level. Decrease in cost to implement in terms of capital cost. Decrease in terminal costs. Most important was the decrease in response time to provide customer services. IMS did not decrease time; it increased cost."

- "A little early to tell. We anticipated a 20% pre-tax return on investment. The price of the equipment as the project goes on has been going down. In the last year, the mini went down slightly over 30%, but on the other hand we underestimated some communication costs and it seems to be evening itself out."

- "Time was the major concern, not cost. The major objectives were to eliminate lag time. By that I mean that it took three to five days to get data in So. Arizona, No. Arizona and Ohio, for example. Mail time was a real problem. Also the ability to get the information back and forth. That's what we expected, and that's what we realized."

DISTRIBUTION

- "None as yet; we hope to avoid getting one or more 3031s by off-loading the host 370/168."

- "Replaced Honeywell 2040 and Univac 1050. Twice the throughput for the same dollars."

- "The older system has a five year payout; the new one has a three year or less payout. In large offices with $14 million in sales and $3 million in accounts receivable, they have two people. With the older system an office with $5 million in sales and accounts receivable of $600,000 required five people."

- "Over a five year period for all applications, we have realized a savings of $750,000 per year. Cost is not as important as time savings."

EXHIBIT III-12 (contd)

- "We've realized a 15% reduction in projected hardware and personnel requirements."

- "Underestimated development costs. Once it was up and running it was OK."

- "Remote division operation realized a savings but we don't know how much."

- "It has always been the responsibility of the remote location to get the data into the main DP center and that has been done primarily by mail, so it has been very costly. With the distributed system, we are able to get the data in quicker and more efficiently. Don't know what the cost savings have been; it's probably been a trade-off."

DISCRETE MANUFACTURING

- "We are saving but we have no tangible way of measuring that savings."

- "We get more for the same amount of money."

- "There are paper savings only."

- "Savings are too early to tell. Another problem we have had is comparability of the two approaches - DDP and central. Technology has allowed us to do some things we have never done before. So some DDP projects would never have been done if they had had to be done centrally."

applications. No evidence surfaced of any unusual applications that were being performed as a result of implementing a DDP system.

- Respondents were not well prepared to discuss the relative percentage of processing done at the node versus the host by specific applications. Usually after some thought the following statistics surfaced:

  - Less than 10% of all applications mentioned were being completely (100%) processed either at the host or remote site.

  - Approximately 60% of all applications that were identified were estimated by respondents to require most (greater than 50%) of the total amount of processing to be performed by the host computer.

  - Of the processing done at the host site the primary means of data communications was via remote batch mode (63% of the time). The banking sector was the principal exception showing an equal split between remote batch and on-line modes of communications.

  - There was very limited evidence of mixed mode transmission; i.e., 77% of the applications processed at the host were handled by a single mode (on-line, interactive or remote batch).

  - Applications processing at the node sites were also accomplished with dedicated single mode transmission. However, there was equal dependence between on-line and interactive modes with remote batch utilized to a slightly less extent.

- Users had extremely limited visibility as to how these utilization factors might change over the next several years.

8. DDP IMPACT UPON COMPUTER SERVICES VENDORS

- Of the total number of respondents interviewed, 70% employed the services of an RCS vendor. Slightly over 50% of these current RCS users believed that DDP would have no impact on their continued use of such services.

- The remaining respondents believed that DDP would, in varying degrees, decrease their RCS expenditures as a result of work taken in-house. These statistics are summarized in Exhibit III-13.

- INPUT was also interested in determining which specific DDP applications might be placed with an outside RCS vendor and the rationale behind such a decision.

- In addition to the usual comments; e.g., "...We want to do it in-house because it is cheaper and better...," several applications were mentioned for possible RCS placement. These included:

  - Energy consumption monitoring and control in retailing. The economic feasibility of energy management had to be clearly demonstrated.

  - Engineering applications in discrete manufacturing which required machines that were beyond the capability of users to justify internally.

  - Trust accounts, mortgage and financial systems, stock and bond transfers, and modeling in banking. Such software services exist and may be implemented relatively quickly.

- It is important to emphasize that most of the respondents to this study were large, sophisticated users. In conducting DDP and related research, it has become clear that there are many areas where relatively small users can reap the benefits of using DDP without making large investments in time, personnel and hardware.

EXHIBIT III--13

THE EXTENT TO WHICH USER DDP SYSTEMS ARE EXPECTED TO IMPACT PURCHASED REMOTE COMPUTING SERVICES (RCS)

	DISTRI-BUTION	DISC. MFG.	PROCESS MFG.	BANKING	TOTAL NO.	%
NO. OF RESPONDENTS WHO NOW USE RCS	4	10	7	7	28	-
NO IMPACT	2	6	3	4	15	53.6 %
DECREASE 0-25%	1	2	1	2	6	21.4
DECREASE 25-50%	-	-	2	-	2	7.1
DECREASE >50%	1	1	1	1	4	14.3
DON'T KNOW HOW IT WILL IMPACT	-	1	-	-	1	3.6
NO. OF RESPONDENTS WHO DON'T USE RCS	6	-	3	2	11	100%
NO DATA	-	1	-	-	1	-
TOTAL RESPONDENTS	10	11	10	9	40	-

- DDP services offered by RCS vendors appear to have a great deal of appeal for small but geographically dispersed companies or institutions that cannot deal with the networking implications of DDP.

- Alternatively, single unit firms are relieved of the challenges and costs of operating a host facility while availing themselves of its benefits through a DDP network.

- Only 25% of the surveyed respondents were using or planning to use value added network services (VANS). Over 60% of the respondents were not using VAN services and had no firm plans to do so. Less than 10% of the sample were checking into VANS over the next 12-18 months but had no firm plans to use such services.

9. CENTRALIZED VS. DECENTRALIZED CONTROL

- Although distributed processing suggests greater local control and management of the data entry and processing functions, it does not necessarily suggest increased DP autonomy at the remote site. Centralized control of equipment procurement and systems development will continue to be carried out at corporate or divisional headquarters.

- The following statistics are offered to support the above conclusion.

  - 87.5% of all respondents indicated that strong centralized control is exercised in system definition.

  - 75% of all respondents indicated that programming specifications are also handled centrally. The programming function was centralized in 70% of the cases.

  - Hardware was centrally specified and procured in 80% of the cases. Two-thirds of the respondents procured hardware across divisional lines.

- Centralized contracting was used in 75% of the cases to arrange hardware maintenance.

- Network, systems and applications software was also handled centrally with similar (70-90%) statistical results.

- Over the longer term, the degree of remote site autonomy will be directly related to management's organizational philosophy; i.e., centralized versus decentralized control.

10. DDP SYSTEM SOFTWARE

- Only 10% of the respondents relied exclusively on vendor supplied applications software. An overwhelming number of interviewees cited limitations in packaged applications software that precluded their unmodified use.

- Fifty percent of all respondents used applications software that was exclusively developed in-house. Approximately 40% of all respondents used a combination of in-house and vendor supplied software.

- Exhibit III-14 serves to illustrate the very high current utilization (approximately 80%) of COBOL followed by PL/1, ASSEMBLER, BASIC and FORTRAN languages in descending order. No significant change in this ranking was expected by users over the next two years.

- Approximately 50% of the total number of respondents were using a DBMS with IMS as the predominant installed product (see Exhibit III-15).

  - DBMS compatibility for minicomputers within the network was deemed unnecessary by 50% of the respondents.

  - Twenty to twenty-five percent of the respondents either desired or required DBMS/mini compatibility.

EXHIBIT III--14

CURRENT PROGRAMMING LANGUAGES USED BY RESPONDENTS

LANGUAGE	DISTRI-BUTION	DISC. MFG.	PROCESS MFG.	BANKING	TOTAL NO.
BASIC	1	3	-	2	6
COBOL	5	8	9	7	29
PL/1	4	5	3	1	13
FORTRAN	2	-	4	-	6
RPG	1	1	1	-	3
MACRO	-	1	-	-	1
ASSEMBLER	1	3	2	4	10
OTHER	1	4	3	2	10

EXHIBIT III--15

DATA BASE MANAGEMENT SYSTEMS INSTALLED - 1978
(21 RESPONDENTS)

	DISTRI-BUTION	DISC. MFG.	PROCESS MFG.	BANKING	TOTAL NO.
IMS	3	5	3	1	12
CICS	1	1	-	-	2
TOTAL	1	3	-	-	4
MARK IV	1	-	-	-	1
DLI	1	1	-	-	2
CMS	1	-	-	-	1
IDMS	-	1	-	1	2
DMS II	-	1	1	-	2
SYSTEM 2000	-	1	-	-	1
IN-HOUSE	-	-	-	1	1
TOTAL RESPONDENTS (21)	6	9	4	2	-

- By 1980, over 40% of the respondents expected to be using IMS with TOTAL and DL/1 in secondary positions (see Exhibit III-16).

- Over 50% of the sample either currently maintain or intend to maintain a centralized data base, with approximately 35% desiring some combination of centralized/distributed data bases.

  - Only 5% of the sample intended to use a distributed data base.

  Many of the respondents cited the current lack of a viable DBMS as restricting their plans to distribute data bases.

- The methodology for data base updating yielded the following statistics:

  - 65% of respondents would update transactions only at the centralized data base.

  - 22% would update only at nodes.

  - 30% would replace node information from the central facility.

- It is interesting to note that 45% of the respondents indicated that they expected to be developing their own in-house network software rather than resorting to a vendor supplied package.

II. OFFICE AUTOMATION AND OTHER ISSUES

- The concept of automating the office, coupled with electronic mail, was generally regarded by respondents as a long-term driving force behind the growth and acceptance of DDP.

  - Office automation will be particularly helpful in the future in justifying the cost of nodal equipment.

EXHIBIT III--16

DATA BASE MANAGEMENT SYSTEMS PLANNED - 1980
(24 RESPONDENTS)

	DISTRI-BUTION	DISC. MFG.	PROCESS MFG.	BANKING	TOTAL NO.
IMS	3	2	3	2	10
CICS	1	-	-	-	1
TOTAL	2	1	-	1	4
MARK IV	-	-	-	-	-
DLI	2	1	-	1	4
CMS	1	-	-	-	1
IDMS	-	-	-	2	2
DMS II	-	-	1	-	1
SYSTEM 2000	-	-	-	-	-
DON'T KNOW	1	3	1	3	8
IN HOUSE	-	-	-	-	-
TOTAL RESPONDENTS (24)	6	6	5	7	-

- The initial embodiment of office automation appears to be through the implementation of an administrative message network. However, most respondents sensitive to this issue believed this type of network was at least two to three years away and might not be viable before 1982.

- Widespread concern was expressed over the following issues:

  - Limited communications capability of minicomputer vendors to support SNA/SDLC.

  - Telephone company's incompatibility with nodes as well as differing network standards (addressed by the recently announced ACS product).

  - Need to reconcile the distribution of data with privacy and security regulations.

  - High cost of both domestic and foreign tariffs and the regulatory difficulties of international communications.

  - Unknowns related to SBS and ACS.

  - The uncertainties related to the full cost of SNA.

  - Economics of remote sites including the availability of maintenance support.

D. DDP MARKET CHARACTERISTICS

1. BANKING

a. Conclusions

- Commercial banks and savings and loan associations are prime users of distributed data processing. Not only were all the banks interviewed involved in distributed data processing in some form but most (88%) were planning to extend the use of distributed data processing in one or more functional/applications areas. (See Exhibit III-17).

- The distribution of banks and S&Ls interviewed is shown in Exhibit III-18. The money center banks (assets above $10 billion) are heavily involved in DDP. All types of regional banks (S&Ls) whose assets are above $500 million are involved in some form of DDP. The DDP involvement even includes international operations.

- Banks with branching were found to be using DDP for data capture and consumer operations. Multi-bank holding companies of unit banks were found to be equally involved with DDP.

- Even very large banks in unit banking states that allow virtually no branch banking were utilizing distributed data processing within the centralized banking facility.

- Bank executives are turning to distributed data processing, because their mainframes are overloaded and they require alternatives to consistently upgrading to larger machines.

- The nature of commercial demand/savings application is high transaction volume processing against large information files. The applications can

EXHIBIT III--17

ACTUAL AND PLANNED USE OF DISTRIBUTED DATA PROCESSING BY BANKING RESPONDENTS

FUNCTION/ APPLICATION	NUMBER OF RESPONDENTS USING DISTRIBUTED DATA PROCESSING
DISTRIBUTED DATA ENTRY	5
SATELLITE PRO-CESSING	8
DDA (MEMO POSTING)	3
SAVINGS	6
LOANS	6
CIR	6
INQUIRY	2
ATM/POS	3
COMMUNICATIONS FRONT-END	5
FUNDS TRANSFER	2

EXHIBIT III--18

ASSET DISTRIBUTION OF BANKS INTERVIEWED ON-SITE

TYPE	ASSETS ($)				
	50M-499M	500M-1.9B	2.0B-9.9B	10B+	TOTAL
UNIT				1	1
BRANCH	1	1	1		3
MULTI-HOLDING		2	2		4
INTERNATIONAL				1	1
TOTAL	1	3	3	2	9

currently only be economically justified on a batch or remote batch basis. Counter to this batch requirement is the need for providing consumer service through computer on-line systems offering reasonable response time (two to five seconds). The ultimate goal of the DP Manager is to off-load the transaction processing onto interactive minis, thereby opening the window (time) available for batch processing at night.

- Multi-bank holding companies have separated the data processing from the lead bank and established bank service companies. The interviews indicated that those multi-bank holding companies that had done so were further along in the use of DDP for their member banks.

- All the respondents interviewed were accomplishing distributed data processing in the context of a centralized host controlling intelligent nodes (satellite systems and branch controllers).

- By their very nature banks and S&Ls are highly centralized organizations. Involvement in distributed data processing is through a centralized host.

  - The senior DP functionary is usually to be found in a wholly-owned subsidiary bank service company or in the lead bank.

  - Consequently, the usefulness of selling to remote sites is non-existent. This holds true even for individual banks and multi-bank holding companies.

- All but two of the respondents interviewed used IBM host mainframes. However, many of the satellite and remote mini systems currently installed or planned to be installed were from vendors other than IBM.

- In general, banks were not sensitive to, or involved with, office automation techniques.

b. Application Analysis

- Banks and saving and loan associations are currently utilizing distributed data processing techniques in order to complete a number of their routine activities. As a minimum, data entry is being accomplished through a combination of on-line data entry as well as remote node processing.

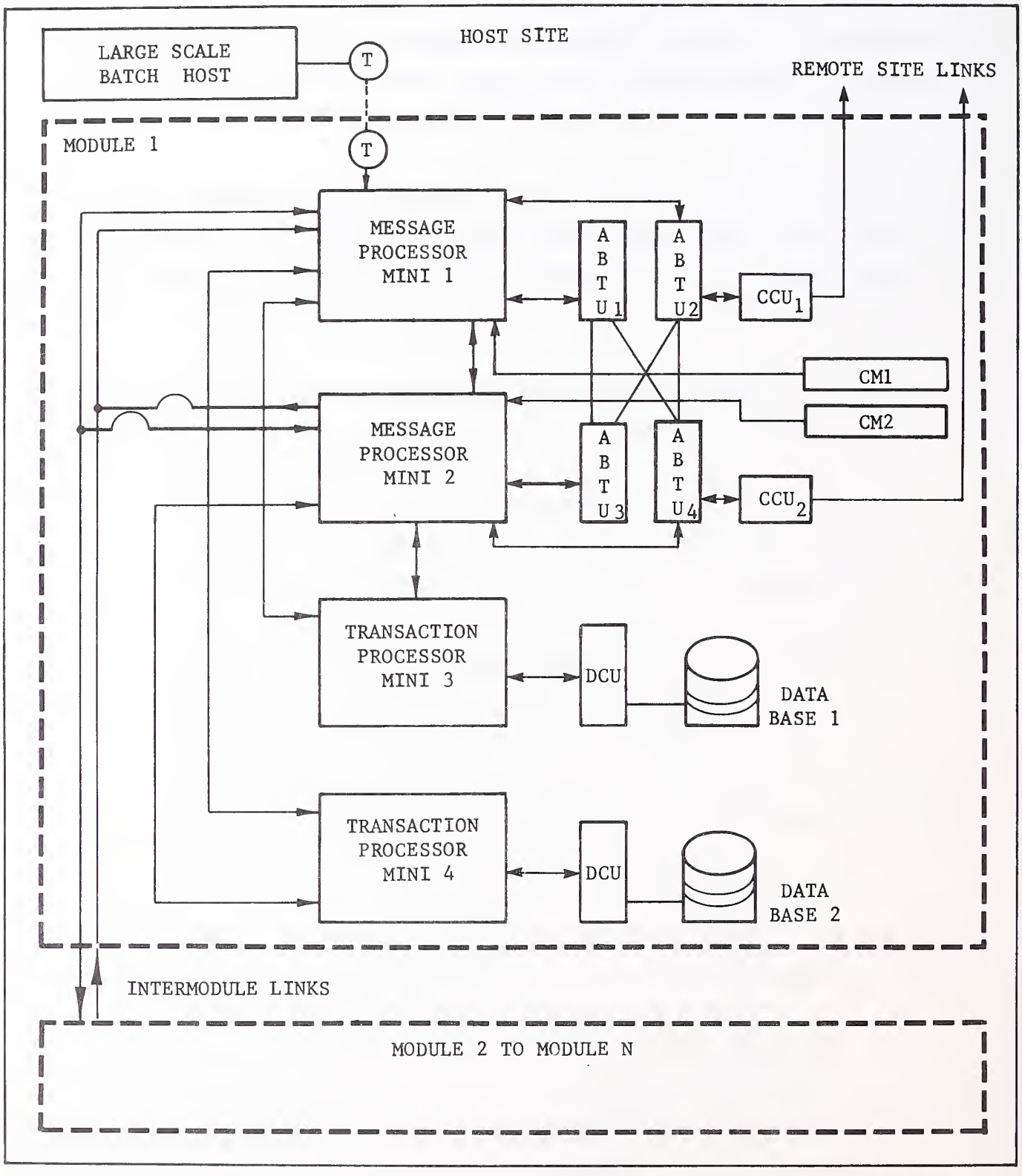
- The offloading of mainframes to a distributed minicomputer network is an activity being undertaken by the larger banks. DDP is also being used by the very largest banking institutions for creating corporate funds transfer and processing networks.

- Within the banking industry distributed data processing is being applied in the following applications:

  - Demand report accounting.
  - Savings.
  - Commercial and consumer loans.
  - Consumer inquiry.
  - Remote data entry.
  - Foreign exchange.
  - Funds transfer.
  - Correspondent banking.

- As shown in Exhibit III-19 a DDP system consisting of multiple processing modules is offloading the daily processing of consumer transactions. Each of the modules consists of a dual set (redundant) of message and transactions processors. The host unit creates a new account data base every night which is downloaded among the node processors. During the day DDA, savings, loans,

EXHIBIT III--19
COMMERCIAL BANK (S&L) BRANCH CONSUMER TRANSACTION
DISTRIBUTED DATA PROCESSING--HOST SITE



ABTU-AUTOMATIC BUS TRANSFER UNIT
T -MAGNETIC TAPE(LOG)
CR -CARD READER
DCU-DISC CONTROL UNIT
C -CONSOLE
CM -COMMUNICATION MONITOR MINI
CCU-COMMUNICATION CONTROL UNIT (FRONT END)
SCC-SYSTEM CONTROL CONSOLE

new accounts as well as account changes are received by each of the message processors and properly routed to the appropriate transaction processor.

- It is through this technique that the distributed data base is updated. Automatic switching techniques are employed which assures high reliability for the system. All of the items except for DDA transactions are processed against the master file. The magnetic ink character reading (MICR) DDA items are processed by the standard batch item processing system.

- Exhibit III-20 illustrates how DDP is used to handle consumer transactions at commercial and savings and loan banks. The remote site node uses a microcomputer as a communications controller, which handles a cluster of teller units, administrative terminals and on occasion some customer inquiry units. The ATMs are interfaced to the host computer through separate communications lines. The MICR systems record information on diskettes for remote job entry transmission to the host computer.

- Exhibit III-21 illustrates how some banks are planning a remote site minicomputer system to be integrated with ATMs and MICR data capture applications. The minicomputer system interfacing with an electronic funds transfer processor routes the transaction through the network to the appropriate host computer. Each local data base at a remote site or node contains records for customers located at that branch.

- DDP for correspondent banking applications is shown in Exhibit III-22. MICR items are captured and edited before being batched on tape and transmitted to the host computer at the end of each day. Results are recorded on tape and printout is delivered the following morning. The "on us" checks that are sorted by MICR are returned to the originating bank while other items are properly entered into the clearance system.

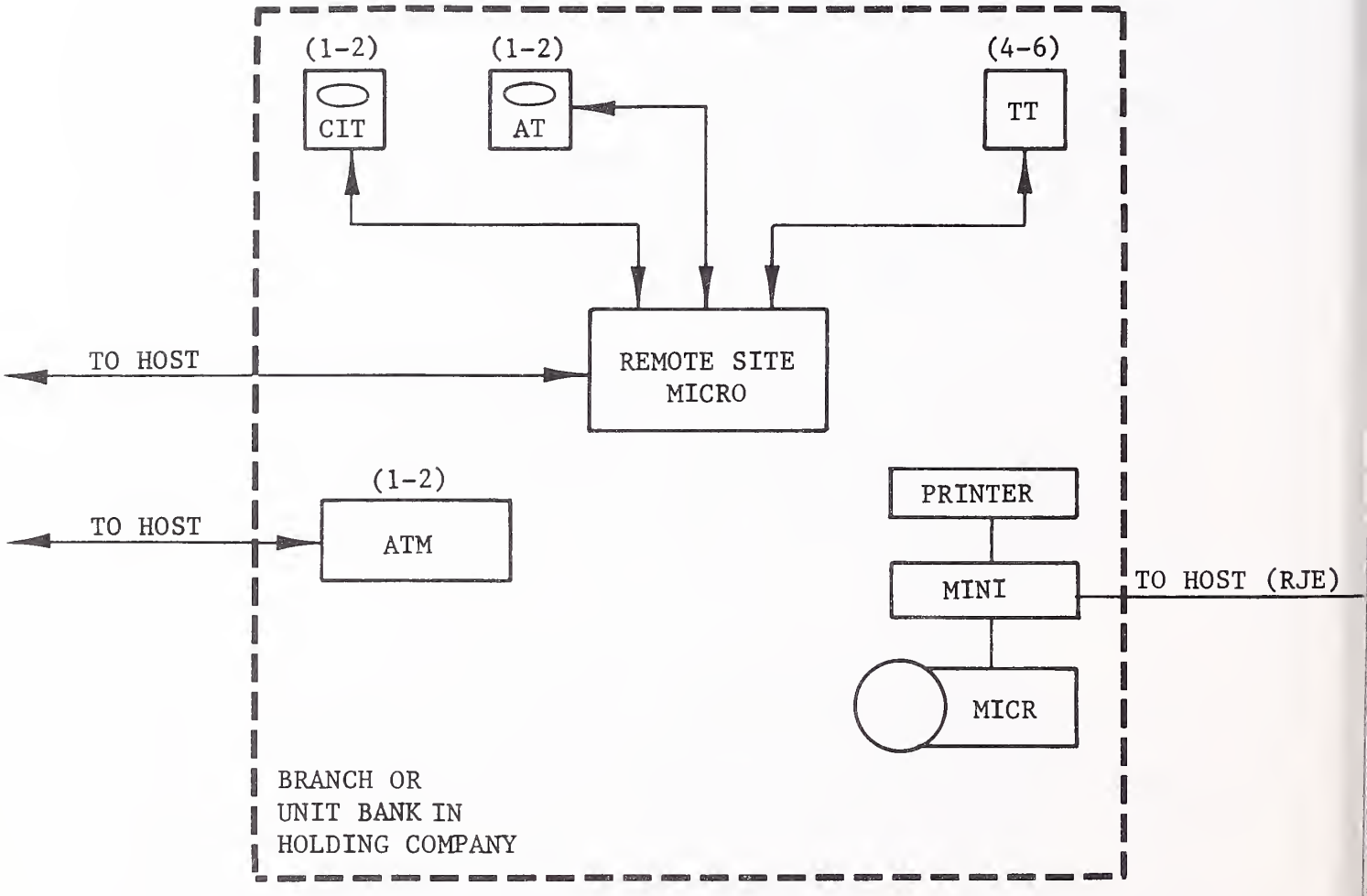
- Exhibit III-23 illustrates where very large banks (as well as bank service companies) who have requirements for enhanced satellite systems effectively become a node within an electronic funds network. Such a configuration is

EXHIBIT III--20

COMMERCIAL BANK BRANCH CONSUMER

TRANSACTION DISTRIBUTED DATA PROCESSING - REMOTE SITE

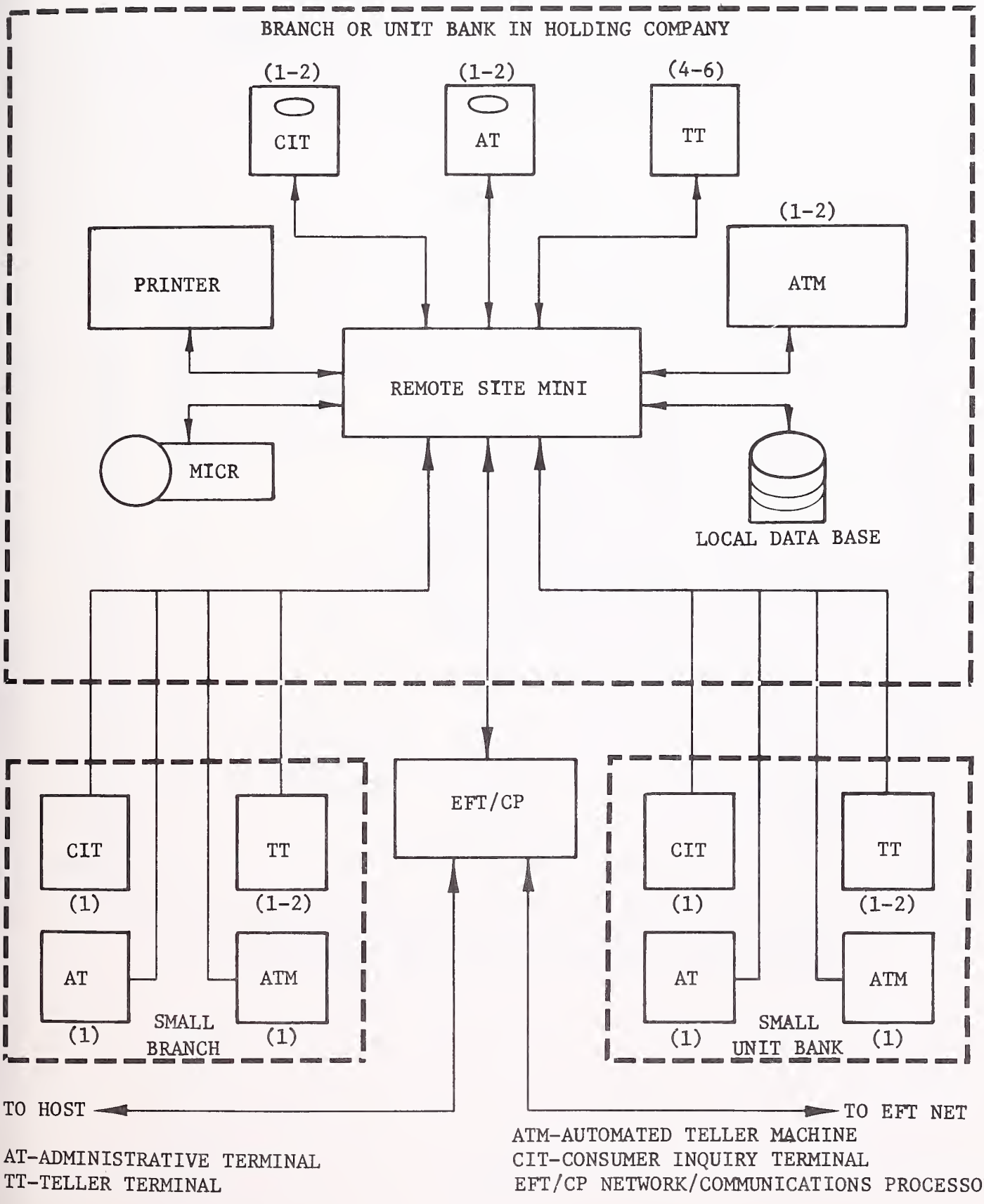
CURRENT SYSTEM



CIT-CUSTOMER INQUIRY TERMINAL
AT-ADMINISTRATIVE TERMINAL
TT-TELLER TERMINAL
ATM-AUTOMATED TELLER MACHINE

EXHIBIT III--21

COMMERCIAL BANK BRANCH CONSUMER
TRANSACTION DISTRIBUTED DATA PROCESSING - REMOTE SITE
PLANNED SYSTEM



AT-ADMINISTRATIVE TERMINAL
TT-TELLER TERMINAL

ATM-AUTOMATED TELLER MACHINE
CIT-CONSUMER INQUIRY TERMINAL
EFT/CP NETWORK/COMMUNICATIONS PROCESSOR

EXHIBIT III--22

COMMERCIAL BANK CONSUMER TRANSACTION

DISTRIBUTED DATA PROCESSING FOR CORRESPONDENT

DATA PROCESSING-SATELLITE SITE

CURRENT SYSTEM

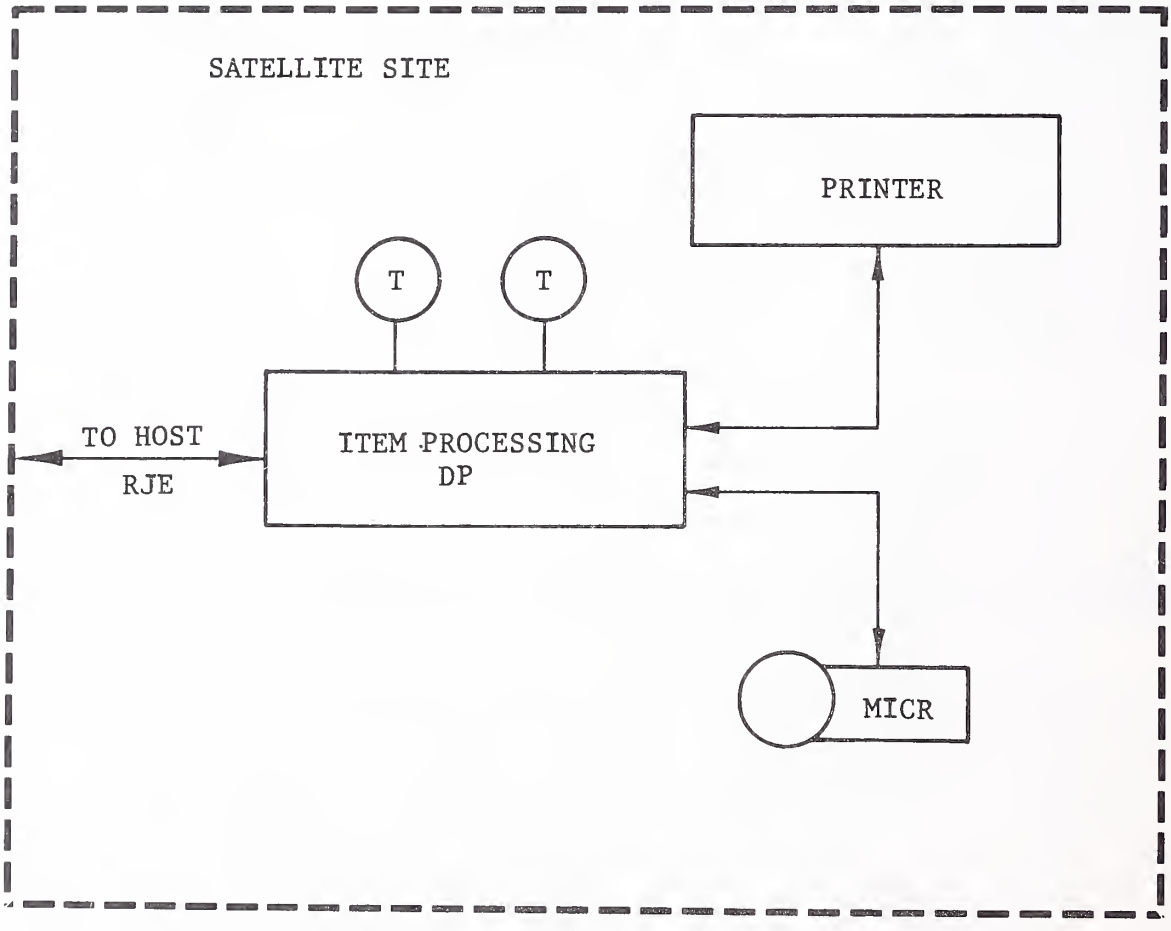


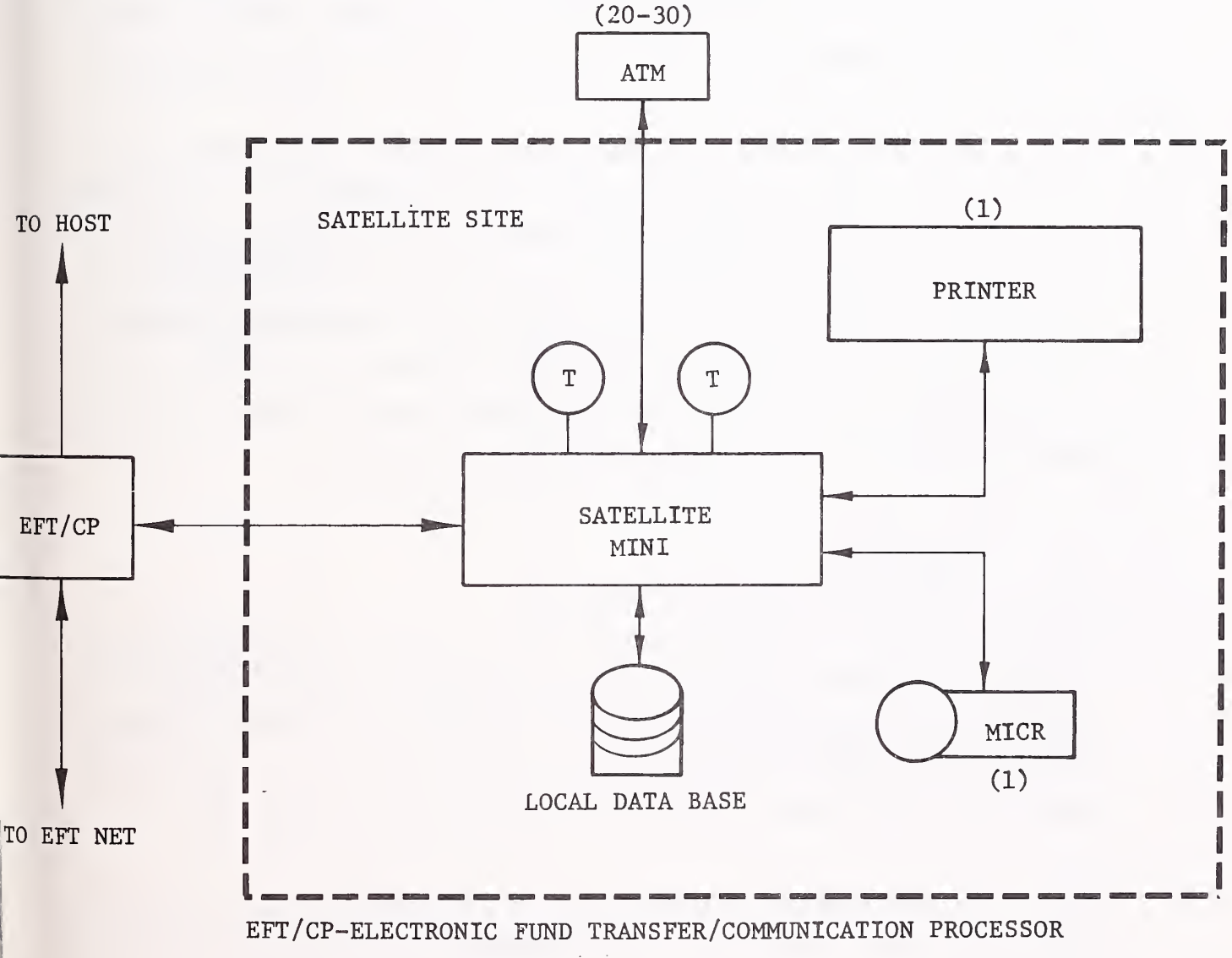
EXHIBIT III--23

COMMERCIAL BANK CONSUMER TRANSACTION

DISTRIBUTED DATA PROCESSING FOR CORRESPONDENT

DATA PROCESSING - SATELLITE SITE

ENHANCED SYSTEM



EFT/CP-ELECTRONIC FUND TRANSFER/COMMUNICATION PROCESSOR

applicable in states where ATMs are shared among participating banks and savings and loan associations. These ATMs are served through a local data base. Other ATM transactions are routed through satellite minicomputers into the EFT network.

- The use of DDP for commercial banks involved in international operations (including foreign exchange and the transfer of funds) is displayed in Exhibit III-24. Presently, the Fed Wire and Bank Wire funds transfer networks are standalone operations. A minicomputer system is connected to the host computer which interfaces with the Society For Worldwide Funds Transfers (SWIFT) Network. Other minis are connected to the host at international money market centers.

- Very large banks are in the process of integrating their foreign exchange and funds transfer networks into a DDP system as shown in Exhibit III-25. Routing and access will be controlled through a minicomputer system and the Fed Wire and Bank Wire networks will be on-line. A mini will be used to control corporate access and the use of the foreign exchange and funds transfer networks. Terminals, located in client corporate offices, will enable financial executives to immediately access money market information sources as well as to provide funds transfer on both domestic and international markets.

c. User Attitudes

- All of the respondents interviewed had a large scale central host and utilized a hierarchical network. Distributed data processing was implemented by: (1) off-loading central processor communications (80%); (2) centralized data base (100%); (3) intelligence at the terminals (70%) and to some degree (40%) specific applications being distributed between the host and the node.

- None of the respondents felt that the decision process for implementing DDP differs significantly from that for accomplishing the entire function on the central host.

EXHIBIT III--24

COMMERCIAL BANK INTERNATIONAL OPERATIONS

DISTRIBUTED DATA PROCESSING

CURRENT SYSTEM

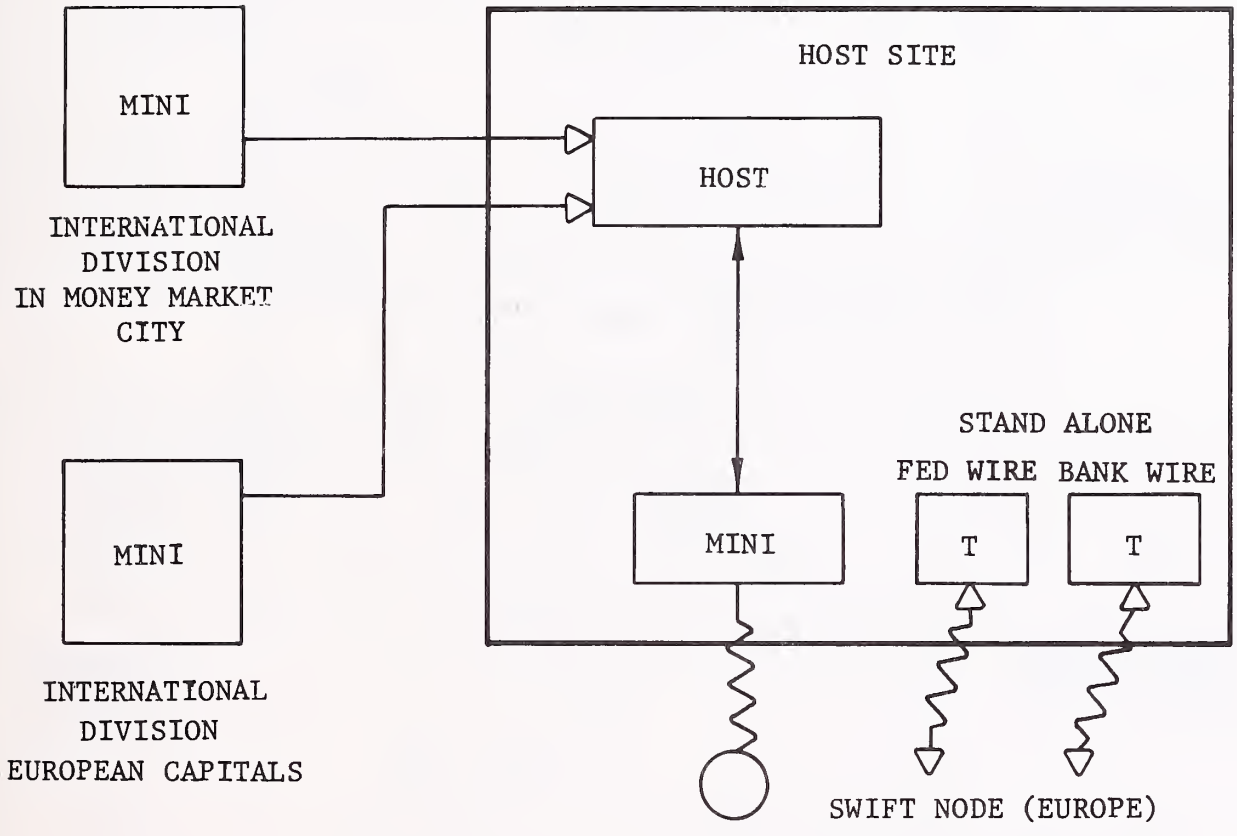
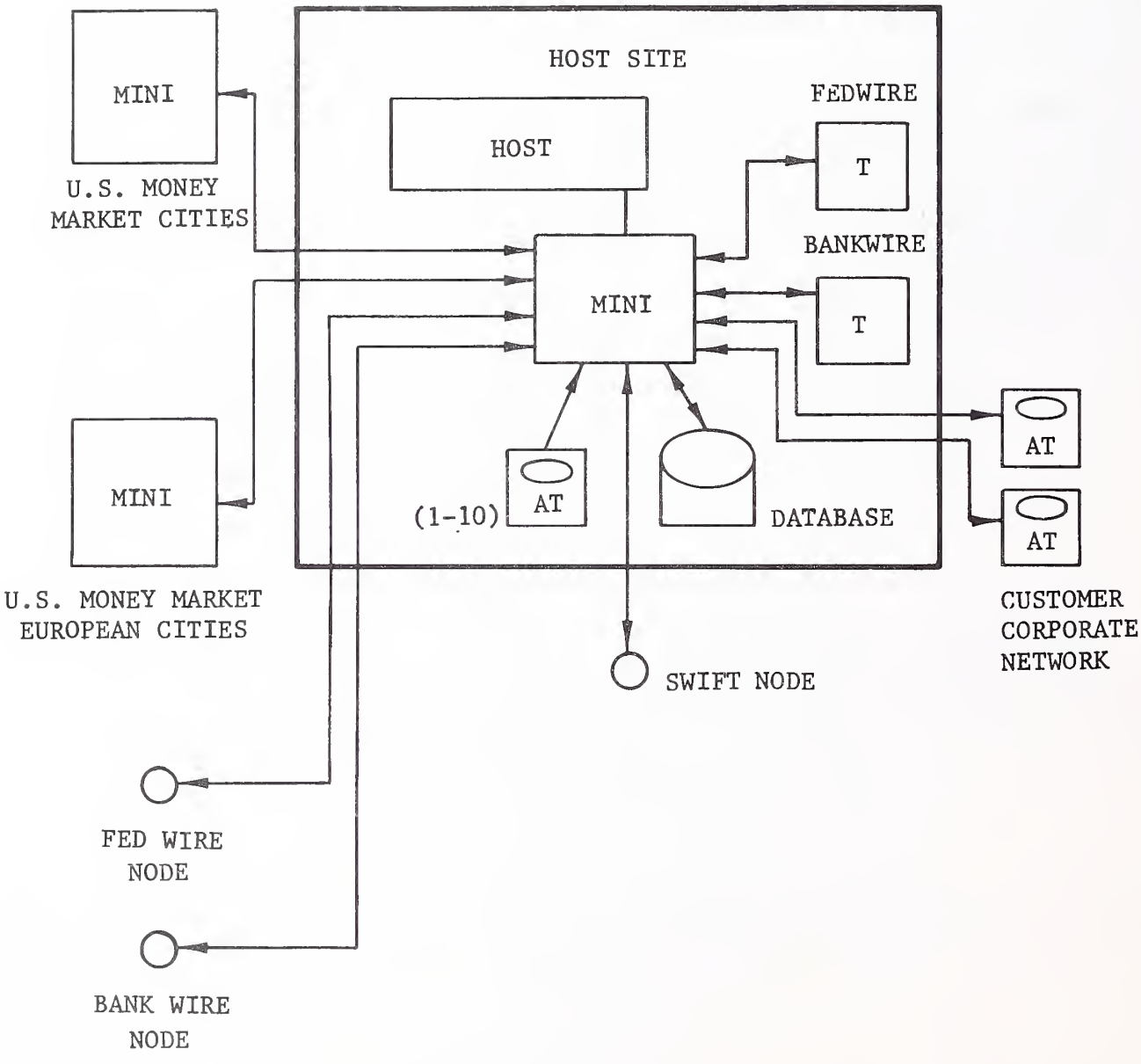


EXHIBIT III--25

COMMERCIAL BANK INTERNATIONAL OPERATIONS

DISTRIBUTED DATA PROCESSING

INTEGRATED SYSTEM



AT-ADMINISTRATIVE VIDEO TERMINAL

- Similarly, 80% of the respondents felt that the developmental cycle time for DDP systems does not significantly vary from that of developing the applications specifically for operation on the central host.

- As a result of being highly centralized, banks spend the greater proportion of their total hardware dollars on central processing as opposed to distributed equipment. Respondents estimated that only 15% of their total hardware expenditures are currently allocated to support the distributed system. They expect this proportion to increase to approximately 25% by 1982.

- Respondents generally felt that distributed processing will enhance the position of the DP/IS manager within the corporate organization.

- Users were frequently hard pressed to come up with quantified realized versus expected savings through implementing DDP. Because cost factors cut across division/department lines, traditional cost saving computations do not apply. However, some users indicated significant realized cost savings.

- Respondents reported very little DDP impact on their use of outside remote computing services. Less than 30% of the respondents felt any degree of DDP impact on RCS services.

- The major portion of respondents interviewed (67%) would consider placing specialized applications (in particular personal trust services) with a computer services vendor.

- Seven of the nine respondents were users of IBM large scale systems 370 equipment. Only two were currently considering shifting to the IBM SNA/SDLC network architecture. However, an additional two were planning to implement the SDLC line protocol in order to improve line discipline with their end user terminals.

- Eight of the nine respondents had implemented a two level hierarchical network of host and slave nodes. The ninth had implemented a hierarchical

network of a host, regional nodes, and a third level in the hierarchy consisting of a branch processor controlling a cluster of terminals.

- Most respondents (80%) developed software for their DDP systems using a combination of both in-house and vendor sources.

- Respondents were interested in turnkey solutions for distributed banking functions both at the nodes and in complete systems applications (such as communications and consumer transaction processing) which could be off-loaded from a large scale host.

- In fact, a consortium of banks has contracted with at least one software vendor (Banking Systems, Inc., see Competitive Analysis, Chapter IV C) to design, develop and install a complete consumer transaction reporting distributed system offloading that entire function from the central host. This is intended to "open the window" enabling the processing of batch operations without adding additional large scale mainframes.

- Respondents utilized COBOL as the primary programming language. Some of the respondents (40%) utilized small segments of Assembly language programming to accomplish specialized functions. Respondents preferred to remain COBOL compatible at the nodes even if the supplied COBOL were a subset of the ANSI standard.

- Although respondents utilized a central information file (CIF) for both processing and inquiry, few (20%) have implemented the CIF through a data base management system. However, most of the respondents (70%) interviewed indicated that they plan to use data base management systems such as IMS, IDMS, or DL/I by 1980.

- The respondents were less sure as to the necessity of DBMS compatibility for the node processors. Those few respondents (20%) who had implemented distributed processing utilizing distributed data bases (refreshed from the host) recognized the importance of DBMS compatibility.

- Virtually all (90%) of the respondents processed transactions against the centralized data base. Some respondents (30%) processed transactions against both the central data base and the distributed data base, but refreshed the distributed data base daily from the host.

- Most of the respondents (70%) required compatibility with IBM network architecture. Sixty percent of the respondents would be currently satisfied with compatibility through emulation. Another 30% require (as a minimum) SDLC as well as emulation. The others have not yet adopted a position.

- All of the respondents required software compatibility between the host processor and the node computers. Over half (60%) required COBOL compatibility across equipment and 30% desired DBMS compatibility.

- Respondents reflected a variety of concerns as to major issues that would impact their future use of distributed processing. A representative sample of their concerns is presented in Exhibit III-26.

- Respondents were not heavily concerned yet in automating their office functions utilizing distributed data processing.

2. DISCRETE MANUFACTURING

a. Conclusions

- As a result of this study's research, and other work that INPUT has performed, it is our belief that the discrete manufacturing sector represents the most promising market area for DDP.

- Interviews conducted with a variety of Fortune class of companies in this group have indicated that many of these firms have been implementing DDP for extended periods of time.

EXHIBIT III-26

RESPONDENTS' PERCEPTIONS OF MAJOR ISSUES IMPACTING THEIR FUTURE USE OF DISTRIBUTED DATA PROCESSING

- "Data privacy and security are a concern. We will have to insure customers that our data base will remain protected."
- "Software compatibility - the real issue is behavorial changes - getting the end user to think of the system as a library resource."
- "Foreign government restrictions - There is a problem of sending information thru each country. They are blocking real progress. Foreign tariffs are exorbitant."
- "Privacy Act - its greater complexity is the key issue - access to data in the network."
- "Getting back to a common deposit system. Bankers need more user oriented services."
- "Regarding software compatibility: (1) development costs; (2) growth of EFTS; (3) reliability and backup; (4) user acceptance."
- "Software compatibility - no great problem - would like it but can get around it easily."
- "Problem of a service company in a one bank holding company. We want to expand our fee for service business and the Feds won't let us."
- "Network architecture - no vendor is willing to take IBM on in the banking industry. Most need IBM compatibility to exist."

- Geographic dispersion seems to have spawned decentralized organizations which in turn facilitates the adoption of DDP.

  - Delegating operational authority to factory managers frequently includes responsibility for local processing as well.

- Turnkey systems suppliers or RCS vendors (a number of whom already provide engineering timeshare services) may have excellent opportunities to sell custom solutions to specific manufacturing problems; e.g., shop floor control, to the remote site directly. Increasingly, these facilities are gaining the authority to justify and install local programmable intelligence.

  - Discrete manufacturing seemed to be more disposed to the purchase of outside services offered by RCS vendors and VAN suppliers.

- Particular sensitivity to tieing the office automation function into DDP was encountered in the primary manufacturing sector. Paper is anathema to plant managers, and improved methods to reduce the generation, transmission and storage of documents could not materialize too soon in their view.

- The industry sample lacked concrete cost/benefit data to support the move to DDP. This was somewhat in contrast to the generally favorable regard the concept has in discrete manufacturing.

- Primary DDP applications are in data capture and order entry.

- This industry sector exhibited the greatest sensitivity to tieing the DDP function together with office automation and such other applications as computer aided design and manufacturing (CAD, CAM) functions.

b. Application Analysis

- Consistent with the total population sample, less than 10% of the applications mentioned in discrete manufacturing were being completely processed at

either the host or remote site. A somewhat larger percentage of the applications processing was being done at the node site.

- Remote batch mode was the predominant means of data transfer to the host. The on-line mode of data processing at the node exhibited a higher bias than either interactive or remote batch modes.

- Order entry was by far the most frequently mentioned application followed by a mix of such specific manufacturing applications as engineering, numerical and shop floor control, and materials requirements planning. Accounting applications were also included.

- Applications software is largely being done in-house with the automotive and aerospace segments demonstrating more of a mix of in-house and vendor supplied software.

c. User Attitudes

- Discrete manufacturing respondents exhibited greater degrees of geographical dispersion accompanied by decentralized organizational structures. Consequently, this industry group exhibited a greater preference for distributing data bases.

- Current DDP network concepts favor splitting applications processing between remote minicomputers and the central host with interactive problem solving being done at the node. Several of the respondents have implemented non-host dependent applications processing at the node for functions where local management had complete authority.

- INPUT believes that the concept of complete distribution of processing to independently run manufacturing facilities or warehouse operations is relatively well accepted. Within the time frame of this report we would expect increasing autonomous operations at nodes.

- Discrete manufacturing respondents generally believed that an increasing percentage of their hardware budgets through 1982 would be directed toward DDP related expenditures.

- Respondents reported absolutely no differences in the decision process for going to DDP versus that for centralized processing.

- In comparison to the banking or distribution sectors, the discrete manufacturing sample did not seem to have as much concrete cost benefit data regarding their DDP installations.

- The use of RCS vendors was widespread within the industry sample, with most respondents (55%) believing that their DDP systems would have no impact upon their future use of such services (see Exhibit III-13).

- There also was a greater bias toward the actual or planned use by respondents of VAN services within this group than any other industry sector.

- Although demonstrating strong centralized control of system definition, software development and hardware procurement, respondents have a bias toward decentralizing the programming and hardware procurement functions.

  - Hardware maintenance responsibility was strongly decentralized.

- COBOL followed by PL/I was the most frequently used programming language.

- IMS and TOTAL predominated as the most frequently encountered DBMS. Compatibility with minicomputers is not regarded currently as an operational requirement.

  - DBMS distribution is (or will be) achieved through a combination of installations at both the host and remote sites.

- Updating is (or will be) accomplished through some mix of transactions against the central data base or at the nodes.

3. DISTRIBUTION

a. Conclusions

- As a group, the distribution sector appears to be in arrears of the other sampled groups in adopting DDP methods. Retailing is somewhat more advanced than the wholesale sub-sector in implementing DDP.

- Major department, discount and supermarket chains have been involved with various forms of distributed processing for several years. Growing numbers of both regional and national restaurant, clothing and hard goods retailers appear to be adopting DDP in order to facilitate store replenishment and inventory control methods.

- INPUT encountered difficulty in finding qualified DDP users among wholesalers who were engaged exclusively in distribution. Companies that were engaged in both the manufacturing and distribution functions appear to be further along in adopting distributed processing.

- The smallest distribution companies or divisions using DDP that were interviewed in this study were in the $150-300 million revenue range with most respondents in the multibillion dollar category.

- Major uncertainties that may serve to accelerate the acceptance of DDP focus on developments in both POS and EFTS in the post-1980 period.

- It is interesting to note the strong interrelationship between banking and retailing. The banking industry appears to be well in advance of retailing in adopting DDP and could exert more pressure upon retailers to accept the concept contingent upon future EFTS developments.

- INPUT encountered isolated instances of retailers sharing common DDP networks with limited numbers of their suppliers; i.e., wholesalers. Accordingly, just as banking may develop a positive DDP influence on retailing so, in turn, might retailing accelerate DDP acceptance in the wholesale sector.

- Distributors are strongly centralized in terms of their structure and there is extremely limited end user DP expertise. Systems design and procurement is centrally performed, and building transparency into nodal equipment is well advised.

- The distribution sector was singular in terms of the respondents (particularly in the $150-500 million revenue class) who regarded DDP as an integral element in plans to sustain rapid corporate growth.

- A desire to offload the mainframe was frequently mentioned as another reason for adopting DDP.

b. Application Analysis

- Both retail and wholesale users placed heavy emphasis on the in-house development of applications software. Respondents claimed that their businesses were so unusual as to negate the value of most software packages.

- Principal applications are focused in order entry and inventory control followed by the usual mix of accounts receivable, payroll, labor and other general business applications.

- No significant work was being done in integrating the office automation function with DDP.

- Smaller respondents (sales below $500 million) had adopted DDP plans in order to provide more timely reporting within the rapidly changing distribution industry.

- Only one of 14 specific applications was being completely processed at a remote site. There seemed to be an even split between the percentage of applications processing done at the host and node sites.

- Of the processing done at the host site, the primary means of data communications was via remote batch mode (78% of the sample).

- Applications processing at the node site was principally performed by a dedicated on-line method.

c. User Attitudes

- Limited evidence was encountered in distributing data bases although file distribution is certainly being done. This is not surprising considering the industry's strong centralized bias.

- The distribution respondents did not seem to have a solid grasp of the proportion of their hardware expenditures directed at DDP applications. However, two retailers reported that more than two-thirds of their current hardware expenditures were DDP related (this was the highest reported of any respondent).

  - Wholesalers expected these percentages to increase through 1982.

- The retailing sample was singular in its lack of using RCS vendors. Three of the four wholesalers used an RCS vendor.

- Similarly, only 20% of the distribution sample were using or planning to use VAN services.

- Retail respondents further believed that their networking requirements were sufficiently unique to require the in-house development of network software.

- Respondents were able to offer more quantitative comments regarding DDP cost savings due to the fact that a majority of companies had been operating a DDP network for several years.

- These comments cited favorable cost/performance benefits associated with DDP that included:

  - Delaying a mainframe upgrade.

  - "Twice the throughput for the same dollars."

  - Forty percent reduced payout periods.

  - Staff reductions.

  - "Two percent improvement in pretax margins."

  - Quantitative yearly EDP savings.

4. PROCESS MANUFACTURING

   a. Conclusions

- Although demonstrating the same degree of geographical decentralization as encountered in discrete manufacturing (suggesting a greater affinity for adopting DDP), distributed processing does not seem to be quite as far along in acceptance.

  - The exception to the above is the petroleum sector, which has apparently been evolving DDP methods for years.

- The industry seems to have a proclivity for purchasing vendor supplied software. As DDP grows in acceptance, INPUT expects that remote site facilities (as in discrete manufacturing) should offer an increasingly attractive market for software and services vendors.

- Exclusive of the petroleum sector, there seems to be limited evidence of the cost/performance benefits of DDP within the process industries.

- INPUT believes that the apparent lack of desire in distributing data bases (contrary to other research) may result from two factors:

  - Limited user understanding of the DBMS concept and,

  - Lack of a credible DBMS to satisfy the control requirements of sophisticated users.

- There is a growing sensitivity to the favorable effect that office automation will have upon DDP.

b. Application Analysis

- Process respondents listed two specific applications out of sixteen that were exclusively performed at a node without host support. There did seem to be a bias to have currently a larger percentage of application processing completed at the host site.

- The primary means of data communications to the host is via remote batch mode.

- Applications processing at the node is heavily weighted toward an interactive mode with remote batch as a secondary method.

- General business types of applications are run at the host with more production related applications to be found at remote sites.

- The petroleum sector included both business and production oriented applications as well as specialty applications related to exploration, refining and modeling.

- There was greater evidence in this sector of the use of outside vendors in supplying applications software. This result was also contrary to earlier research findings.

c. User Attitudes

- The process industry sample exhibited a high incidence of employing remote minicomputers to process applications completely at the node independent of host support. Irrespective of this apparent high degree of local autonomy, most data bases were to remain centralized. This observation conflicts with other research work performed by INPUT.

- The exception to the above is in the petroleum sector, which is highly decentralized and is characterized by a great degree of data exclusivity and processing autonomy at remote sites.

- Consistent with the total sample size, the process sector generally anticipates an increasing percentage of hardware expenditures for DDP.

  - It is interesting to note that these judgements were offered even though the industry sector did not exhibit the same degree of tangible DDP cost benefits as evidenced in distribution and finance.

- The process sector (exclusive of the small petroleum sample) made extensive use of RCS. A majority of these respondents expected reductions in their expenditures for RCS as their DDP systems matured.

- Most process respondents were not using VAN services and had no plans to do so.

- System definition, software development, and hardware procurement and maintenance are all strongly centralized functions.
  - Some decentralization of system definition and software development functions was evidenced.
- COBOL was by far the predominant software language used followed by FORTRAN and PL/I. No significant change in language usage is expected through 1980.
- As noted earlier, DBMS were not frequently encountered and were principally limited to IMS.
- In keeping with the industry's apparent predilection to procure outside software, 77% of the respondents indicated that their network software was vendor supplied.

E. DDP USER EXPERIENCE PROFILES

1. INTRODUCTION

- INPUT has selected ten profiles of user's effective implementation of distributed data processing networks. The profiles illustrate, in more detail than that which is presented in the previous sections, the background, current DDP systems implementation, and future plans and considerations of the selected users.

- The profiles indicate the wide variety of potential solutions to distributed processing systems requirements.

- The first profile on banking illustrates the wide number of functions that large banks (which INPUT considers to be on the leading edge of distributed processing) are currently distributing. This action is being undertaken as an attempt to stem the tide of the growth of large mainframe processors and to provide solutions to security and other concerns.

- The second profile illustrates the implementation of an SNA/SDLC architecture in the distribution industry.

- The third profile within discrete manufacturing presents an alternative to the utilization of a manufacturer supplied network architecture. This user has achieved a significant degree of processing and data base distribution by means of a very efficient systems implementation.

- The fourth profile illustrates a distributed processing system that replaced what proved to be an expensive on-line interactive system in a manufacturing environment.

- Finally, the last profile involves a unique implementation of DDP in the distribution sector with processing functions also distributed within the host site.

2. INDUSTRY PROFILES

a. Banking

(1) Background

- The company is a very large international bank headquartered in a major metropolitan area and operating throughout a populated state through some nearly 400 branches. In addition, it maintains an international network operating one of the largest funds positioning operations in the world.

- Some seven years ago the bank decided to centralize its data processing in one large facility that currently contains three IBM System/370 Model 168s. Once centralized, the bank proceeded to establish three regional centers for the purpose of data entry, data concentration and data output.

- In the last several years the bank has been in the process of off-loading the central host initially through specialized communications processors. This has been followed by distributing data entry and, more recently, through a concerted effort of distributing those centralized functions that could conveniently be remotely performed.

- This has been accomplished while maintaining transparency; i.e., the applications programmer need insert no special commands to tell the system where the function is to be executed within the network.

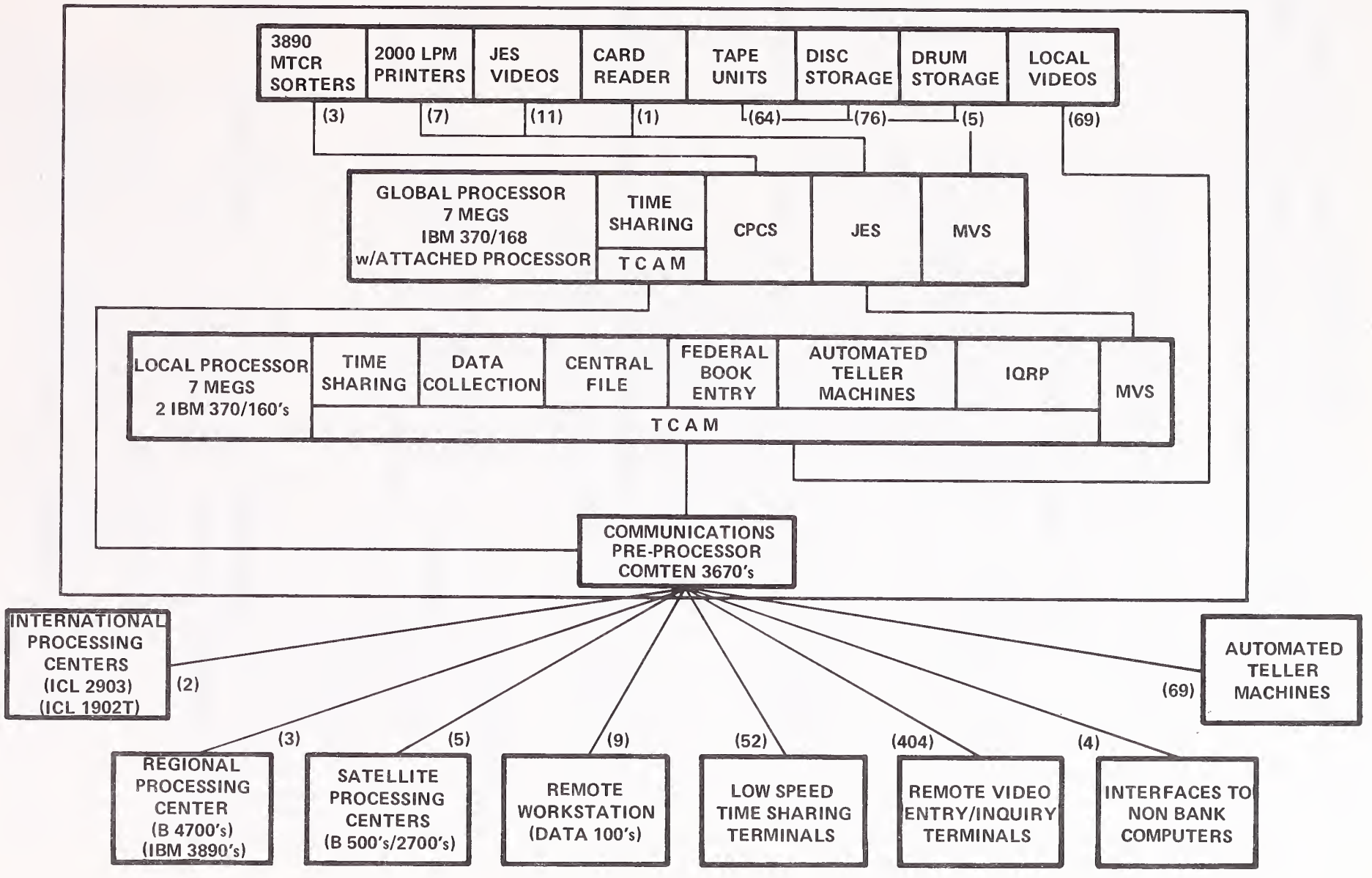
(2) System Design And Implementation

- The system implementation is shown in Exhibit III-27.

EXHIBIT III--27

CASE STUDY 1

CURRENT DISTRIBUTED DATA PROCESSING NETWORK



- The host consists of two IBM System/370 Model 168 shared processors with seven megabytes of core memory. The communications handling has been offloaded onto two Comten controllers with the second unit acting as a backup.

- The central host supports distributed processing at:

  - Two international data centers.

  - Three regional data centers for MICR data capture.

  - Five satellite processing centers for MICR data capture.

- The system currently uses bisynchronous telecommunications as the network protocol. Management has elected to implement the SDLC protocol but is reluctant to shift to SNA network architecture.

- The central site processes 63 major bank applications utilizing over 1,500 separate computer programs. The production output represents over 10 million lines of print per day. In addition, over 13 million lines of microform are produced in conjunction with the item processing data capture operation.

- The teleprocessing environment contains over 530 video and hard copy terminals located in bank branches and throughout the state as well as at strategic locations throughout the world. The video terminals are used for inquiry, data collection and timesharing.

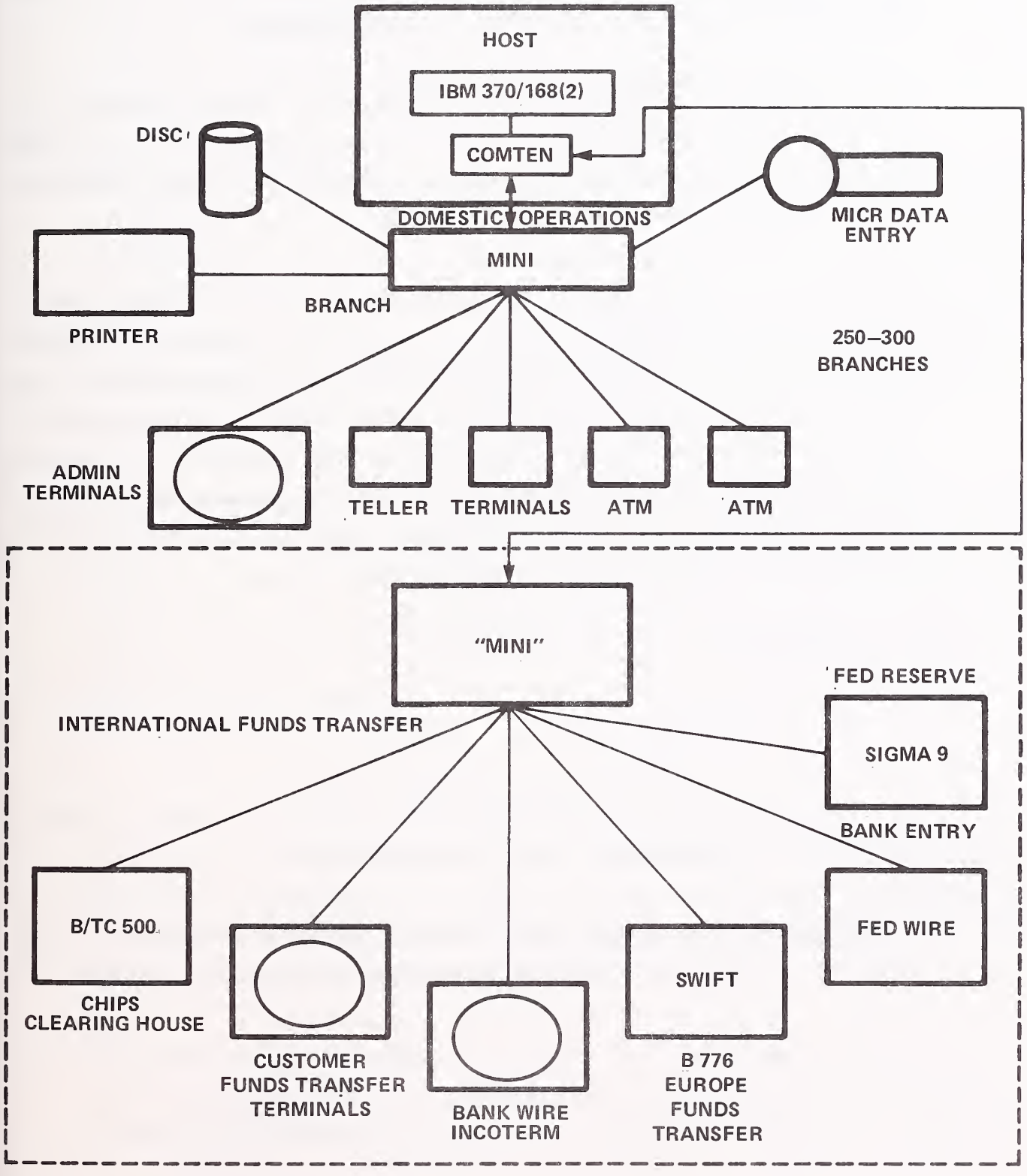
- The automated central file system (ACS) is the major data base and is centrally maintained. The centralized file contains over 3 million customer accounts and processes over 80,000 inquiries a day.

(3) Future Plans And Considerations

- An enhanced distributed network is shown in Exhibit III-28.

EXHIBIT III--28

ENHANCED DISTRIBUTED NETWORK



- The bank is vitally concerned about the vulnerability of its central data center to disruption due to: (1) labor unrest associated with potential unionization; (2) sabotage (terrorism); and (3) power failure.

- The bank is attempting to distribute consumer servicing functions to their three regional data centers and major branch installations.

- It is intended that these facilities operate for at least 24 hours in an autonomous manner when and if the host is not in operation. They are in pilot test utilizing the Burroughs S1000 Series and NCR 7750 Series distributed MICR data entry and proof of deposit systems.

- The bank is in the process of integrating its foreign funds positioning, foreign exchange, and funds transfer networks through the use of selected minicomputers. These minicomputers will maintain their own data base (which will be refreshed from the host) and will allow for the location of video terminals in corporate financial offices, permitting multi-national corporations to position and transfer funds through the bank's financial communications network. This network interfaces with other international networks such as the SWIFT (Society For International Funds Transfer) network.

b. Distribution

(1) Background

- The company is a manufacturer and distributor of consumer products which it sells through other distributors and directly to the public.

- Its most recent data processing capability was achieved as a result of being acquired by a conglomerate and later spun-off by that same conglomerate.

- It is worth noting that key personnel involved in the development of the profiled distributed data system came from the aerospace industry, where they were involved in the design and development of tactical data networks and tactical message switching systems.

- The initial attempt to develop a distributed processing system for order entry, accounts receivable, customer inquiry, and reorder distribution utilized Sanders equipment. Datapoint became a subsequent supplier.

- The system under development at that time was not directly connected to the central host and eventually proved unreliable, inadequate (lacked essential features) and was not responsive (too rigid) to the end users' needs.

- When the corporation subsequently acquired a data center from the aerospace industry (as a result of the corporate spin-off), the new President of the corporation solicited assistance from that data center.

- Personnel from the center looked at the key applications and noted the similarity between what the manufacturer required and the technical requirements of a tactical data message switching system. The data center was experienced in using large-scale IBM System/370 systems for simulation and elected to look at IBM SNA/SDLC architecture as the means to implement the distributed data network.

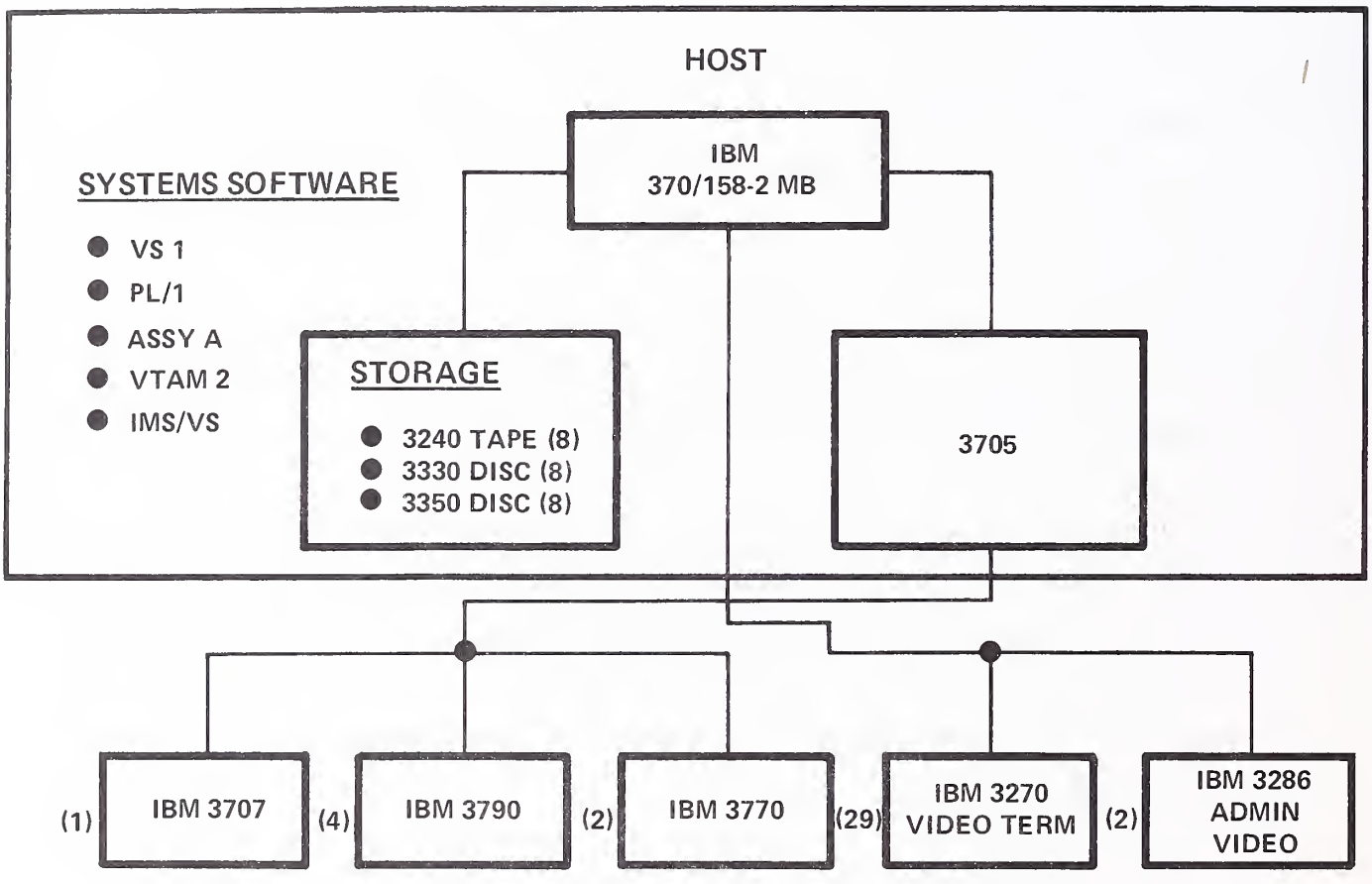
(2) Systems Design And Implementation

- The systems implementation is shown in Exhibit III-29. The host is an IBM System/370 Model 158 -2mb machine. On-line data entry and inquiry is achieved locally thru twenty-nine IBM video and two IBM administrative terminals using the IMS/VS data base system.

- The system is programmed primarily in PL/I (with some assembly) using structured programming. The SNA/SDLC net uses VTAM2 as the telecommunications monitor and supports seven IBM Series 3700 nodes at manufac-

EXHIBIT III--29

DISTRIBUTION
DISTRIBUTED SNA/SDLC NETWORK



MANUFACTURING

- ORDER CONTROL
- PRODUCTION SCHEDULING
- STATUS REPORTING
- BULK SHIPPING

REGIONAL SALES OFFICES

- ORDER ENTRY
- INQUIRY
- ACC REC
- ACC PAY
- SALES STATUS
- REPORTING
- ELECTRONIC MAIL
- CREDIT LETTERS

DISTRIBUTION CENTER

- SHIPPING
- BACK ORDER
- INVOICING
- INVENTORY CONTROL

turing, regional sales offices and distribution centers throughout the U.S., Canada and Europe.

- It is noted that the success of the SNA/SDLC implementation was directly due to the expertise of the data center personnel; this expertise was acquired from prior "bit fiddling" while implementing defense department tactical message switching systems.

- The primary application is order entry with other applications including accounts receivable, accounts payable, financial management information reporting, customer service, and "customized consumer product services." This last application is a direct result of utilizing the distributed data network as an "electronic mail" system.

- The system has been up and running for well over a year. It is an outstanding example of the effective implemention of an SNA/SDLC architecture.

(3) Future Plans And Considerations

- The user has recently added the following applications:

  - Credit letters.
  - Field systems reporting.
  - Electronic mail.
  - Central backorder generation.
  - Automated account maintenance.

- The user is in the process of implementing the following applications throughout the distributed network:

- Incentive payroll (manufacturing).

- Labor efficiency reporting.

- Accounts receivable inquiries.

- Accounts receivable check entry.

- Improved inventory control.

- Credit memo processing.

c. Discrete Manufacturing

(1) Background

- The user is a manufacturer of industrial equipment which it sells directly and through distributors in the United States, Canada, and Europe. It also has manufacturing plants located in these three areas.

- The company elected to use distributed data processing relatively early in its history. Originally, the data processing function was autonomous at each of the operating divisions. In 1958 data processing was consolidated at the corporate level. The company used card data transmission systems to conduct order entry and inventory control at the centralized facility.

- In 1970, they were looking for something better and decided to have data entry and data error correction decentralized.

- After conducting a study, Sanders Data 804/810 intelligent terminals were selected. Datapoint and Four Phase systems were also considered. The Sanders equipment was selected because it was mini based with adequate disk storage (5 megabytes each), displays, a printer, and a suitable communications interface capability.

(2) System Design And Implementation

- The current distributed network is shown in Exhibit III-30.

- The user developed his own software including the operating system and the communications and data entry package (utilizing Sanders DMS software) for the distributed network.

- Transaction centers were set up to handle payables, order entry, inventory control, accounts receivable, and corporate MIS.

- The company created 300 different input formats which validated the data upon entry. The system permitted operator interaction in order to correct, recall and batch balance all data prior to transmission to the central IBM System/370 host.

- The company also placed intelligent terminal equipment at smaller branches and at warehouses. A company designed data base permitted inquiry through rotational "polling" and the preparation of shipping documents without interaction from the host.

- The data base is replenished by the host periodically, clearing up any errors that may have resulted in data transmission, etc. The user does not maintain local stock counts on a perpetual inventory basis.

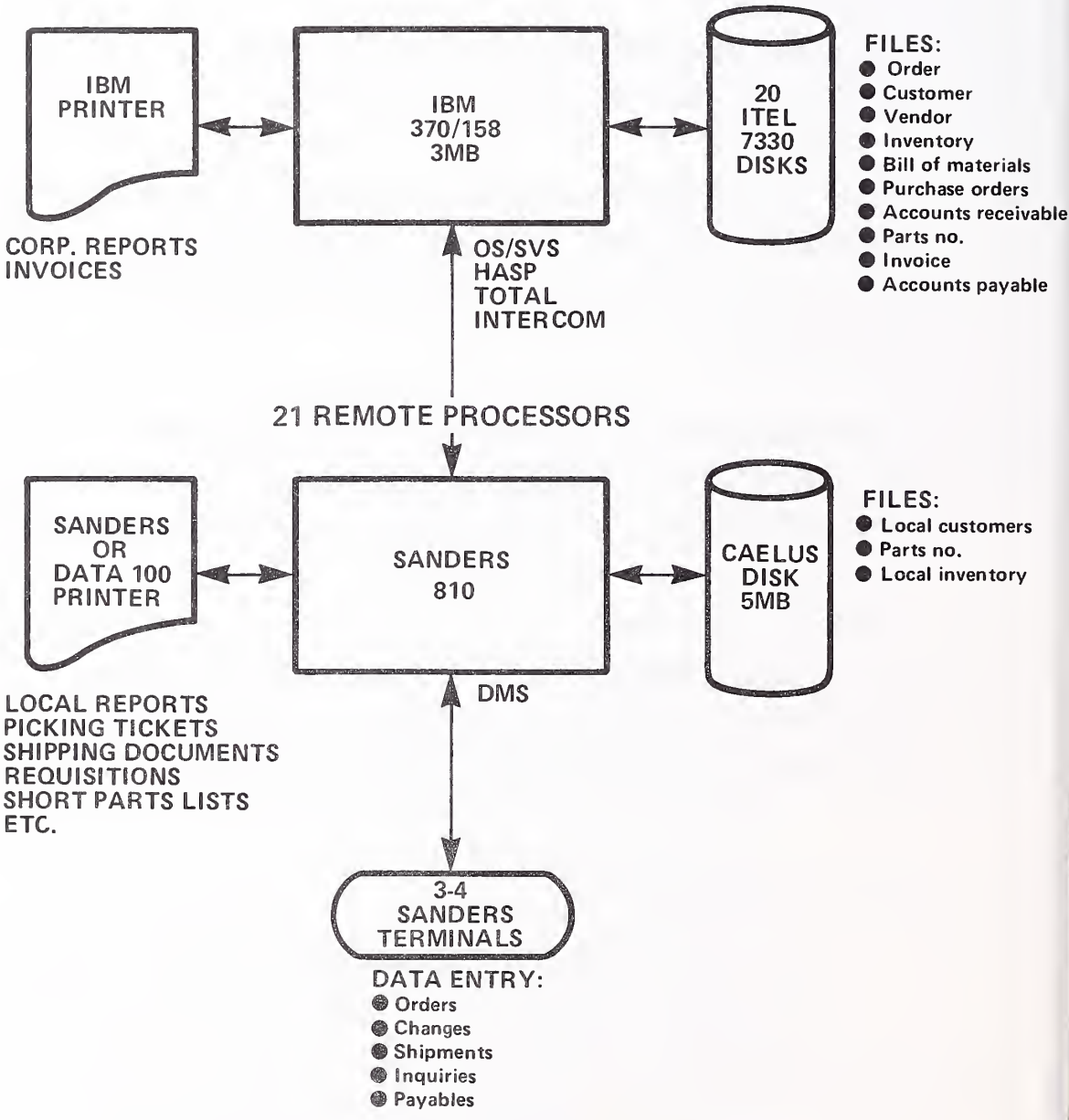
- The system operates as follows:

  - Orders are entered at the intelligent terminal nodes and processed locally where possible with data held for nightly transmission to the central host.

  - The information is transmitted on a remote batch basis after data compaction.

EXHIBIT III--30

PRESENT DDP SYSTEM IMPLEMENTATION



- The host processes the information and transmits data back to the node.

- Software in the intelligent terminal system produces the shipping documents and local warehouse information.

- The company has implemented a complete electronic mail system. An order can be placed anywhere in the United States or six other countries. The system makes minimum use of communication lines by compacting the data and by maintaining local data bases at the nodes.

(3) Future Plans And Considerations

- All non-intelligent terminals are being replaced with Texas Instruments intelligent terminals in order to provide more flexibility in order entry and invoice and statement preparation.

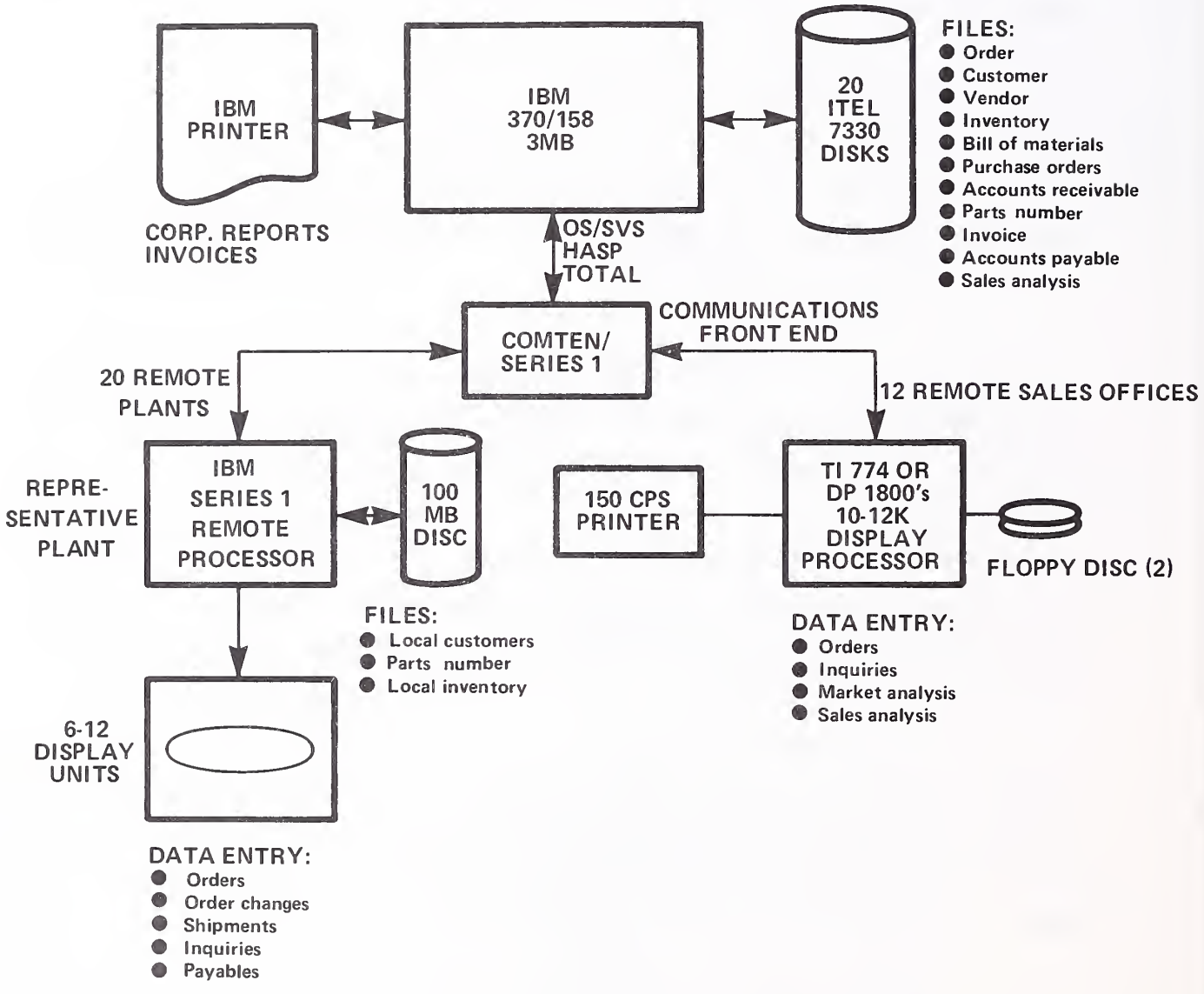
- The company has been a beta test site for the IBM Series/1 and intends to replace the Sanders and Datapoint units with IBM Series/1 systems. The upgraded configuration of the system is outlined in Exhibit III-31.

- In addition to providing order entry, inventory control, payables, receivables, and management information data systems, the Series/1 will be used for shop floor data collection and energy management applications within the manufacturing segment of the network.

- The IBM Series/1 is used to downline load not only the data bases but the computer software that operates at the nodes. The user expects that the Series/1 at the nodes will handle the host output in an unattended manner at night.

EXHIBIT III--31

UPGRADED DDP CONFIGURATION



- The proposed configuration is a three level hierarchical network. Inquiries from customers can be processed in the order entry network or through a value added network like Telenet. By approaching distributed processing in this manner, the user has reduced communication expenditures considerably (greater than 50%).

- When a word processing option is available for the Series/1, it will be added.

- The company will continue to utilize its own data communication protocols until the Series/1 has been upgraded to become compatible with the IBM SNA/SDLC architecture. At some point the user feels he will be able to evaluate the IBM architectural performance in relation to his future needs and make an independent decision about implementing IBM SNA/SDLC architecture.

- BASIC will be used as the language for data storage and retrieval at the node.

- A data base system is being sought which will store data at various points in the communication net to serve optimally the end user requirements.

- A relational structure is required in the data base software development. A concept of "virtual terminals" is being examined, which it is believed can be accomplished through devices like the "staging" capability on the IBM 3850. The user desires an approach that would give him a virtual disk on the staging controller.

- Finally, the user is interested in a remote diagnostic system for the IBM Series/1. Conceivably, a Series/1 located at the host site can check all the Series/1s in the net, restart and reload them as necessary, and substitute other Series/1 processors through electronic switches to accomplish the work of a failed processor within the network.

d. Discrete Manufacturing

(1) Background

- The company is engaged in the manufacture and distribution of technical and consumer products. It has several large manufacturing plants located throughout the United States in addition to a number of distribution centers. There are also a large number of district sales offices, some of which are co-located with the distribution centers.

- The original approach to handling the basic applications of order entry, accounts receivable, customer service, accounts payable, and financial information reporting was through the utilization of two Honeywell 3200 computers in an on-line, real-time, interactive system.

- The cost to implement the system became excessive, its reliability poor, and its response time unacceptable.

- The implementation at that time was the responsibility of the Data Processing Manager. The company reorganized and formed a corporate director of computer services hiring an extremely competent "nuts and bolts" type corporate EDP executive.

(2) System Design And Implementation

- As an initial stop gap measure, the company elected to install a rather large IBM System/370 Model 148 configuration in order to shift the processing of major applications away from an interactive (and toward a batch) mode.

- The company then conducted a feasibility study and subsequently put out a "blue sky" RFP to some thirteen manufacturers for the implementation of a distributed processing system. Three vendors including Hewlett-Packard, DEC, and Computer Automation were selected from the initial thirteen responses.

- The IBM 3790 was considered but rejected as not meeting many corporate technical requirements.

- The three contractors were requested to benchmark several of the important applications following the more detailed definition of the proposed system.

- As a result of the benchmarking and further performance analyses, Computer Automation was selected as the DDP vendor using its Syfa system.

- The systems configuration is shown in Exhibit III-32. A number of processors are located at:

  - The manufacturing facilities.

  - The distribution points with co-located sales offices.

  - District sales office.

  - The home office (two large Syfa systems). These were installed to aid in program development, systems implementation and test.

- The system was installed on schedule.

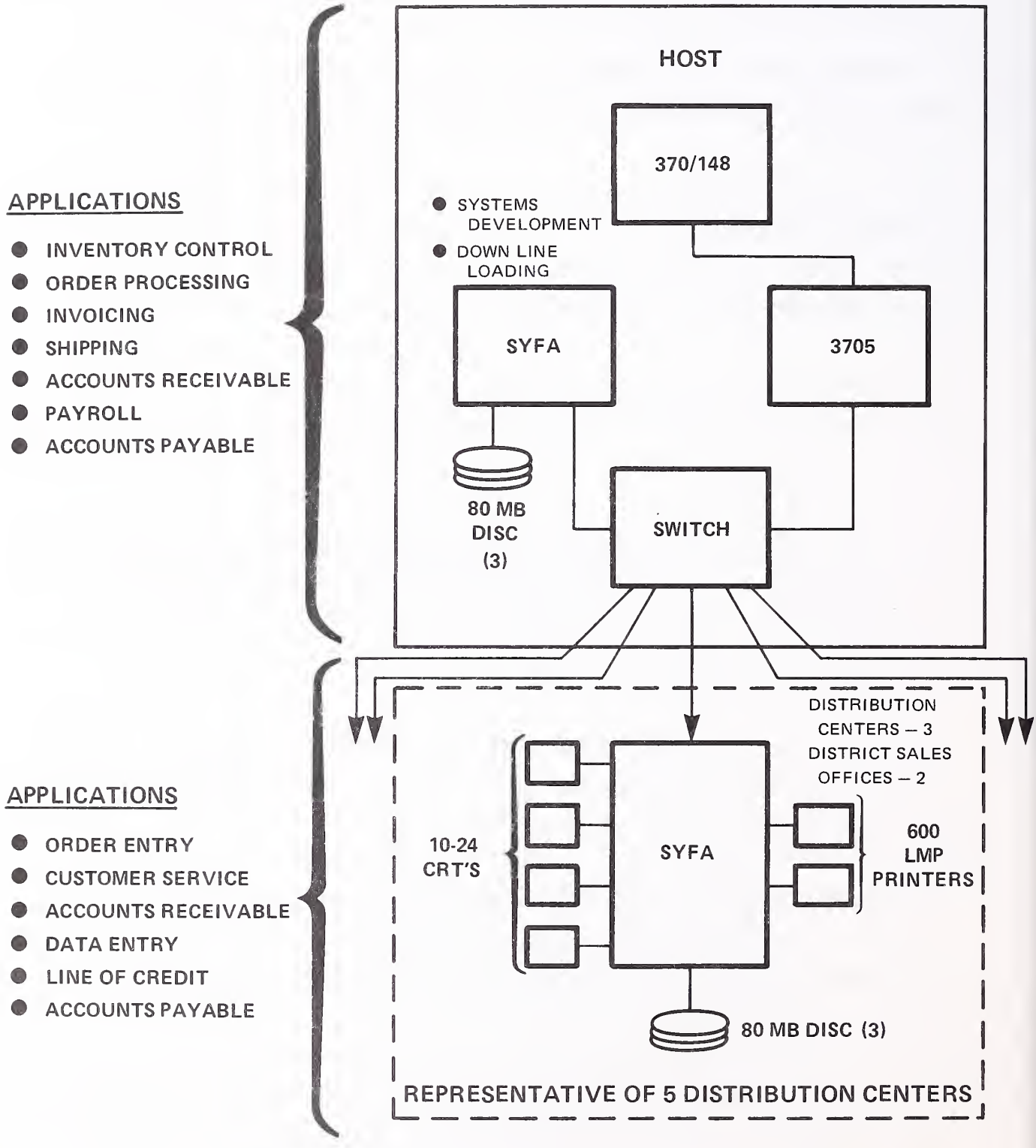
- One Syfa system remains at the home office and is used for program development, and downloading software and distributed data bases to the outlying nodes.

- The primary application is order entry. In addition , customer service, accounts receivable, inquiry, accounts payable, and "line of credit" applications are accomplished utilizing software and distributed data bases at the nodes.

- The system operates in an on-line and interactive mode at the nodes, transmitting information to the central host site on a remote batch basis.

EXHIBIT III--32

DISCRETE MANUFACTURING
INSTALLED DISTRIBUTED DATA PROCESSING SYSTEM



- A polling system is used for inquiry around the network using two-minute time slots.

- The main processing is accomplished on the IBM System/370 Model 148. Results are transmitted in summary form to the node computer which expands the data, operates on it and produces the final output.

- Alternately, the input data is compacted by the node processor and forwarded to the host processor utilizing similar data compression and transmission techniques.

(3) Future Plans And Considerations

- The end users (manufacturing, marketing and customers) appear quite pleased with the system as implemented. It is currently installed in three facilities. The manufacturer expects to complete installation of the entire node network by early 1979.

- The company expects to save $3 million over the equivalent cost that the prior on-line interactive system would have incurred. First year savings in that ratio have already been accomplished and a five year payback is expected.

- The company also expects to shift to an SDLC protocol and a DBMS system (probably TOTAL). Conversion to an IBM SNA/SDLC network architecture will be initiated if their current study shows this option to be appropriate for their network configuration.

e. Distribution

(1) Background

- The company is a manufacturer and distributor of consumer products. It is a subsidiary of a large multinational conglomerate. Consumer products are sold through distributors and directly to the public.

- Two years ago the company made an extensive study of its information processing needs. This resulted in the decision to raise the reporting level of the data processing director directly to the President of the corporation and away from the controller. The corporation went to the open market and obtained an outstanding data processing executive from the aerospace industry.

(2) Systems Design And Implementation

- A systems engineering approach was used to define the major cost effective criteria upon which the system would be designed and developed. The major criteria are:

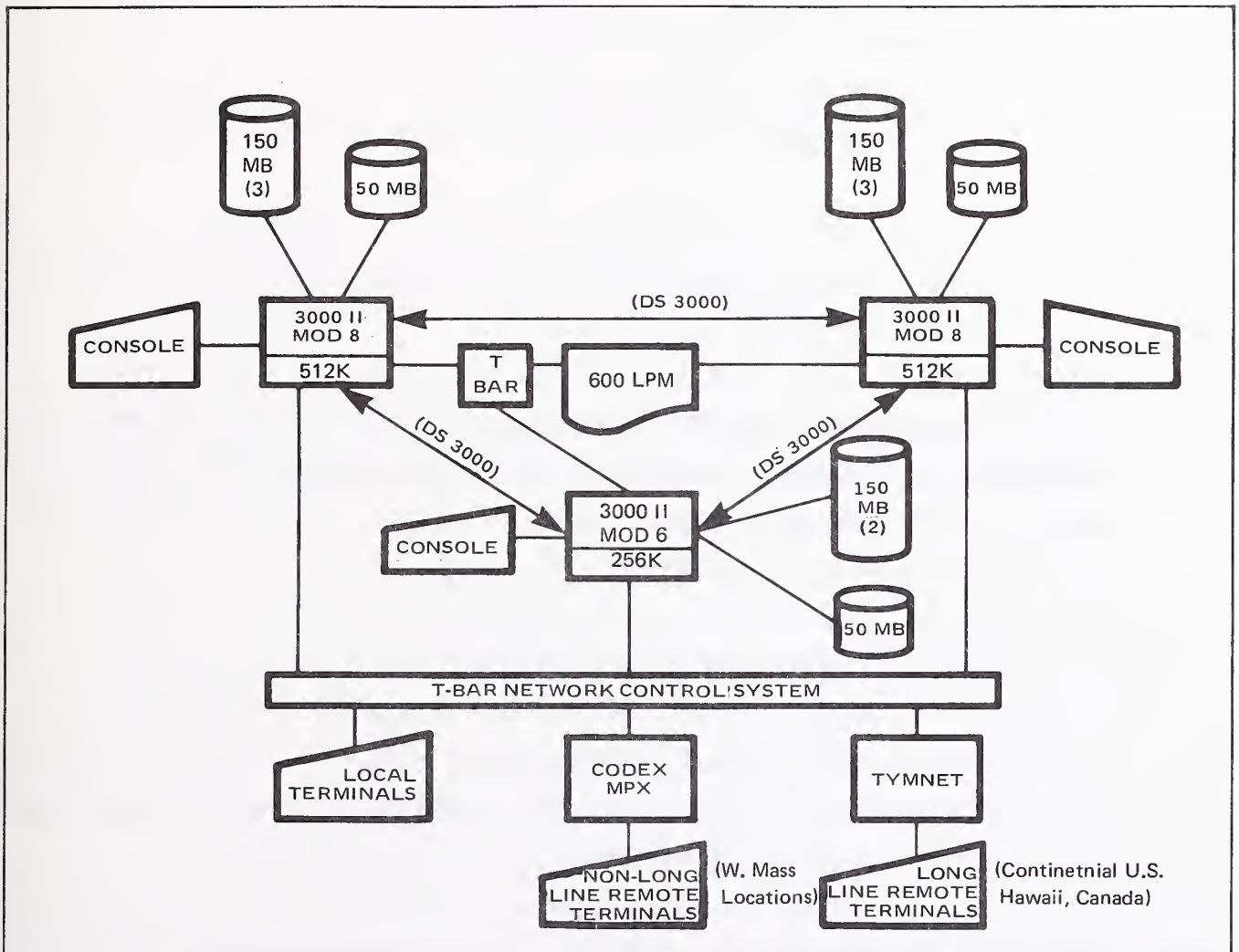
  - Responsiveness.
  - Reliability through modularity.
  - Use of the state of the art for both software and hardware.
  - Cost effective performance in relation to traditional batch processing.

- The data processing executive decided to replace both the Univac 1050 and the Honeywell 2040 which were incompatible systems. After a competitive process involving Data General, DEC, Hewlett-Packard and Honeywell Information Systems Inc., the company chose the H-P 3000-II in a multiple (three processor) configuration.

- The systems implementation is shown in Exhibit III-33. The three processors were interconnected through Hewlett-Packard's distributed System 3000 network architecture. Each of the processors is able to adapt to work load requirements by sharing specific tasks among the other two machines. This distributed central host is interconnected to the outside world through an electronic switching system.

EXHIBIT III--33

DISTRIBUTION
DISTRIBUTED HOST CONFIGURATION



150 MB — Memorex 677 150M-Byte Disk Drives With (1) Microcomputer System, 1677 Disk Controller Per Central Processor

50 MB — Hewlett-Packard 7920 50M-Byte Disk Drive

T-BAR NETWORK CONTROL SYSTEM — Switches All Terminals Among Processors, Individually or by Group Function

TERMINALS — Various Hewlett-Packard Terminals Connected Directly, Multidropped and Via Modems

CODEX MPX — A Number of Codex Corp. LSI 4800 Modems with Multiplexer Option

TYMNET — Tymnet, Tymcom CP-62A Network Computer for Interfacing to the Tymnet Data Communications Network

- By using distributed processing, the company believes that it has doubled throughput capacity for the same data processing dollar expenditure.

- The company has over 150 CRTs, graphics terminals, printers, and plotters installed in eight warehouses and seven sales locations within the United States. The intelligent terminal system is interconnected to the host through three types of electronic networks:

  - Hard wired within the corporate center.

  - Connected through modems within the local manufacturing/distribution region.

  - Connected through Tymnet for long distance transmissions both within the United States and internationally.

- It is the company's intention to use existing software packages where possible and purchase a material requirements planning package and a payroll and general ledger package. Order entry, customer inquiry processing and distribution software will be developed in-house.

(3) Future Plans And Considerations

- The company plans to utilize microprocessors within its network in order to establish compatibility between peripherals and communication network nodes that are currently incompatible with the H-P network architecture.

- Micros will also be utilized to establish synchronous high speed data communications between strategic sales and distribution locations and the central (distributed) host.

- Two H-P 1000 systems are planned both to implement a job floor data entry system and provide data extraction and control for selected process control applications; i.e., automated warehouses.

- Technical and programming support has been centralized at the host site. However, the end user is involved on an interactive basis for the systems development of such elements as data input screen marks and report layouts.

f. Banking

(1) Introduction

- Minicomputers supporting host processors at headquarters, in conjunction with minicomputers or microcomputers at remote sites, have provided cost effective solutions to growing DP requirements in banking.

  - Additionally, DDP has served to assist in off-loading the mainframe and reducing the rate of capacity utilization.

- The bank discussed in the following profile has been employing DDP for several years in order to reduce teller time per transaction and reduce inter-office telephone calls occasioned by demand deposit and time deposit activities.

- Although the use of automated teller machines (ATM) is only now in a pilot mode, tying ATMs onto the DDP network at some future date is expected to facilitate the adoption of electronic funds transfer (EFT) techniques.

(2) Bank Overview

- Security Pacific National Bank, headquartered in Los Angeles, is a full service retail national and international bank with operations in more than 20 foreign countries.

- It is the second largest bank in California and the tenth largest in the United States. With 528 banking offices at the end of 1977, it also has the second largest banking office system domestically.

- Banking offices have been opened at the rate of 20 per year over the last several years exclusive of acquisitions.

- Employees number approximately 19,000 with $14.9 billion in deposits at the end of 1977. Assets are in excess of $18 billion.

- Systems software and applications personnel number approximately 12 in support of the bank's DDP efforts, which is referred to as the Bank Terminal System.

(3) DDP Background

- The bank's efforts in DDP date back to about 1974 when it became clear that methods had to be adopted to cope with the steadily increasing volume of consumer transactions occasioned by both demand and time deposit accounts and loan activity.

- A monetary savings could be realized by utilizing interactive minicomputers to support a network of terminals located at banking offices.

- Furthermore, as more banking offices were opened (with concomitant additions to transaction volume), clusters of minicomputers could be added to the system in a modular fashion in order to accommodate the increased volume.

- In addition, perhaps the major reason behind the move to DDP was because of the redundancy that the concept affords at a cost significantly below that of a large mainframe utilizing standard front end communications controllers.

- A competitive minicomputer system was also considered but not selected due to limitations of the configuration. All functions were to be performed in one processor with the second unit functioning as a "hot backup."

- The alternate approach that was examined and selected was a DDP configuration, centered around multiple redundant minicomputer clusters that were

configured to handle both the on-line transactions and communications functions at the host site, independent of the bank's 370/168 three megabyte machines used primarily for batch functions.

- Each of the banking offices would have a programmable teller controller handling both administrative and teller terminals. ATMs could be subsequently added at each banking office and tied to the communications front end by means of an asynchronous line protocol.

- A pilot study was conducted and the minicomputer cluster system subsequently recommended to senior planning committees within the bank. Final approval came from the Office of the Chairman.

- The primary factors in justifying the system included:

  - Savings in inter-bank telephone calls.

  - Overdraft protection.

  - Reducing the average time required for each customer transaction.

- Other key elements in selecting DDP included:

  - Ease of expansion.

  - Modularity (particularly in facilitating troubleshooting).

  - "Fail soft" operation through redundancy.

  - Design flexibility.

- The minicomputer vendor selected was General Automation (GA) for the following reasons:

- Lower estimated cost and time to implement the system.

- Physical proximity to the bank's headquarters in Los Angeles.

- Prior experience with DDP in banking through its work with the Bank of America.

- Banking office equipment was supplied by Incoterm and included 16K byte controllers operating on software downline loaded from the host. The controller interfaces with four to eight teller terminals and one to two administrative terminals. Both terminals are the same except for keyboard differences.

- There are no peripherals at the remote site other than the terminals. No data bases are distributed or maintained at the banking office locations, which is done in an effort to maintain centralized control.

- The GA minicomputers are all 16/440 units with 65K words (see Exhibit III-34). They are arranged in clusters of two units each with one cluster acting as dual communications handling processors (CHP) and three clusters functioning as transaction handling processors (THP).

- Each CHP logs transactions and addresses 16 SDLC lines with the facility for taking its companion's communications lines in the event of a processor failure. Furthermore, each CHP can handle two asynchronous lines for ATM transactions.

- Network control is provided by a PDP 11/05, which is used to check out modems, monitor line problems and detect attempts to break into the ATMS. Operators man the system console on a twenty-four hour basis.

- Several automatic bus transfer units (ABTU) are used within the CHP cluster to allow the switching of communications lines, magnetic tapes and disk drives.

- There are currently three clusters of THPs employing CDC 3345 80 megabyte disks, which comprise the transaction data base.

- Functionally, the system generates a log of activity against a customer file. At the conclusion of the banking day, the log is transferred (by tape) to the central mainframe computer system for the creation of a report of "holds." Various customer record changes such as names, addresses, etc., are also made. A new data base is then generated by the mainframe and loaded on the on-line data base prior to the next day's activities.

- In addition to the CHP and THP clusters, the bank also operates a test system for purposes of program development, checkout and system simulation.

(4) Results To Date

- Security Pacific National Bank (like most banks) has been traditionally a large mainframe user. This was its first attempt at using minicomputers within a DDP environment, and it found many of the niceties missing, particularly with regard to operating systems and documentation.

- Throughput limitations were encountered by virtue of the minis having only 65K of memory and limited space for buffers. In general, the bank had difficulty in debugging mini software and hardware and integrating the processors.

- Critical hardware milestones and the time required to implement them included:

  - ITC controller and terminal installation at 528 sites - 12 months.

  - ICC Communications Control Center installation - 6 months.

  - Shipment of GA hardware for on-site program development - 12 months.

- Installation of the test bed configuration for program development - 6 months.

- Key software accomplishments included:
  - Programming message accountability for update type transactions.
  - Generating a disk recovery system to rebuild on-line data packs.
  - Developing a dynamic data base load facility to reload the data base while still on-line.
  - Establishment of inter-cpu communications.
  - Writing all of the applications for the DDA/TDA functions.
  - Completion of the data base I/O Manager and,
  - Testing the redundancy features.
- Pilot installations were implemented in a few banking offices starting in 1977.
- User acceptance is reported to be excellent, particularly after the initial shakedown period. Much of this acceptance is attributed to a comprehensive training program.
- Communication line problems have been encountered throughout the network. These have been related to extended response times in certain instances and may have been as a result of low quality lines.
- SDLC experience has been favorable, with this protocol being used between the banking office controllers and the CHPs. A modified form of SDLC is used between CHPs and THPs at the host site.

- The system has been operational for over one year and the bank is pleased with:

  - The redundancy features which afford a higher reliability than a uniprocessor system.

  - The relatively low cost associated with redundancy; e.g., the hardware cost of each minicomputer cluster has been approximately $200,000 including disk.

  - The ability to add clusters in a modular fashion as the size of the system increases and future applications are added.

(5) The Future For DDP

- The bank's experience with minicomputer front ends has been quite favorable and minis will be considered for future on-line activities.

- Mainframes will continue to be used for data base related applications.

- Future operations may implement selected real time posting of transactions to accounts rather than the current time delayed memo posting process.

- Although data bases are not planned to be distributed among banking offices, additional remote intelligence requirements are perceived, particularly in manipulating screen masks.

- Security Pacific has two ATM installations in a pilot mode with nine more planned in the short term.

- The same data base used to service DDA and TDA transactions is also used with the ATMs.

- Future applications might also include:

- Development and DDP integration of additional loan applications such as a data base to service commercial loans and,

- A broadcast facility to disseminate information items of interest to banking offices throughout the network.

g. Discrete Manufacturing

(1) Introduction

- The following case study was selected for profiling because it deals with one of the more sophisticated future DDP planning efforts that INPUT has uncovered in discrete manufacturing.

- The user selected has approximately two years of DDP experience collected through a number of trial installations which to date have yielded marginal results. Nonetheless, future expectations for DDP remain exceedingly high and the company has now embarked upon an aggressive program to implement fully a "second generation" system.

- Accordingly, the bulk of this profile will be directed toward highlighting how the lessons learned to date have structured the company's DDP philosophy and current thinking regarding its future networking requirements.

(2) Company Overview

- The Byron Jackson (BJ) Pump Division of Borg Warner, the subject of this profile, is the largest of several divisions within Borg Warner's Energy Equipment Group (EEG). This group services the industrial products market by supplying pumps, valves, seals and other key capital goods components.

- Borg Warner is a diversified, multinational manufacturer of a variety of products used in air conditioning, chemicals and plastics, transportation equipment, and industrial products. Total corporate sales have increased at a

compound rate of 11% over the last five years and reached $2.03 billion in 1977.

- The Industrial Products Group (which includes EEG) has exhibited a 13% compound sales growth since 1973 and is the most profitable operating entity within the corporation with 1977 sales of approximately $435 million. EEG annual sales represent approximately 60% of this total.

- There are a total of five major product and service groups within Borg Warner. However, the Industrial Products Group is the only one of these five doing work in DDP.

- Byron Jackson, with over 5,000 employees, operates manufacturing plants in Los Angeles (division headquarters), Tulsa, the Netherlands, Canada, Australia, Argentina and Mexico. There are approximately 15 service centers and 54 sales offices worldwide.

  - The current DP staff numbers approximately 70 people worldwide and operates on a $3 million annual budget, which has recently been growing at about a 20% compound rate. The Director of Management Information Systems reports directly to the President of BJ.

(3) DDP Background

- BJ's move toward DDP began in 1973 when the company became interested in developing a remote computing capability as an improved means of satisfying user requirements for more timely information reporting.

  - Available products were judged to be unsatisfactory in meeting specifications formulated to satisfy stipulated requirements.

- In 1975, DDP was re-examined from an expanded perspective:

- As a tool to be used in aiding a growing move toward a more decentralized operating structure and,

- In converting its DP philosophy away from a customized applications approach and distributing functions under data base control.

- An internally staffed project team (named Delta) was organized to examine the three basic DP functions:

  - Input.

  - Output.

  - Storage and processing (data base concepts).

  The group evolved a set of rules to control the fragmentation of the above functions and prevent the "customizing" of these activities at remote sites.

- Adopting a DDP approach was the most viable solution proposed by Delta and was subsequently approved by the MIS Steering Committee, which included senior operating management within the EEG.

- In order to gain operating experience with the DDP concept, several trial installations were implemented in 1976. These systems, built around IBM's 3790 Communication System, were planned to be installed in Los Angeles and Huntington Beach, California, as well as in Tulsa, Oklahoma, and the Netherlands.

- Four major objectives were identified and included the following:

- The installation of IBM's Systems Network Architecture (SNA). Communications disciplines are regarded by BJ as the key to successful DDP. It is believed that SNA will become an effective network standard, and its early adoption will facilitate any future moves toward an integrated corporate network.

- Conversion of several critical data base applications and input structures to the user nodes; e.g., accounts payable, master scheduling, purchasing, etc. However, it is important to note that the basic intent behind EEG's DDP efforts is to move functions out of the host rather than applications (see the operating philosophy discussion in Section D).

- Testing in the user environment and,

- Training the remote staff to be able actively to use the DDP tools provided (including on-site programming) rather than just functioning in a downloading mode.

- Primary data base applications included the usual mix of business related jobs (order entry, sales analysis, accounts receivable, general ledger, etc.) as well as manufacturing applications including scheduling, inventory control, purchasing, routing, shop floor and quality control.

- The problems encountered were primarily centered on the conversion of key data base applications and dealt with the host software, microcode and I/O requirements relating to the 3790.

  - It was clearly not intended to operate the 3790 as a simple RJE station but rather with full capability as a remote, intelligence based processor operating on required applications.

- Development continued through an 18 month period, with the first two goals (SNA installation and applications conversions) generally being accomplished.

- SNA was indeed implemented through the installation of the virtual telecommunications access method (VTAM) resident on the host IBM System/370 Model 158 computer and a network control program (NCP) functional within a 3705 communications controller. Approximately six months were required to complete this task fully.

  - Synchronous Data Link Control (SDLC) line protocol was also implemented with 3775, 3776 and 3777 communications terminals.

- Host site testing was completed and system test begun in the user environment approximately one year after the start-up. Significant problems were encountered, particularly with 3790 microcode and host software support.

- The 3790 sites were intended to operate in four fully integrated modes including:

  - RJE.

  - Standalone.

  - Being capable of operating on-line to the host from remote terminals by means of CICS (customer information control system); i.e., on-line compatibility.

  - Exercising the capability to search for information within the remote data base and, if unavailable, accessing the host data base automatically; i.e., remote site transparency.

- Although each of the above modes of operation were implemented, they proved not to be functional in what was regarded as a sound technical and operational manner. Furthermore, remote site programming has proven to be extremely difficult.

(4) The Operating Philosophy And Approach

- As a result of the preceding experiences, EEG has formulated a communications network philosophy and a set of rules to control processing and data fragmentation. INPUT believes that these are worthy of review.

- In general, it is EEG's thesis that conventional network thinking is counterproductive to implementing data bases and has spawned the following types of problems:

  - New technology introduced to provide additional applications leaves earlier applications with more expensive and less efficient technology.

  - Each application generates its own unique I/O requirements, limiting standard approaches and sharply increasing network overhead; i.e., increasing marginal costs that offset gains from economies of scale.

  - Mixing technologies (old vs. new) tends to reduce the favorable benefits of new technologies.

  - The development of multiple applications, with their increasing network demands, aggravates the problem of maintaining control.

- EEG believes a network should be designed to:

  - Be flexible enough to accommodate change.

  - Introduce new technology with minimum disruption.

  - Minimize marginal DP costs.

  - Maximize data base strategies.

  - Centralize overhead in order to gain the advantages of economies of scale while decentralizing direct DP costs to the user.

- Maintain hardware, communications and software consistency in its use of data bases, leased lines, etc.

- Provide checks and balances between user requirements and DP management controls.

- EEG refers to its conceptual solution to these objectives as Functional Network Architecture (FNA), which stresses input, output, and data base functions rather than payroll, shop loading, inventory control or other types of applications or services.

- Three basic control systems have been established for input, output, and data base functions. In conjunction with these control systems a set of ancillary policies have been adopted whereby:

  - The maximum amount of hardware, communications and software overhead is centralized; e.g., access methods, the DBMS and protocols are all centralized.

  - Network attached equipment is centrally ordered and leased where practical.

  - On-line and batch I/O programming capabilities are decentralized; i.e., conducted at remote sites.

  - I/O storage and restart controls are decentralized.

- Furthermore, all data elements, standard processing routines, master file structures and I/O interfaces are centrally controlled.

- These policies serve to distribute capabilities and responsibilities for I/O while maintaining centralized control over all data management activities. The central site is responsible for high overhead and long lead time functions generally associated with storage and processing, while the remote sites are

responsible for quick reaction to user output requirements and maintaining the highest level possible for input quality.

- A system of checks and balances has been implemented to accomplish the above functions and consists of the following organizational units:

  - An MIS Steering Committee concerned with satisfying both tactical and strategic issues necessary in developing and improving the business strengths within EEG.

  - System Management Teams which are responsible for developing annual system plans submitted to the MIS Steering Committee and,

  - Project Teams charged with the responsibility of conducting the delegated work tasks.

(5) The Future For DDP

- Against the above background of operating experience and network philosophy, EEG is poised to implement its "second generation" DDP system to support its multinational manufacturing operations. The system is intended to handle the basic spectrum of manufacturing systems, from process control through job shop control, including any hybrid mix of the two and to accommodate fluctuations based on product mix changes and strategic plans.

- EEG's proposed network is illustrated in Exhibit III-35.

- The current configuration (which is basically identical to the proposed network) consists of a three megabyte IBM System/370 Model 158 host computer with VS1, VTAM, CICS, JES2 and System 2000 Data Base Management.

  - Remote processing units or RPU sites (a euphemism adopted by EEG to distinguish its remote programmable intelligence sites from the central

site or CPU) operate both RJE-Batch and Interactive Mode (to host) as well as standalone at the remote. These are currently the 3790 units.

- A General Automation 16/440 is used for both shop data collection and controlling numerical machine tools. It interfaces with the host directly using 2780 emulation. Currently, a 3790 interfaces with 15 terminals in the same facility in order to access the host data base. Both the 16/440 and 3790 may eventually be replaced by a single RPU.

- Future system requirements will continue to use SDLC as the line protocol.

- Each remote site, in addition to a transaction oriented processor, will nominally consist of:

  - 100 megabytes of disk.

  - 15-25 terminals to support both RJE and on-line operations.

  - 2-3 serial and line printers.

  - Tape drives to run both microfiche and tape to printer data conversions.

- It is important to emphasize that the future remote site must satisfy the hardware, software and communications requirements to facilitate the aforementioned RJE, standalone, on-line compatibility and remote site transparency requirements.

- Procurement plans are uncertain at this time as to whether a single vendor will be selected (consistent with SNA/SDLC requirements) or multiple vendors with their respective equipment servicing dedicated functions (or applications as appropriate).

- Key vendor selection criteria will focus upon:

- Hardware and software functionality.

- Lead time for hardware delivery (120 days after completion of contract negotiation).

- Ease/difficulty of maintenance.

- Ability to write code at the node.

- SNA compatibility (it is possible that Borg Warner's four other major operating groups may elect to employ SNA in the future resulting in a corporate network capable of being integrated by means of IBM's Advanced Communications Function).

- Every effort will be made to retain the 370/158 through 1980 as functional requirements are offloaded to the remote sites. The System 2000 DBMS will be refined and improved at the host.

- The current and proposed network will also handle voice, telex, and data traffic. Although there are a number of off-line IBM System 6 word processors within EEG, there are no current plans to integrate an electronic mail function with the proposed network.

h. Health Industry

(1) Introduction

- In conducting DDP and related research, it has become clear that there are many areas where relatively small users can reap the benefits of using DDP without necessarily making large investments in time, personnel and hardware. A variety of services are becoming increasingly available which offer viable DDP solutions to small users.

- These services are provided by remote computing service (RCS) vendors who employ large mainframes as hosts in a DDP network. Various users may occupy single or multiple nodes within the network.

- This approach appears to have a great deal of appeal for small but geographically dispersed companies or institutions not equipped to deal with the networking implications of DDP.

- Alternatively, single location firms are relieved of the challenges and costs of operating a host facility while availing themselves of its benefits through a DDP network.

- This profile describes a California hospital utilizing an RCS network--an increasingly viable, but different approach to DDP.

(2) Hospital Overview

- Mt. Diablo Hospital Medical Center is a non-profit district hospital located in Concord, California. It traces its origins back to 1930, although its current 303 bed facility was dedicated in 1975.

- The hospital employs 1,200 personnel and services an area populated by about 400,000 people. The current annual operating budget is approximately $34 million with roughly 99% of funds derived from patient and third party billings.

- In addition to general medical/surgical nursing care units, the hospital offers a variety of critical care units, a Diagnostic-Therapy Center which provides cobolt treatments for cancer patients, a hemodialysis unit, and special maternity and infant programs.

- There are 36 specific medical departments within the hospital which are supported by 41 identifiable groups including:

  - Planning.

- Personnel.

- Finance.

- Administration.

- Education and training.

- Public relations.

- The DDP department reports to the Director of Finance and currently operates with about eight staff members and a monthly budget of $24,000. This does not include a separate budget for a laboratory minicomputer system which functions independently of the profiled DDP installation.

(3) DDP Background

- Mt. Diablo's data processing experience dates back more than ten years with its most recent installation (prior to installing a DDP node) consisting of a used NCR Century 200 and HP 2100. The HP machine was used for data collection at nursing stations and provided information to the NCR "host" via computer compatible magnetic tape.

- Both computers were physically separated by a city block and required a staff of six full-time programmers to satisfy software requirements.

  - The monthly operating budget under these conditions was approximately $32,000 which included $1,500/month for maintenance of the NCR machine alone. The overall average hourly service cost was about $600.

- Difficulties were being encountered by the in-house programming staff in providing software in a timely manner to satisfy various user requirements.

- Some programming tasks were estimated to require one year to become operational.

- Additional problems included:

  - Programmer difficulties in mastering the very diverse user requirements to be found in a hospital like Mt. Diablo with its large number of medical and administrative departments and functions.

  - Operating in a multi-vendor environment with attendant service and maintenance problems.

- A variety of alternative solutions were examined approximately 18 months ago including the possibility of upgrading the existing hardware. This latter approach was eventually rejected for the following reasons:

  - The relatively large depreciation charges associated with owned hardware.

  - The service and data accuracy problems associated with the installed keypunch equipment.

  - The costs and related difficulties of maintaining an in-house programming staff.

  - Concern over the rapid obsolescence of purchased equipment.

- One of the alternatives examined (and eventually selected) was to exercise the option of choosing a remote computing service (RCS) vendor specializing in the health care field. The company chosen was Shared Medical Systems (SMS) headquartered in King of Prussia, Pennsylvania.

- Perhaps the most pivotal factors contributing to the selection of an RCS vendor were the reduced operating cost and the immediate availability of specialty software packages to satisfy the diverse needs of a hospital.

- SMS, with annual revenues in excess of $50 million, offers a variety of hospital related applications services generally divided into the following categories:

  - Financial Management including patient and insurance company billing, accounts payable and related financial statistics.

  - Resource Management including payroll, personnel, inventory, etc.

  - Patient Care, which offers a variety of specialty packages applicable to admissions, pharmacy, laboratory, outpatient, etc.

- SMS also provides archival storage services for its clients.

- These services are provided to more than 400 hospitals in about 37 states by means of a private wire communications network utilizing dual IBM System/370 Model 168 -3AP hosts at corporate headquarters. Each of the subscriber hospitals represents a minicomputer based DDP node in the network.

- Participants in the decision to select an RCS approach (and SMS as the vendor) included the:

  - Director of Finance and Comptroller

  - DP Manager

  - Hospital Administrator

  - Board of Directors

- The equipment which was installed (on lease) within Mt. Diablo includes a Four Phase IV/40 clustered-video display processing system which controls four CRTs, a printer, and a 2.5 megabyte disk. The NCR and HP 2100 equipment were removed and sold in May, 1977, approximately two months after SMS was brought in.

- Cost savings were achieved simply through reductions in staff (particularly programmers), increased accuracy in data entry by replacing keypunch machines with terminals and eliminating equipment related depreciation charges.

- The system became operational in May, 1977. Key applications and the time required for their implementation included:

  - Patient accounting and census - two months.

  - Accounts payable - three days.

  - General ledger - one month.

  Most of the remaining applications required about two months to install/convert.

- In addition to the SMS packages, Mt. Diablo also uses two other (non-SMS) software services offerings including:

  - A statistical budgetary system providing payroll hours, average hourly salary per department, etc., provided by Amherst Budget Systems in Illinois.

  - An inventory ordering and buying system operated by California Data Services in Irvine, CA. Hospital data is transmitted directly to Irvine for processing.

(4) Results To Date And Future Plans

- Average monthly charges for the SMS installation have been in the $9,000-13,000 range and include all lease, teleprocessing and service costs. This has resulted in about a 25% cost savings in the DP department largely as a result of the elimination of six full time programmers.

- Vendor hardware and software service experience to date has been very good.

- Users are generally quite pleased with the sharp improvement in the timeliness of reports; e.g., census information is distributed by 7:00 AM which materially contributes to smoother routines in bed allocation and meal preparation.

- Alternatively, the hospital has lost some flexibility in being able to service special department requests.

- Within the next 12 months, Mt. Diablo expects to upgrade its existing installation to the equivalent of a Four Phase IV/70 cluster controller with a capability to handle 20-24 distributed terminals. Emphasis is on increasing accountability (responsibility) of individual departments in the reporting and data entry functions. Two more printers will be added in addition to upgrading disk capacity to 10 megabytes or greater.

- The existing lab system (using a Digital Equipment Corporation processor) may be tied into the Four Phase equipment by means of a compatible tape. Laboratory charges (of which there are hundreds daily) are still keypunched with obvious room for improvement.

- Selected applications which are currently performed in a batch mode will be done on-line and will include:

  - Master patient index.

  - Patient admitting.

- Bed availability.

- Patient census and billing.

- Patient charges including X-ray, pharmacy, etc.

- Although the hospital has been well satisfied with the RCS approach and expects to continue using this method in the short term, it has not ruled out the possibility of reverting back to an in-house approach at some future date. This will be contingent upon further declines in computer system pricing in conjunction with the availability of customized or packaged software systems.

i. Processing Manufacturing

(1) Introduction

- The process industries by virtue of their wide geographical dispersion (much like the discrete manufacturing sector), represent a particularly attractive area for using a DDP methodology.

- However, the actual implementation of DDP could represent an extremely challenging undertaking, particularly when the company in question may have a number of quite diverse operating groups.

- This is true in the following profile of a large multinational corporation with diverse information processing requirements in both its chemical and materials businesses.

  - The chemical operations are oriented toward engineering applications and plant business systems.

  - The materials group is more concerned with process control and automated warehouse applications.

- Problems are further compounded by a proliferation of multivendor equipment currently operating in batch, on-line and interactive modes. This has spawned, in some instances, three networks servicing the same facility.

- The company's identity is not disclosed.

(2) Company Overview

- The company is a multinational diversitied manufacturer within the petrochemical industry.

- Recorded sales for the most recent reported fiscal year were in excess of $2 billion and the company has experienced a 10% annual compound growth in sales since 1973. Materials and chemical operations represent the two largest product groups.

- Worldwide employment for the corporation and consolidated subsidiaries are in excess of 30,000, with approximately two-thirds of this total employed domestically. Major operations are heavily concentrated in both the southeast and southwest. International facilities are to be found in Europe, South America, Canada and Mexico.

- The data processing function was centralized at the corporate level in the late 1960's in order to increase standardization and enhance operational control. The DP budget of $12 million supports a staff of 250 domestically.

(3) DDP Background

- Prior to 1977, a variety of corporate and individual company level systems had been developed in an effort to satisfy sharply diverse requirements among the materials and other manufacturing operations.

- These diverse requirements were satisfied by placing the data processing function at the local level. However, this spawned multiple types of networks

and terminals such that there are now installations that may have as many as three sets of communications lines (with different types of on-site terminals) in order to service:

- Remote job entry stations collecting data for batch operations.
- On-line order entry applications coupled with administrative traffic and,
- Interactive program development.

- Furthermore, the company identified some years ago the need increasingly to automate warehouse level functions. Accordingly, it adopted a "three level" form of DDP system. This has been implemented in one network thus far whereby warehouse control operations (level one) provide data to minicomputers (level two) for purposes of inventory control and stores replenishment. Summary information is then passed on to an IBM System/370 Model 138 (level three) computer which then interfaces with the host.

- An initial installation of an IBM Series/1 to perform warehouse related functions has also been implemented in one of the materials plants.

- All of the preceding has served to create a multiple vendor equipment environment (see Exhibit III-36) including:
  - Data 100 RJE stations.
  - IBM 370/138, 370/148, 370/165, 370/168, Series/1, 3790 and 3270 terminals.
  - Xerox computers.
  - Digital Equipment Corporation (DEC PDP/11) minis.

This equipment operates in a domestic network with extensions to Canada, Brazil and Belgium for message traffic.

- Early in 1977, Network Services (a corporate entity charged with responsibility for operations, technical development, and support and maintenance) was reorganized with increased responsibility in providing long-range planning and plant support for the materials and chemical operations.

- A primary motivation for this action, and the group's subsequent involvement with DDP, relates to management's concern with the large capital expenditures at the host center and the obvious redundancy of network facilities.

- One of the group's pressing tasks is to attempt to get standardized and uniform systems installed across divisional lines. It must do so against a background of diverse user requirements and a plethora of vendors offering non-standard sets of equipment.

- Although it is intended to continue to have all programming centralized, one or more trained software professionals will be in residence at remote sites to take care of ad hoc requirements.

(4) Efforts To Date

- In examining methods that might be employed to satisfy the preceding requirements, Network Services undertook a detailed study of each major system that was needed within one of the operating groups and examined a number of different possible solutions. These included batch, RJE, DDP and the use of regional processing centers.

- A detailed evaluation of the costs associated with teleprocessing, staffing, hardware, space, etc., was performed for each of the above proposed solutions.

- Key factors that were also examined included:

- The time required to perform various functions.

- Maintenance and location support requirements at the remote sites and,

- The architectural intent of various vendors' equipment; i.e., where the product stands in its development cycle and its capability of being upgraded.

- The company selected a minicomputer based DDP approach as being the most cost effective in satisfying the disparate processing requirements for both major operating groups.

- Both the IBM Series/1 and the DEC PDP/11 machines (which have been operational for some time) were selected (at different intervals) as representing the best hardware solutions then available for the particular applications in question. They will be considered as candidate minicomputer types to satisfy future automated warehouse applications.

  - Results will also be compared with the 370/138 system operating with CICS and DL I installed at one of the materials plants.

  - This facility has been operational for at least six months but will require additional experience before yielding results suitable for "before vs. after" comparisons.

  - Experience with one installed 3790 has yielded satisfactory results as far as IBM's specifications are considered. However, the product's operating limitations may not be adequate to satisfy the proposed automated warehouse application.

- The Series/1 is currently operating in a non-automated warehouse application and providing batch data to the host.

- Interactive processing is not needed for some plants, which results in emphasis being placed on summary data derived from remote batch inputs.

(5) The Future For DDP

- The company will continue to operate with both its RJE and on-line terminal systems. However, card readers will probably continue to be used for several more years.

- Studies are underway to convert the existing multiple networks effectively into a single network populated by one terminal type capable of performing all functions; i.e., RJE, on-line and interactive.

- SNA is being considered as the network standard, and potential vendors' equipment is being examined with regard to the extent that it will be SNA/SDLC supported.

  - It is important to emphasize that other protocols and network standards are also being evaluated.

  - A decision is not expected for about 12 more months.

- In the software development area difficulties have been encountered as a result of minicomputer limitations in data base handling.

  - Since the Series/1 does not have a DBMS, the company is developing a data base handler for its initial installation.

  - TOTAL is being satisfactorily used on the DEC equipment.

- It is important to emphasize that philosophically the company is not committed to a more centralized network structure. They desire to have a DBMS more localized to the distributed minicomputer installation with relatively

small amounts of summary data transmitted to corporate headquarters or among various locations.

- The concept of a corporate wide and centrally controlled DBMS is regarded as inconsistent with:

  - The current and expected availability of such a product.

  - The need to take advantage of current technology that affords economical solutions to the DP requirements of remote locations.

  - A desire to control the growth of corporate network services.

- Over the next 15-18 months, the following sequential milestones are expected to be achieved for the chemicals division:

  - Complete the evaluation and selection of a second generation minicomputer family. The IBM System 34 is a viable candidate to satisfy the business systems capabilities.

  - Develop a functional specification for the first major application.

  - Complete installation of the first system in the proposed network operating with a major application.

j. Retailing

(1) Introduction

- The following user experience profile describes one of the earliest and most sophisticated point-of-sale (POS) oriented DDP networks encountered by INPUT in retailers with sales below one billion dollars.

- The timeliness of DDP information reporting in the dynamic retail environment sharply facilitates the company's operations.

- The system has been implemented as both a sales aid and planning tool for dealing with building supply contractors and consumers of hard goods.

- It is unique in that the system is completely designed and maintained by the company with limited vendor dependence. Major system components have been centrally procured and assembled by the company.

- Resulting financial information supported by sufficient operating experience indicates that DDP does offer tangible cost/performance benefits over more traditional centralized DP operations.

- This DDP network currently has a limited data interface with the company's suppliers but could become a future model for integrating the order function between wholesalers and retailers in the distribution industries.

- The company's identity has been withheld by request.

(2) Company Overview

- The company is a major regional building materials and hard goods retailing chain with 185 stores in 16 eastern states.

- Products sold to both contractors and consumers run the gamut from structural lumber, building hardware, plumbing and electrical supplies to kitchen and laundry appliances, housewares, home entertainment equipment and mobile homes. There are approximately 10,000 merchandise items for sale which have spawned two million stock keeping units (SKUs) in the central inventory file.

- The company had net sales in excess of $600 million in its most recent reported fiscal year and has had approximately a 17% compounded growth in

sales over the previous four years. The rate of annual store expansion has averaged about 14% which, if sustained, should approach the corporate goal of 300 stores by 1981. The company's productivity, profitability, rates of growth and financial performance measurements compare very favorably with leading retailers.

- Approximately 5,000 people are employed by the company with about 110 personnel in the data processing area. Of the latter, 30 are involved in the DDP program with the remainder assigned to centralized functions.

  - The data processing budget, exclusive of capital expenditures, has averaged about 0.5% of sales in recent years.

(3) DDP Background

- The implementation of a point-of-sale (POS) data system dates back 15 years (when sales were less than $50 million) and has been an integral part of the company's long-range plan to develop an effective sales/planning tool to facilitate its growth.

- Philosophically, the company perceives itself simply as a marketing firm, buying and selling merchandise with the underlying sales function as the most important activity to be performed in its business environment.

  - Accordingly, the data processing function (among others) is seen as proposing "least expensive" solutions to facilitate the salesman/customer interface, with the use of computers as incidental to the stated objective.

- The company's recent POS efforts traces its origins back to the 1972/73 time frame. Prior to this point in time, it evaluated and tested a variety of alternative system solutions and distributed network implementations that included:

- Optical scanning and ticket reading (Kimball).

- Key-to-disk.

- Mail and courier services.

Data input/output was the limiting factor in the above solutions.

- The current DDP system (see Exhibit III-37) is built around an IBM System/370 Model 148 host which interconnects with three Data General Eclipse 300 processors. The latter handle accounts and expenses payable as well as personnel applications. Both IBM 3270 and Applied Digital Data Systems (ADDS) terminals support the host facility.

- An IBM System 7 acts as the communications controller with each remote node (retail store) looking like a 2780 to the 370/148. The System 7 is currently being evaluated for replacement or upgrade. The communications protocol is binary synchronous (bisync) operating over 2,400 bits per second (bps) dial-up lines.

- Less than one minute per day per remote site is required to transmit the necessary store/host data, which includes an inventory update as well as automatic resupply and price adjustment information. Data compression techniques are used to facilitate these transmissions.

- Currently, 118 of the 185 total stores are operational in the DDP network. Store equipment includes the following:

  - One Data General Nova 1200 CPU with 65K bytes of memory.

  - Eight to twenty low profile (facilitates installation at check-out counters) custom CRT sales terminals (initial units were Conrac).

  - One Diablo 10 megabyte disk.

- Two printers made by Centronics and Tally.

- One ASR-33 asynchronous terminal for administrative message traffic.

- One ADDS control terminal for accounts receivable and credit authorization.

- In addition to the store interconnection there exists a secondary network that permits suppliers to establish a communications link with the company in order to facilitate ordering and billing. Although only three of the company's 150 major suppliers are currently on the system, the future potential for a wholesaler/retail DDP network is extremely intriguing.

- Key accomplishments in the implementation of the system included:

  - Developing a duplicate POS billing system that required 120 days.

  - Bringing up an accounts receivable system for purposes of credit authorization and the local printing of statements that also required 120 days and,

  - Developing a unit inventory or real time inventory system that required almost one year.

- Significant early software difficulties were encountered in attempting to handle a relatively large number of terminals without the benefit of a more powerful operating system, or virtual memory, in a small machine.

- The first in-store system required one year to become operational with the second taking nine months. Since that period, the company has sharply decreased the time necessary to bring a store on-line. It is now down to several days.

- It is instructive to note that each store maintains its own inventory file which is duplicated at the host. Each time a sale is made, the item is deducted from the local inventory coupled with an appropriate addition to the receipts record. Periodic physical inventories serve to reconcile differences between host and remote records.

- The retail store environment proved to be far more hostile than expected. Equipment filters were unable to handle dust and smoke (from fork lift trucks) and disk packs were being discarded every three weeks. The company resorted to custom cabinets operating under positive pressure and without using external air for cooling.

- The most important criteria used in selecting a vendor was cost and maintainability (not surprisingly). The company is unique in that it performs its own maintenance and installation. Major system components are specified and procured centrally from vendors.

- The company did its own system design including developing communications software and establishing its own line protocols. Programming is done centrally and is down line loaded from the host through the System 7.

- Functionally a second communications network exists to handle administrative and special order traffic. There are 193 asynchronous ASR 33 terminals to handle this function.

- FORTRAN IV is currently being used with the in-store minicomputer. Difficulties in retaining programmers, who have written assembly code for the IBM System/370 Model 148, are causing a shift to COBOL.

(4) Results To Date

- Management's experience with the current DDP system appears to be outstanding and includes the following favorable results:

- Data is significantly cheaper to acquire.

- Information is available in a more timely fashion. These include administrative reports related to accounts receivable and monetary figures enabling rapid decisions related to the disposition of cash at each store.

- Relatively untrained people are able more effectively to operate a business.

- Procedures are more effectively enforced.

- To underline the above in a more quantitative fashion, the following statistics are offered by management:

  - Store operating pretax margins have improved by 2%. It should be noted that sales personnel have authority to lower prices in order to meet competition. The in-store system permits management quickly to pinpoint difficulties that may arise in using this "negotiated price" sales approach.

  - The capability of maintaining an in-store unit inventory has materially contributed to reducing shrinkage from about 1% to below 0.4%.

  - Average in-store system costs have scaled down over the last five years from in excess of $100,000 to about $35,000 with a payback of less than three years.

- Each store pays for its own system hardware, and the corporate data processing center is charged with all operating costs. These costs are reported to be more than offset by cash and price discount savings achieved through centralized bulk purchasing.

- On the negative side, the company has had to deal with the design and maintenance issues surrounding a complex network. It elected to do so after satisfying itself that vendors were not in a position to satisfy their particular operating requirements.

(5) The Future For DDP

- Over the next two years the company expects to have 250 stores in operation with all stores having an installed computer system.

- Within the next year the company expects to select a new minicomputer system to further upgrade its in-store processing capability. Additional performance features may include:

  - Providing security and environment control.

  - Replacing the special order processing network of ASR 33s with a video terminal tied to the in-store minicomputer. This will serve to integrate both the administrative and computer functions into a single communications network.

  - Providing more management types of reports to be printed at the local level detailing operating margins, inventory status, commission sales, etc.

- The 370/148 will be upgraded to handle COBOL with the addition of more memory and disk.

- Several DBMS systems will be evaluated in order to facilitate inventory management.

- The company will continue to examine non-telephone company network alternatives, particularly in interfacing data with those systems belonging to its suppliers. If successful, expectations are for savings in telephone charges.

IV THE DDP COMPETITIVE ENVIRONMENT

IV THE DDP COMPETITIVE ENVIRONMENT

A. INTRODUCTION

- The rapidly decreasing cost of computer hardware is being complemented by increasing user demand for remote data input, processing and communications capabilities.

- These "new systems economics" have tilted the cost performance benefits for many users toward the on-site installation of programmable intelligence based systems operating within telecommunications networks. The combination of remote programmable intelligence and telecommunications is distributed data processing, or DDP.

- The advent of DDP is serving increasingly to blur the lines of distinction between hardware, software and systems vendors while offering both opportunities and challenges to all of these suppliers.

- Most estimates place suppliers of DDP related hardware at a figure approaching 100 when considering mainframe, minicomputer, microprocessor and intelligent terminal vendors.

- Similarly, INPUT estimates that there are approximately another 50 RCS vendors with sales in excess of $10 million who are, in varying degrees, involved with DDP.

- No hardware or RCS vendor can afford to ignore the market opportunities or competitive challenges being presented by the integration of software, - networking and communications systems against the backdrop of decreasing computer costs.

- INPUT believes that the packaging of hardware and services to satisfy unique user requirements is an omen of the positions to be taken by both IBM and AT&T in the post 1980 time frame.

B. IMPACT OF DDP UPON VENDORS

1. SERVICES VENDORS

- Approximately 50% of the respondents surveyed in this study expected a reduction in their traditional expenditures for remote computing services as a result of the competitive inroads to be made by DDP nodes.

- However, INPUT believes that there is potentially more to be gained than lost for RCS vendors as a result of the opportunities presented by DDP.

- Recent announcements by National CSS, ADP, Keydata and others in providing users on-site computers linked into their networks take advantage of opportunities afforded by the rapid growth of the in-house timesharing market.

- Furthermore, by bringing their software expertise to bear on minicomputers (which have traditionally not been software supported by their manufacturers), the RCS vendor continues to satisfy a major need of less sophisticated users.

- Accordingly, services companies are probably the only firms now capable of installing, operating and fully supporting turnkey DDP systems.

- However, the potential stumbling blocks that must be overcome by RCS vendors include:

  - Establishing a credible maintenance operation that can allay user concerns over reliability and service issues.

  - Developing a sales and marketing force capable of dealing with the systems implications of DDP.

  - Structuring an effective marketing strategy consistent with the resource limitations that many RCS vendors face by virtue of their relatively small size.

- INPUT believes that one of the most attractive DDP market segments that RCS vendors can address in the short term are those relatively smaller users outside of the Fortune class of companies who are not being addressed by the national account strategies of many hardware vendors.

2. HARDWARE VENDORS

- Hardware suppliers have been in the vanguard of taking advantage of significantly decreased memory and computational costs.

  - This has been particularly true with regard to minicomputer and intelligent terminal vendors who have, in varying degrees, developed excellent OEM business.

  - OEM derived revenues for several minicomputer vendors range in the 60% area.

- However, the traditional value added of packaging components and selling processing power is also decreasing at a rate proportional to the reduction in costs brought about by advancing technology. It is well known that the cost of a computer per se is a diminishing percentage of total systems costs and the

manufacture of only computers offers increasingly limited value added benefits.

- Hardware vendors have responded in a variety of ways to the above issue in an effort to offer value added solutions to user systems problems. These include:

  - Offering a dedicated network architecture by many of the mainframe and several of the minicomputer vendors.

  - Adopting the networking and protocol standards of IBM.

- However, many users remain exceedingly uncomfortable with committing to a single vendor's standards.

- Furthermore, hardware vendors, in varying degrees, remain deficient in providing such critical value added components as:

  - Systems software including DBMS packages.

  - Problem analyses and solutions.

  - Communications networking.

  - Documentation and training.

  - Maintenance and customer support.

  - Responsiveness and flexibility to end user requirements.

- Recognizing these shortcomings, a number of vendors have adapted various strategies to solve these difficulties including:

  - Reorganizing marketing organizations into "national accounts" in order to gain better visibility at the end user level.

IN

- Developing, either directly or through joint ventures with system software houses, industry oriented applications packages suitable for "turnkey" installation at the node or intelligent terminal points in distributed networks.

- Licensing, developing directly or through joint ventures, cross industry software packages particularly in the DBMS area.

- Arranging third party maintenance and service agreements.

C. INDUSTRY STRUCTURE

1. ANALYSIS OF VENDOR SURVEY RESULTS

- Eighteen hardware vendors in three categories were interviewed including:
  - Five mainframe vendors.
  - Six minicomputer manufacturers.
  - Seven intelligent terminal vendors.
- The following analysis is based upon significant data obtained from 15 of 18 vendors interviewed.
- A copy of the vendor questionnaire may be found in Appendix B.
- Survey data summarized in Exhibit IV-1 indicate that DDP sales currently occupy an important percentage of total sales to:
  - End users.

EXHIBIT IV--1

RELATIVE IMPORTANCE (PERCENTAGE) OF DDP SALES IN VENDORS' MARKETING STRATEGIES, 1978 AND 1980

	1978	1980
	%	%
STANDALONE DIRECT END USER SALES		
0	-	-
< 5%	6.7	6.7
5-10%	-	-
10-20%	6.7	-
20%	86.6	80.0
DK	-	13.3
OEM SALES		
0	6.7	-
< 5%	20.0	13.3
5-10%	-	-
10-20%	6.7	6.7
20%	66.6	60.0
DK	-	20.0
SYSTEM HOUSES		
0	20.0	13.3
< 5%	6.7	6.7
5-10%	13.3	13.3
10-20%	13.3	6.7
20%	33.3	33.3
DK	-	13.3
BUNDLED W/OEM	13.3	13.3

DK= DON'T KNOW

- OEMs.

- System houses.

- Eighty-seven percent of the vendor sample claimed that more than 20% of their total sales to end users was DDP related. Similarly, 67% of the respondents claimed more than 20% of their sales to the OEM market were DDP related, and 33% of the respondents claimed 20% of their sales to system houses were also DDP related.

- DDP sales directly to the end user market clearly occupies a dominant role in current and future vendor plans. The slight decline in the 1980 percentage is due to vendor uncertainty as to the proportion of end user and OEM sales that will be DDP related by that time.

- The majority of the respondents (53%) felt that greater than 30% of their 1977 sales were involved in distributed processing. By 1983 more than 50% of these vendors believed that more than 50% of their annual revenues would be derived from DDP related sales (see Exhibit IV-2).

- Taken from still another viewpoint, the estimated percentage of the respondents' total base of installed computers which are currently employed in a DDP mode is shown in Exhibit IV-3. It was significant to note that one-third of the respondents felt that over 30% of their total installed base was utilized in a DDP mode.

- Forty percent of the respondents were focusing their DDP offerings to specific industry sectors. Not surprisingly, those vendors that had concentrated on specific industries felt they were gaining market share at the expense of their competitors. The six most important industries identified by the survey in descending order of importance included:

  - Finance.

EXHIBIT IV--2

DDP VENDOR SALES AS A % OF TOTAL SALES 1977-1983

% DDP SALES	1977	1980	1983
	%	%	%
<10 %	6.7 %	-	-
10-20 %	13.3 %	-	-
20-30 %	6.7 %	6.7 %	6.7 %
≥30 %	53.3 %	6.7 %	-
30-50 %	6.7 %	40.0 %	40.0 %
≥50 %	-	6.7 %	13.3 %
50-75 %	6.7 %	6.7 %	-
75-100 %	6.7 %	20.0 %	20.0 %
DON'T KNOW OTHER	-	13.3 %	20.0 %

EXHIBIT IV--3

ESTIMATED PERCENTAGE OF VENDORS' INSTALLED COMPUTER BASE EMPLOYED IN A DDP MODE

PERCENTAGE INSTALLED BASE	PERCENTAGE RESPONDENTS
≤5 %	-
>5-10 %	13.3 %
>10-20 %	33.3 %
>20-30 %	13.3 %
>30 %	33.3 %
DON'T KNOW	6.7 %
TOTAL RESPONDENTS	100% (ROUNDED)

- Manufacturing.
- Government.
- Insurance.
- Distribution.
- Transportation.

- Most of the respondent vendors felt little impact from the IBM Series/1 in 1978 (see Exhibit IV-4). However, by 1980 several of the vendors become more uncertain with the potential impact generally expected to become greater. One vendor believed that the Series/1 introduction was IBM's way of sanctioning the DDP concept and would, by definition, expand the market.

- A list of non-Series/1 products that respondent vendors expect from IBM in the DDP area is shown in Exhibit IV-5. In 1978 the IBM small systems (System 32 and 34) were of greatest concern. However, a majority (53%) of the respondents had either no comment or just didn't know. The vendor responses to the 1980 timeframe become more varied and if anything even less conclusive. Some representative comments are offered in Exhibit IV-6.

- Approximately 60% of the respondents regarded vertically integrating semiconductor manufacturers as potential competitive threats in the DDP market. Representative comments on this issue are offered in Exhibit IV-7.

- Exhibit IV-8 offers representative comments as to which vendors were regarded as the two most important competitors.

- A majority (67%) of the respondent vendors are including office automation as part of their DDP marketing strategy with at least 50% of the sample planning on offering word processing systems. Only 25% of the sample were planning on offering a business system product.

EXHIBIT IV--4

THE DEGREE VENDORS PERCEIVE THE IMPACT OF SERIES/I UPON THEMSELVES, 1978 AND 1980

	1978	1980
	%	%
NOT AT ALL	26.6 %	20.0 %
DECREASE SALES SLIGHTLY (1-5%)	53.3	13.3
5-10% DECREASE	6.7	13.3
10-20% DECREASE	-	13.3
20-25% DECREASE	-	6.7
DON'T KNOW	-	20.0
NO COMMENT	6.7	6.7
WILL INCREASE OUR SALES	6.7	6.7
TOTAL	100%	100%

EXHIBIT IV--5
OTHER DDP PRODUCT OFFERINGS
EXPECTED BY VENDORS FROM IBM (1978—1980)

	1978	1980
	PERCENT	PERCENT
SYSTEM 32	6.7	6.7 %
SYSTEM 34	26.6	6.7
SYSTEM 36	13.3	6.7
3270 MARKET		6.7
NEW LOCAL PROCESSORS	6.7	13.3
3790	13.3	6.7
"MORE LIKE THE SERIES 1"		6.7
"WHATEVER THEY PUT OUT!"		6.7
NONE	6.7	
AUTOMATED OFFICE/ WORD PROCESSING		6.7
NO COMMENT/NO DATA	13.3	20.0
DON'T KNOW	40.0	20.0 %

NOTE: MULTIPLE RESPONSES

EXHIBIT IV-6

REPRESENTATIVE VENDOR COMMENTS REGARDING IBM's THRUST IN DDP

- "1978 - System 34 and 3790 functioning systems with increased software support."

- "New processors rumored - don't know what will actually happen - the SNA approach is one of solidification of a number of protocols to SDLC - careful central control of their systems - if announcements follow that then the competition is able to better compete - if they allow more "democracy" in a distributed sense so that everything doesn't have to go through a central host they will be much more formidable as a competitor - there are some openings and everyone's after it, but if IBM provides local processing capability in connection without going through a host then we've got our hands full."

- "1978 and 1980: The 3790, we believe it to be much stronger than the Series/1."

- "1978 and 1980 - The thrust will be the System 36."

- "It depends on the System 34 and how they enhance the Series/1 - it could easily make a tremendous impact - all of the IBM ads imply distributed processing - they now use the term distributed data processing and that was never used before - it would lead one to believe they will off-load capability from mainframes - we may see a fire sale on 3790s."

- "1978: The System 34 rather than the Series/1 - rumored Series E low end machine that is an alternative to the System 3 and low end 370 standalone - by 1980 we'll see more of the same - communications services through SBS."

EXHIBIT IV-6 (contd)

- "1978: None this year - they are pushing up their heavy artillery - It will mesmerize people - By 1980 no fee - they will come out with products directed at traditional mini markets."

- "1978: Don't know - more product enhancements System 34 and Series/1 - by 1980 we'll see automated office, SBS and new typewriters as word processors."

EXHIBIT IV-7

PERCEIVED THREAT OF SEMICONDUCTOR VENDORS IN DDP

- "If they build in reliability and build in options that reduce costs they will be a threat."
- "They're comng into the OEM market more - the so called hardware market. Also moving into the lower end with microprocessors pushing the mini."
- "All of the semiconductor companies who are OEM types will try something like National Semiconductor and Itel or Fairchild and Magnuson - we will see more of this."
- "The growth of TI and National Semiconductor could have an impact in the future."
- "No threat by semiconductor vendors - they are more in the minicomputer end than in terminals."
- "Microprocessor vendors like TI and Intel are moving up in the marketplace."
- "Vendors that pose a threat are TI, National Semiconductor and Intel...semiconductor vendors are trying to do to DEC what DEC has done to IBM - push low end of the line up."

EXHIBIT IV-8

MOST IMPORTANT DDP COMPETITORS

- "Datapoint is number one in 1978 - they're the generic leader in DDP - innovative concept - number two is IBM due to size and wide product line."

- "DEC is number one and Data General and H-P are vying for second and third position - same will be true in 1980."

- "Number one is DEC for both OEM and end user - number two is Data General and number three would be Prime - we're running into them all the time -In 1980 DEC and Data General will be vying for the one and two positions and Data General will be very close to DEC."

- "Number one is IBM - they're the biggest and the best based on sheer size - number two is DEC - it's the best mini and they have the largest installed base - same in 1980."

- "Number one is IBM - they have fantastic support, wide product line and low pricing - number two is DEC - same in 1980."

- "Number one is Datapoint - Datapoint 1500 primarily - we see alot of them - number two is H-P - they're big and strong - same in 1980 with DEC vying for number three position."

- "Number one is IBM in terms of all products - number two is Datapoint for distributed data processing competition - number three is Texas Instruments with their 774 Series - number four is Mohawk Data Sciences - same in 1980."

EXHIBIT IV-8 (contd)

- "Number one is IBM - we've been beat on bids by their 3790, System 34 and System 3 - number two is Four Phase with the 470 and 490 - by 1980 number one will be IBM, number two Four Phase, three Datapoint, four Courier."

- "Number one is DEC, number two H-P - same in 1980 - the top three mini vendors (DEC, H-P and Data General) have enough of a head start that we feel Interdata and General Automation will fall out. Datapoint and Sycor are even further behind - We could be more threatened by specialists such as Prime and Tandem - large transaction oriented systems."

- Not surprisingly, IBM was regarded as the foremost DDP competitor, followed by DEC.

- The vendor respondents felt that RCS suppliers will have at least a moderate impact on their markets. In INPUT's judgement, the recent introduction of the "on-site hardware" concept currently being implemented by ADP, NCSS and others is too new to be evaluated by hardware vendors.

- Most respondents have developed their own field maintenance and support staffs and in some cases are supplementing this arrangement with third party maintenance alliances.

  - The majority of vendors felt they were very much in competition with the IBM service organization and, under certain conditions, make special arrangements to service remote facilities.

- Over 70% of the respondents were supporting 3270 emulation and SDLC line protocols. Only one-third of the vendors were supporting X.25.

- It also appears that the majority (66%) of the respondents intend to develop compatibility with the IBM SNA/SDLC network architecture.

  - Although most respondents believed the development of standards would be beneficial, none of them wished to be pioneers.

- The importance of applications packages in vendor marketing strategies is presented in Exhibit IV-9 and appears quite mixed and inconclusive. This appears to be somewhat inconsistent with what some users will be looking for in node turnkey systems.

  - Only 27% of the sample were industry oriented or cross-industry applications packages. Most vendors believed that large users wanted to do their own industry oriented programming. Small business users could be the exception.

EXHIBIT IV-9

VENDOR PERCEPTIONS OF THE IMPORTANCE OF APPLICATIONS PACKAGES

	%
IMPORTANT	0
MINIMAL - MODERATE IMPORTANCE	13.3
INCREASING IN IMPORTANCE	13.3
NOT IMPORTANT	33.3
NOT APPLICABLE	13.3
OTHER UNDER INVESTIGATION/ DEPENDS ON SITUATION	26.6

- COBOL was the most widely supported programming language offered (80% of the sample) followed by BASIC (53%) and FORTRAN and RPG (40% each).

2. DDP NETWORK ARCHITECTURE COMPETITIVE ANALYSIS

- The cost effective implementation of distributed computing networks is highly dependent on the definition and design of a "transparent" communications network architecture. Transparency is defined as the transfer of data from point-to-point within the network without the specific intervention of the end user from a systems or programming perspective.

- The IBM SNA/SDLC architecture was the first completely defined and publicly announced distributed data processing network. Virtually all of the mainframe vendors and the major minicomputer suppliers have subsequently introduced announced plans for distributed network architectures.

- Exhibit IV-10 attempts to present the key features of three of the mainframe vendors and two of the maxi/mini suppliers network product offerings. Both Burroughs and CDC are planning to announce their distributed network architectures before the end of 1978.

  - Honeywell refers to their network as the Distributed Systems Environment (DSE), but has not as yet defined the architecture's specifics.

- All of the architectures attempt to use the principle of "layering;" i.e., the functions that each layer is meant to support can be designed, implemented and operated independently (transparent) of the higher or lower functional network.

- At the top of the chart are the user application programs usually coded in such higher level languages as COBOL, FORTRAN and PL/I. These programs often interface with data base management systems such as IMAGE, IMS, and TOTAL.

EXHIBIT IV--10

SELECTED VENDOR NETWORK CHARACTERISTICS

VENDOR	DEC	HEWLETT PACKARD	IBM	NCR	UNIVAC
NETWORK DESIGNATION	DEC-NET	HP-DSN	SNA	DNA	DCA
USER LANGUAGE PROGRAM	COBOL FORTRAN BASIC	BASIC FORTRAN COBOL APL	COBOL FORTRAN PL/1 APL	COBOL FORTRAN	COBOL FORTRAN
NETWORK ACCESS METHOD	DIALOG	SYSTEM SERVICE REQUIRES REQUESTS LANGUAGE CONSTRUCTS	TCAM/VTAM	NCR/TAM ANSI COBOL '74 MCS	TERMINATION SYSTEM (TS)
NETWORK MANAGEMENT METHOD	NSP	DISTRIBUTED POINT-TO-POINT STORE & FORWARD MULTIDROP LOOP VAN	370X NCP/VS	DISTRIBUTED NCR DTN POINT-TO-POINT STORE & FWD. MULTIDROP LOOP VAN REPORTING	DCP AMS NMS
MESSAGE CONTROL PROTOCOL	DAP POINT-TO-POINT TASK-TO-TASK FILE-TO-FILE TASK-TO-FILE	DS/3000 DS/1000 CCIT X.25	SDLC	CCIT X.25	CCIT X.25
COMMUNI-CATION LINE PROTOCOL	BISYNC DDCMP ADCCP X.25 HDLC	BISYNC MODIFIED BISYNC HDLC	SDLC	NCR/DLC ANSII/ADCCP ISO/HDLC IBM SDLC	SAI UDLC ADAPT IBM SDLC ANSII/ADCCP
DATA BASE MANAGEMENT SYSTEMS	DMS	IMAGE	IMS/DMS	TOTAL	DMS 1100

- The first level of implementing the distributed network occurs with the access method. Each vendor has developed its own network access method. The IBM methods are TCAM and VTAM. NCR uses a terminal access method (TAM) and the ANSI COBOL 74 management control system accessing method.

- Network philosophies begin to diverge widely from the access method. The IBM network management method is highly centralized, although the recently implemented Advanced Communications Function (ACF) allows intercommunication between post processors and selected nodes. The other vendors such as Hewlett-Packard, DEC, NCR and Univac all distribute the management function within the network which reduces exposure from disruption if the host(s) become inoperable.

- In order to provide IBM compatibility in the message control area, mini vendors are supporting such protocols as are required for the IBM 2780 and HASP. Several of the vendors including DEC, Hewlett-Packard, NCR and Univac have agreed to implement the international standard for interfacing with packet switching networks (CCITX.25).

- At the next level, that of the communications link protocol, IBM's SDLC is becoming something of an industry standard primarily because of the need by mini and intelligent terminal vendors to provide users with IBM compatibility.

- It is worth noting that both NCR and Univac have provided a methodology for supporting either their own older or foreign terminals operating within their distributed network architectures. By supporting the ANSI II/ADCCP protocol, both NCR, DEC and Univac are able to provide compatibility with the IBM bisync protocol.

- The effective implementation of distributed data base management systems is also a critical DDP network requirement. With the exception of the two remote computing vendors (ADP Network Services and NCSS), only Hewlett-Packard with its IMAGE data base management system has to date been able to achieve a significant measure of transparent distributed data base imple-

mentation. Other vendors such as DEC and NCR indicate that they have plans underway to provide a distributed data base capability within their data base management systems.

GLOSSARY:

IBM

PL/I: Programming Language I.

APL: A Programming Language.

IMS: Information Management System.

TCAM: Telecommunications Control Access Method.

VTAM: Virtual Telecommunications Access Method.

ACF: Advanced Communications Function.

NCP: Network Control Processor.

VS: Virtual Storage.

SDLC: System Discipline Line Code.

NCR

TAM: Terminal Access Method.

MCS: Management Control System.

DTM: Data Transfer Network.

DLC: Data Link Control.

ISOHDLC: International Standards Organization High Data Link Control.

UNIVAC

TS: Termination System

DCP: Distributed Control Processor

AMS: Application Management Services.

NMS: Network Management Services.

SAI: Systems Architectural Interface.

UDLC: Univac Data Link Control.

3. COMPETITIVE STRUCTURE

a. Mainframe Suppliers

(1) IBM

(a) Products And Strategies

- IBM's foray into Distributed Data Processing (DDP) dates back to late 1973 when it introduced the 3790 Communication System which offered remote users the processing capabilities of a machine at the low end of the System/370 family, but with a catch; i.e., the 3790 was completely dependent upon the host.

- Although billed as a DDP product, it was in reality a variation on the theme of centralized processing as all programs were written and supported at the host

and frequently downloaded to the 3790 at the remote site. This served to leave the remote 3790 user vulnerable to the host becoming inoperative.

- Nonetheless, the product offered good terminal screen formatting and data entry and did serve to provide some level of offloading of the host. Additionally, it was (is) fully supported by IBM and is an integral element in the company's Systems Network Architecture (SNA).

- As the product moved into the marketplace a number of shortcomings soon surfaced, including insufficient disk capacity, operational difficulties due to a lack of software support at the site, inflexibility to the attachment of foreign terminals and its relatively high cost in comparison to minicomputers (which are minimally supported).

- Subsequent 3790 upgrades have since enabled local programming and permitted remote 3270 terminals to be attached via suitable data links.

- Early user difficulties have contibuted to a checkered reputation for the product with most of the marketplace not regarding IBM (until recently) as practically supporting the DDP concept.

- However, the above perspective has changed significantly over the last 18 to 20 months with the dual introduction of the Series/1 and the System 34.

- The System 34, which may operate with up to eight peripherals, appears aimed at the first-time user within the small business computer market. However, it supports both the bit-oriented synchronous data-link control (SDLC) communications protocol as well as the older character-oriented binary synchronous communications (BISYNC) protocol. These features effectively enable the System 34 to function as a node in a DDP network with a 370 or 30XX host.

- The Series/1 represents one of the most flexible and price competitive products announced by IBM to date. It has the capacity to be used as a basic building block by either sophisticated end users or system houses that are

configuring DDP networks. It may function as either a powerful remote machine or a limited capacity host.

- Although IBM offers only limited support (traditional for minicomputers) for the Series/1, it may have a variety of foreign peripherals attached to it while operating with a throughput capability approaching a 370/138. It may also be operated in a 3270 emulation mode enabling degraded operation with a 370/30XX host.

- It is possible that a combination of events may have contributed to IBM's recent and expected flurry of DDP related product introductions. These include:

  - High growth opportunities in the minicomputer and small business computer market.

  - "An idea whose time has come;" i.e., DDP (which is probably closely tied to the user's desire to break or slow the mainframe upgrade cycle).

  - Increasing competitive pressures by plug compatible and minicomputer vendors on IBM's traditional lines of business.

  - Initiation of a long-term product/market strategy tying all of the above together and consistent with corporate revenue growth requirements in the post-1980 time frame.

- Although some confusion exists in the marketplace as to which operating division within IBM has the DDP charter, steps are being taken to resolve this short-term problem. In the interim, the Series/1, System 34 and, to a lesser extent, the 3790 offer a powerful combination of products (with more to come) in support of the DDP concept.

(b) Projected Strategies And Organizations

- IBM's past and current DDP strategy can best be characterized as one of containment. This is in large measure due to the success of the Data Processing Division (DPD) in selling ever larger central processors in order to drive IBM software systems.

- However, the poor performance of IBM software for interactive and transaction processing is precisely what opened the door for distributed processing (both conceptually and economically). The controlled distribution of this excessive large scale software burden must be the keystone of IBM's future DDP strategy.

- While it appears that IBM is less than enthusiastic about DDP, it is more a question of timing rather than failure to recognize the economic significance of DDP. INPUT's conclusions concerning the situation from IBM's point of view is as follows:

  - In order to maintain traditional growth IBM must achieve revenues in excess of $30 billion by 1982, and in excess of $50 billion by 1987.

  - IBM's data processing revenues are currently heavily weighted towards central general purpose systems and associated peripherals (greater than 75%).

  - Increasing proportions of data processing dollars are being spent for: minicomputer systems, terminals, data communications services (and hardware) and program products. These are areas in which IBM has not been traditionally strong.

- It appears obvious that IBM must increase market penetration in all of the areas associated with DDP. Moreover, no one questions the fact they have the resources (financial, management and technological) to be successful.

- This being so, why has IBM not pursued these markets more aggressively and with more success? Several answers come to mind:

- They haven't had to because the sale of conventional systems has been adequate to achieve corporate revenue objectives.

- They do not feel comfortable with marketing to small end users -a weakness intolerable to IBM management. (This is indicated by hiring experienced minicomputer salesmen for Series/1 and the emphasis on OEM sales.)

- A vital ingredient in the overall IBM strategy is not yet available - communications.

- Rapid pursuit of DDP would result in significant offloading of large central mainframes and be self-impacting.

- While most executives think they would like to have IBM's "problems," the shift to DDP requires both imagination and courage on the part of IBM corporate management. While IBM may appear to "win them all," the last major technological strategy shift was the announcement of System/360, and that was not as smooth as it appeared to the outside world.

- The IBM corporate perspective is important in understanding how their DDP strategy is being implemented.

  - DPD continues to play its role of servicing large scale customers and providing them with an overall framework (SNA) to proceed towards DDP. This containment strategy is working and the backlog for 3033s represents more raw computer power than IBM currently has installed.

  - The General Business Group has been formed bringing together the General Systems Division (GSD) and the Office Products Division (OPD) under common management.

  - OPD is the fastest growing division in IBM, but its conventional product lines are potentially subject to impact as office automation occurs.

However, it does have experience selling to end users in an office environment and GSD needs this type of marketing orientation. Since OPD needs an infusion of GSD technology, it should be a happy marriage as data processing and word processing merge.

- The current conflict between DPD and GSD products was noted earlier. IBM corporate reaction is that this represents "healthy competition." Some confusion in the marketplace doesn't bother IBM as they pursue DDP from both extremes.

- The missing ingredient of communications services (and products) was anticipated by IBM when they invested in Satellite Business Systems (SBS) - ostensibly because common carriers were not meeting the data communications requirements of IBM customers. When SBS services become available in the early 1980's, data transmission requirements will be satisfied for large IBM customers. IBM will then have enormous new markets available for graphic transmission, teleconferencing, electronic mail and integrated data and voice communications systems.

- It is apparent that IBM is pursuing an interim corporate strategy which not only controls the growth of DDP (including communications) but allows the time to prepare its entire organization for major new business opportunities in the 1980s. In order to achieve its growth objectives, IBM must embrace DDP on the broadest possible basis. It is currently in the process of methodically implementing a plan to accomplish this.

- Because of this interim situation, those users making heavy long-term commitments to the current IBM product line (for DDP) run a serious risk of being caught with obsolete equipment. But then, "replacing the old iron" has always been the name of the IBM game plan.

- By the time it becomes obvious that "data processing" is a cheap commodity available to all, IBM will be prepared to become the world's largest supplier of

information systems (including communication services and products). During the 1980's concentration will be on business (and office) information systems. In the 1990's these services will be generally distributed into individual residences and IBM (or its successors) will provide products and services in the consumer market. At this point, DDP will be fully defined - long after the term has any significance or is of any interest.

(2) NCR

- Over the last five years NCR has instituted major changes in the way they are doing business as a mainframe supplier. They have made a rapid transition from that of an electro-mechanical cash register supplier that was also a proponent of on-line systems connected to large central processors. They are currently utilizing electronic systems and networking to provide the retail and financial market sectors with a complete line of compatible products operating in a distributed environment.

- This specialization in two market sectors has allowed NCR to offer a customer the ability to start on a small scale and upgrade to the most sophisticated form of networking with NCR products. It has reoriented its marketing organization to support the user along industry lines. Symbolic of this metamorphosis is the dispersion of NCR research, engineering, and manufacturing facilities to strategic locations throughout the world.

- Key to NCR's success is the introduction of intelligent terminals based on microcomputers designed, developed and produced at NCR's microelectronics laboratory and production facilities.

- Introduction of the NCR 8000 series of computers spans the gap from small entry level devices to a capability just under the IBM System/370 Model 158. The user can grow through "migration path engineering" which integrates processing power, operating systems and a networking capability in order to satisfy end user's requirements.

- NCR is capitilizing on its specialization through both acquisition and joint ventures with large users. For example, in 1976 it acquired Data Pathing, Inc., in order to penetrate the manufacturing information systems market.

- It is working with Manufacturers Hanover Trust in developing distributed consumer transaction systems in support of both branch banking and multibank holding companies. NCR is also involved in a joint venture with Montgomery Ward and Company in developing an electronic POS system.

- NCR in conjunction with Bank of America is developing the BANCR image processing system. Under this system, image processing is used to capture and electronically store information from checks. The functions of proofing, account updating and report generation would be performed by processing the digitized electronic image and not through the traditional MICR item processing equipment.

- The current marketing organization is oriented toward retail, financial, commercial and industrial sectors as well as medicine, education and government. The marketing force is organized on a "national accounts basis" so that NCR could sell distributed systems to Fortune 1000/100 companies.

- The NCR field service organization has been reorganized to support the specialization of the marketing group. Specialization within the field organization is oriented toward the rapid response and servicing of NCR's terminal oriented systems.

- The company has developed a good distributed network architecture (NCR/DNA). The architecture supports NCR's concept of placing computational intelligence as close to the data entry source as is economically feasible. The architecture supports horizontal integration as opposed to IBM's vertical concept in SNA. New items in the product line will be supporting DNA. Some problems do exist in fully supporting existing products.

- NCR uses the TOTAL data base management system which does not yet provide for distributed data base operation. NCR has utilized TOTAL combined with their own systems design and implementation of complete software applicational packages for the banking and major segments of the retail market sector. The applicational packages have been particularly effective in selling NCR systems to the smaller and medium sized commercial banks, savings and loans, and selected retailers.

- NCR is a significant provider (greater than $100 million annual revenues) of remote computing services to the banking, credit union, and savings and loan industries. They are in the process of upgrading their service centers with the latest NCR 8000 Series distributed systems coupled with improved software.

- NCR has decided to provide COBOL compatibility across its entire product line. They've accomplished this by using an Intel 8080 based interpretive COBOL compiler. This allows NCR systems engineering working with end users to configure, write and install modular terminal systems without requiring access on a timesharing basis to a large NCR central processor.

(3) Honeywell

- Earlier this year Honeywell expanded the top of its computer line with the introduction of the Level 68 Distributed Processing System (DPS). In addition to competing with IBM's 30XX series, the new product enables Honeywell to join the ranks of mainframe vendors committed to distributed data processing.

  - Its acquisition of Incoterm enables Honeywell to extend its market presence in distributed data entry and in general and specifically in distributed consumer financial systems within banks, savings and loans and credit unions.

- Honeywell has a wide variety of minicomputer processors which it groups under the generic term "level 6." These processors support Honeywell's expertise in the process control market by offering control systems, systems

monitoring, data conversion, on-line processing and message processing functions. Honeywell has bridged the gap between these minicomputers and its large host processors (the Series 60s) with a distributed systems network architecture.

- The basic elements of the distributed system environment include:

  - Level 66 host processors.
  - Datanet 6600 network processors with the NPS/remote terminal supervisor software.
  - Level 6 satellite processors with local data bases.
  - DST6/500 intelligent terminals.
  - RBT6/300 remote batch terminals.
  - DIP 7700R display terminals.

- The distributed systems environment network architecture includes a new standard bit oriented protocol called high level data link control (HDLC) apparently similar to IBM's SDLC.

- Network communications capabilities are provided by a front end network processor (FNP) with the Datanet 6670 as the newest version. The network processing supervisor (NPS) supports remote job entry, transaction processing, timesharing, and direct program access for on-line transaction execution as well as data collection and distribution, message switching, automatic restart, statistical recording and network control functions. A remote terminal supervisor permits remote job entry directed output and interactive communication.

- Honeywell's distributed network architecture, DSE, has not yet been defined although it is reported to be capable of supporting hierarchical, ring or hybrid structures. Honeywell states that they are committed to a "true distributed system capability."

- The high level data link control (HDLC) protocol is a bit oriented protocol having code transparency and the ability to accommodate two simultaneous operations.

(4) Burroughs

- Burroughs is extending their concept of a master control program into distributed computing networks. Although their announcement concerning specifics of a communications network architecture is not due out until later this year, two product lines indicate their commitment to the distributed data processing marketplace.

- The new Burroughs B80/B800/B1800 product line represents a common architectural family which has been implemented in a variety of mini/microprocessor configurations. These are all supported by an integrated system of operating, application and high level language (COBOL) software called the computer management system (CMS). Small users can completely transfer application programs as they grow from the small B80 to the large B1800.

- The B80/1800 Series is also software upward compatible with the larger Burroughs B4800/6800 systems. This makes an impressive product line which can readily be interconnected in a transparent distributed computer network architecture.

- Burroughs' commitment to distributed data processing in the financial sector (banking, S&Ls, credit unions) is evidenced by their introduction of the series S1000 distributed MICR data entry and proofing systems. The systems combine MICR proofing with proof of deposit processing which are interconnected between satellite and central host item processing systems. Planned

products improvements will permit the user to retain the "on us" checks on a local basis while accomplishing all other functions normally associated with a complete proof of deposit system.

- At the next level, Burroughs is providing distributed satellite processing by incorporating MICR item processing with their new line of distributed processing minis (Series 80/1800). This will permit larger financial institutions to both perform proof of deposit together with associated MICR item distribution on a regional level for those banks handling $200-500 million in deposits.

- With its acquisition of Redactron (word processing) and Graphic Sciences Inc. (facsimile), Burroughs can be expected to supply word processing and office automation as part of its distributed data processing product mix.

- The company has developed a product line of modular terminal systems (all of which are intelligent) which support bisynchronous, synchronous, and SDLC line protocols. The modular terminals permit Burroughs to offer a "total systems capability" to Fortune 1000/100 companies at all levels (office, warehouse, regional, divisional, national and multinational) of commercial operations.

- Burroughs is focusing its DDP market strategies in the following industries:

  - Finance (banks, S&Ls, credit unions).
  - Discrete manufacturing.
  - Process manufacturing.
  - Medical.
  - Wholesale.

- It is in the process of revising its data base language (DMS-2) to provide compatibility across the entire product line. Data bases will be capable of being distributed from the central host(s) to appropriate nodes. The Burroughs approach to "natural language processors" facilitates the design of user oriented distributed data processing systems. The architectural concepts emphasize interpreter based designs which aid in the implementation of transparency in distributed networks.

b. Minicomputer Vendors

(1) Digital Equipment Corporation (DEC)

- DEC pioneered the development of the mini market by offering an initial product to small scientific users with subsequent offerings to satisfy time-sharing requirements. The most widely accepted product families are the PDP 8 and PDP 11 which were initially installed in scientific and control environments. The company's larger computers (DEC 10s and 20s) have been installed primarily in a timesharing environment for scientific and some management science problem solving.

- DDP is a highly important part of the DEC corporate marketing strategy. A separate product line has been established within the corporate matrix organization to develop a DEC presence in the market. The product line does not yet include offerings from the large computer group (DEC 10s and DEC 20s). The current DDP strategy appears to focus on supplying all of the products in a network up to the IBM central host. IBM mainframe compatibility is inherent in current product offerings.

- DEC has an exceedingly well planned systems network architecture (distributed network architecture (DNA) - see Section IV C 2). The DNA architecture has a layered approach with the current implementation oriented toward the PDP 8 and PDP 11 products. However, additional effort is underway to incorporate full network compatibility with their large computer group, including the VAX 11/780, which is the company's first 32 bit mainframe

machine. When fully developed DNA will be compatible with both IBM and DEC mainframes.

- It appears that the company's overall strategy will be to offer completely integrated distributed data processing systems in specialized market areas including financial, transportation, and government (state and federal).

- DEC has two specialized marketing groups responsible for selling DDP as a total systems concept. They include:

  - Business products whose area of specialization is insurance, manufacturing, and distribution.

  - Services products that focuses on telephone companies and public utilities.

- Philosophically, their network concept is to transfer data in form and using batch mode. Systems design attempts to access the mainframe (IBM hosts) files through "3270" emulation.

- Interactive transaction processing may be accomplished through a hierarchy of PDP 11/34, PDP 11/60 and PDP 11/70 machines configured through the company's TRAX product. Alternately, DECNET could be used to interconnect with a non-DEC mainframe; i.e., an IBM host.

  - TRAX is a cross-industry distributed system capable of being used by financial institutions (banks and insurance companies), process and discrete manufacturers, and federal government agencies.

- DEC's current strategy is not to compete with IBM on a product basis. However, in pursuing the OEM market they do compete with such IBM products as the System 3, 32, 34, and more recently the Series/1. DEC believes it has an advantage over those products in the following areas:

- Better interconnect software.

- Shared files.

- Commonality between DEC products.

- Some pressure is being felt from the semiconductor vendors at the low end of its market. Semiconductor vendors are borrowing a page right out of DEC's strategy with IBM; i.e., integrating forward.

- It appears that DEC plans to offer complete distributed processing systems (to specialized market sectors) that can not only co-exist with IBM mainframes but can also be installed in place of them.

- DEC's introduction in late 1977 of the VAX 11/780 oriented toward transaction processing represents the company's commitment to produce a line of 32 bit machines rivaling established mainframe capabilities.

- Furthermore, the introduction of the DEC 20 System this year indicates further commitment by DEC to produce "maxi-mini" products.

- The company's products support a thorough understanding of the timesharing and site transaction processing systems environments. DEC system architectures are increasingly able to handle the equivalent of "the batch environment" and are approaching the concept of "throughput" which the Burroughs architectures of the 1960's proposed for the multiprocessing host site environment.

- Although not necessarily offering pioneering solutions to "transparency" in the communications and data network environments, DEC's products and systems follow closely behind.

- Applications software development is primarily through system houses.

- Current and planned DEC processors will compete with the range of IBM products from the IBM System 3 Mod 3 through the System/370 Model 158 in terms of "throughput" power. The DEC 2020 competes with the System 3 Mod 15 at the low end of the market and the 2060 competes with an IBM System/370 Model 158 at the upper end.

- Utilizing the LSI 11 microprocessor family or the PDP 11/34, DEC offers word processing on either a standalone basis or within a distributed system. At the top end of the market the word processing terminals interacting with a PDP 11/34 in a distributed network can be used for office automation, electronic mail, and message switching.

(2) Hewlett-Packard (H-P)

- Hewlett-Packard has developed a highly sophisticated distributed processing network within its own organization to handle its manufacturing, scientific, engineering, and administrative data processing applications. In a true sense it has taken this experience and translated it into the commercial marketplace.

- Consequently, the company has become a recognized leader in DDP applications within the manufacturing sector.

- HP offers its own factory data collection system.

- The company's DS/1000 system enables the interconnection of HP1000 computers in a distributed system capable of star, ring or hybrid configuration. The Image/1000 DBMS affords very good network transparency. The system is capable of providing RJE compatibility with a 370 system host.

- Hewlett-Packard is able to obtain another level of vertical integration through the H-P 3000 series processors which are more specifically oriented toward business data processing. The Hewlett-Packard distributed systems network (HP-DSN) for the H-P 3000 allows interconnection of H-P 3000s in any networking configuration and complete compatibility with the H-P DS 1000

network. The network architecture has been designed to achieve transparency such that the H-P 1000 operates as a virtual terminal with respect to the H-P 3000 Series II system.

- The System 2026 is offered specifically for data entry and communications oriented applications. The system is an H-P 1000 with an improved operating system and specific applications software for order entry. It can operate as an RJE station to the IBM System/370 through either 2780 or 3780 terminal emulation.

- H-P distributed systems are "very friendly" to the end user; i.e., the system handles many of the programming details normally associated with interactive terminal operations. This "friendliness" is achieved through offering the end user almost total transparency with respect to data telecommunications and data base distribution.

- The company makes its own peripherals and can configure a dedicated hardware system eliminating multivendor equipment and simplifying the user's maintenance support requirements.

- The H-P 3000 Series II distributed processing system is supported by COBOL, RPG, APL, and SPL programming languages. The company is dedicated to remaining compatible with IBM communication protocols and network structures. The H-P 3000/1000 distributed systems will support the SDLC protocol, giving compatibility to IBM's SNA.

- Hewlett-Packard intends to support the X.25 interface for data transfer through a foreign value added network.

- Recently, Hewlett-Packard announced the H-P 3000 Series III together with a new enhanced version of the H-P 3000 operating system. The system allows H-P to compete with large IBM mainframes by doubling the throughput capability of the 3000 Series system without significant (less than 20%) cost increase.

- Improvements in distributed network architecture allow data compression prior to transmission. Query software is available to access an IMAGE data base at a remote site as if the data base were local.

- The H-P distributed systems network has excellent resource management, security, and network control capability. The network control allows for network reconfiguration for down-line loading of both data base and control programs and for remote system diagnosis of potential hardware malfunctions.

(3) Data General

- Data General is a leading minicomputer vendor operating in the second tier of the traditional mini competitive environment. The company's product line extends from its microcomputer based Micro Nova family up through the Eclipse M/600 introduced earlier in 1978. The M/600 boasts price/performance capabilities equivalent to medium scale mainframes.

- The company's formalized entry into distributed processing dates back about 15 months when it introduced the CS/40 family of computers suitable for use in remote applications.

- Earlier this year the company complemented the CS/40 with the new CS/20 and CS/60 small business computers. The CS family represents a compatible product line for use in small offices or within the distributed networks of Fortune types of companies.

- Data General has paid significant attention to program compatibility offering versions of ANSI 74 COBOL with additional screen handling extensions across its entire product line. The systems are upward and downward compatible (within memory constraints) and form the basis of multi-station nodes on a larger distributed computing network.

- The microcomputer based CS/20 is a single station unit that can function either as a standalone small business computer or an intelligent data entry

system in a distributed net. The CS/20 operates as either a Hasp II work station or as a remote job entry system. The communications protocols supported include BYSNC (maximum rate 50kb), SYNCH (maximum rate 50kb), and SDLC. ASCII and X.25 can be handled in special cases.

- Data General is in the process of looking at expanding its support of the SDLC protocol but will not at the present time consider fully supporting IBM/SNA architecture at the nodal level.

- The interactive nature of the COBOL compiler helps both end user and system houses develop applicational packages for such business functions as accounts receivables, payables, general ledger, financial statement preparation, inventory control and management information systems.

- The customer can either write his own applications software or lease/purchase a turnkey package from Itel Corporation.

(4) Computer Automation

- Computer Automation entered the distributed processing market with its SyFa system approximately two years ago, which has since become the company's fastest growing major product.

- The SyFa system is an integrated software/hardware product oriented toward network communications and distributed processing in support of a large IBM host processor.

- The system is designed to allow branches or divisions of a corporation to accomplish a significant amount of local processsing yet be able to interact with an IBM mainframe. The SyFa system operates interactively with up to 24 terminals and can communicate concurrently with the mainframe host. The Syclops operating system supports simultaneous execution of interactive applications, communications emulation, printer spooling and background utility.

- The system communicates directly with the mainframe by emulating the appropriate protocol which include IBM 2780, IBM 3780, or ICL 7020. SNA/SDLC capabilities for the IBM 3790 are under development. The system utilizes IBM 3270 emulation to interact as an intelligent terminal with an IBM System/370 mainframe.

- The main programming language is Sybol, a business oriented high level language designed for interactive applications. It is a COBOL-like language with powerful file handling capabilities, communication control features and a special screen generation subsystem. COBOL, BASIC or FORTRAN are not supported but are claimed to be easily converted.

- The SyFa system includes down-line loading of software and data throughout the distributed network from a designated central location via an RJE link.

- The company's latest SyFa related announcement is a virtual network architecture (VNA) which supports the following major communication protocols: SNA/SDLC, BYSNC, X.25,and such vendor equipment as IBM 3790s, IBM 3270 terminal clusters, Teletype data speed 40/4 clusters and X.25-compatible devices.

- The preceding results from the lack of standards for protocols and represents a "hedged" position pending resolution.

(5) Texas Instruments (TI)

- INPUT regards TI as a major potential participant in the DDP market.

- The company has developed an extremely sophisticated internal data communications network over the last decade which makes use of IBM hosts integrated with hundreds of TI minicomputers and thousands of its terminals.

- In addition to its network operating experience, the company is now developing its own DBMS.

- The company's DDP related product line includes:

  - The 990/9900 family of upward software compatible mini and microcomputers.

  - A broad line of intelligent terminals and printers.

  - Its packaged Data Exchange System (DXS) which is TI's version of a DDP node.

- The DXS is based on the 960 minicomputer and can be expanded to use 400 MB of disk. Each DXS can handle up to six subprocessors or 256 terminals or printers. Communications by means of 3270, 3780 or 2780 emulation is possible.

- TI can leverage its leading edge technological capability to pioneer new solutions to hardware and system problems. We are referring to its work in bubble and charge coupled device (CCD) memories and its long range efforts to incorporate "solid state software" in its minicomputers and calculators.

- Importantly, the company has enjoyed good end user visibility.

c. Remote Computing Services Vendors

(1) Problems And Opportunities

- INPUT believes that the ADP and NCSS on-site minicomputer announcements add a new dimension to the Remote Computing Services marketplace, in general, and to the EDP industry, particularly in the area of distributed data processing.

- ADP and NCSS have combined cost/effective mega/mini hardware with their proven and effective software systems and extensive networking. This move will enhance the use of distributed computing in the marketplace.

- By implementing their software in this manner, ADP and NCSS have finally brought effective software to the mini marketplace.

- Data processing managers will welcome their announcements. It affords the managers an easy vehicle for bringing remote computing back under their wing. RCS vendors will have to take a new look at their relationships with DP managers of large-scale host installations.

- Users and vendors of all types are aware of improving hardware economics and of the broadening range of problem solutions.

- As absolute dollar expenditures for RCS increase, this budgetary item becomes an inviting target for hardware suppliers.

- However, the provision of processing capability (unlike that from the traditional hardware supplier) is only one component of RCS. The other value added components are:

  - Problem analysis and solving.

  - Responsiveness to end user requirements.

  - Wide array of proven software.

  - Availability, reliability and back-up.

  - Communications networking.

  - Training and documentation.

  - Special feature including public data bases, proprietary models, special peripherals, etc.

(2) Participating Vendors

(a) ADP Network Services

- ADP views the ONSITE service as an extension of their present network services, using a new, and for some users, more cost effective delivery vehicle in a distributed data processing environment:
  - Special peripherals such as plotters and typesetters, when needed.
  - Access to shared data bases.
  - Geographically dispersed legion of problem solvers, helpers and trainers.
- The move has a dual purpose. It permits ADP to reduce prices, which greatly reduces the risk of losing large customers in their client base. It also offers the opportunity to extend their service offerings within a client company by increasing the probability of becoming the single remote computing services vendor. ADP even sees the likelihood of large mainframe users off-loading timesharing (TSO for example) from their mainframes.
- The ONSITE service is closely coupled with the ADP network. Although it is possible to disconnect from the network (manual console switch) while running with highly sensitive data, the primary mode of operation is on-line to the network.
- The ADP concept is that of a totally bundled service:
  - Mini hardware on-site.
  - ADP operating system and system software.
  - Professional services.
  - Maintenance.

- On-line fault detection, isolation, and reconfiguration.

- A minimum level of network host usage.

- Utilization of VAN networking services.

- ADP has added both a micro maintenance processor and a micro communications processor which link the DEC 2020 closely to their network. The micro communications processor implements packet switching in the network. The maintenance processor monitors the DEC 2020 for both utilization and fault detection. ADP monitors the ONSITE systems around the clock from a central control facility that is used for troubleshooting and for dispatching maintenance personnel for repair and maintenance.

- Remote diagnostics will be run nightly against each installation, from Ann Arbor, with some capability for remote reconfiguration to patch around bad memory or whatever; the hardware is configured to provide enough redundancy to maintain 99.5% uptime or better. Approximately once a month the installation will receive physical preventive maintenance by an ADP field maintenance person. For this reason no installations will be made initially that cannot be adequately and timely serviced from one of the initial marketing areas.

- ADP had bundled the value of their operating system and systems software with that of the ONSITE hardware. The bundled price plus quantity discounts for the DEC 2020 (greater than 100 on order) protect ADP's margins.

- The ONSITE service is targeted at users of remote computing services with annual RCS expenditures greater than $300,000. Early customers are existing ADP clients, including General Motors.

(b) NCSS

- NCSS, like ADP, has announced a family (NCSS 3200) of minis for on-site use of its customers. There are some similarities as well as some significant differences in both the hardware offering and NCSS's market entry approach.

- NCSS indicates that the Series 3200 is intended to be placed with larger companies. It will be offered as a more cost effective system to large IBM installations which are doing a degree of in-house (i.e., TSO) timesharing. The Series 3200 will enable the customer to off-load his large mainframe and take over some outside timesharing.

- NCSS bases market entry on:

  - Series 3200 is price competitive with the IBM System/370 Model 138 but with twice its performance.

  - Series 3200 is IBM compatible, requiring little, if any, applications programs conversion.

  - Capitalizing on the value added of the reliable NCSS software including:

    . Operating system - VP/CSS.

    . Systems software - COBOL, PL/I, APL, FORTRAN, BASIC, NOMAD (DBMS).

  - The ability to bring to the mini market high quality operating systems software that has hitherto been missing.

- The NCSS System 3200 can also be integrated with the NCSS network, either utilizing a network host or in communication with other user minis through the NCSS packet switching network.

- They have applied to the FCC to become a VAN vendor. Customers can use the Series 3200 to create an effective distributed computing network.

- NCSS will maintain a diagnostic center that the field service people can plug into, but they, as yet, do not plan to implement their automatic network diagnostic capabilities down to the on-site hardware.

- NCSS indicates that the System 3200 can efficiently operate timesharing, RJE, and batch concurrently. In that regard, the Series 3200 could be used as RJE (HASP) to a user's larger IBM mainframe.

(c) Keydata

- Keydata is a remote computing vendor that offers on-line services primarily to the distribution segment of the marketplace. Currently half of its on-line users do not need data communications within their organization. However, the other 20% of the users who do represent over 50% of the company's revenues.

- Keydata offers turnkey systems to its users; i.e., it supplies the hardware, software and service. The typical user requires a good deal of hand holding. He knows little if anything about data processing.

- With the rapidly falling cost of minicomputer systems coupled with the increasing cost of telecommunications, Keydata had to do something to protect its customer base. The current offering of the Unity series is not strictly distributed processing; however, it lays the ground work for the future distributed system Keydata has under development.

- Keydata offers turnkey systems in the following areas:

  - Electrical distribution.

  - Plumbing distribution.

- Heating and air conditioning distribution.

- Industrial supply distribution.

- Food distribution.

- Printing and paper distribution.

- The four packaged systems currently offered range from $50,000 to $300,000 (bundled). The low cost basic Keydata Unity one model 10 system consists of the system control desk, a CPU with 64,000 characters of memory and a 1900 character video display terminal with a ten megabyte disk and a 70 LPM printer.

- The largest system, the Unity 4 model 160, consists of a compatibile processor with 256K of memory, 32 megabytes of disk and 20 video display terminals, and three high speed printers. The minicomputer is supplied by Data General and field maintenance is accomplished through Control Data Corporation.

(d) Banking Systems, Inc.

- Banking Systems, Inc. is a software systems house that provides management services, consulting, planning and remote computing services from five data centers, primarily to financial institutions. Estimated revenues are $3.5 million.

- The company is under contract to a consortium of medium to large banks to determine the feasibility of designing and implementing a minicomputer distributed processing system. The system's purpose is to off-load all of the consumer transaction processing from the commercial side of the bank. The system under design and development has characteristics similar to those implemented by the Bank of America and by Security Pacific.

- The company has completed the initial systems design and is in the process of equipment selection leading to a pilot demonstration model.

- The design includes such considerations as joint use of automated teller machines (ATMs) by participating banks and the handling of distributed data bases at the nodes. The system, when completed, will be offered to the initial subscribing members at a cost significantly lower than that offered to new users.

(e) Kaman Sciences, Inc.

- Kaman Sciences, Inc. is a remote computing vendor offering services to both the communications and banking industries. The company developed its communications expertise through its military divisions and has applied this capability to the commercial world of remote computing.

- Kaman Sciences offers a turnkey commercial radio/television station communications system centered around DEC equipment. The system is down-line loaded from the host, and its program data base is also distributed and refreshed from the host.

- The company offers correspondent banking services to banks in three areas of Colorado and is planning to expand its services to adjacent states. Satellite miniprocessors are used for MICR data capture, data transmission, and final report output.

d. Intelligent Terminal Vendors

(1) Introduction

- Intelligent terminal vendors have been instrumental in pioneering DDP. They entered the market in direct competition with mainframe vendors offering cost effective intelligent terminal systems to perform data entry formatting, editing for local storage and subsequent RJE transmission to the host. Products were expanded to include interactive terminal systems.

- A growing trend among these intelligent terminal vendors is to integrate their products more fully using higher levels of intelligence in order to perform complete standalone data processing applications at the nodes.

(2) Selected Vendors

(a) Pertec

- Approximately 18 months ago Pertex (fiscal 1978 sales of $109 million) entered the distributed processing market with the introduction of its XL family of products. XL tied together various Pertec (CMC) product offerings into two distributed processing systems; i.e., the XL 40 and the recently introduced XL 20.

- Prior to the XL introduction, the company focused its efforts on being an independent supplier of peripheral equipment to OEMs and users of minicomputer and microcomputer-based systems.

- Recent growth has been aided by several acquisitions including that of CMC (distributed data entry systems), and MITS (microcomputer based systems).

- The XL 40 system supports SDLC, 3740/41 and 3776/3777. Both the XL 20 and the XL 40 support binary synchronous communications including 2770, 2780, 3780 and 360/20 HASP Multileaving work stations.

- The XL 20 and XL 40 systems are programmed through a format programming methodology oriented toward generating data entry, screens and output report formats.

- Approximately 600 XL systems have been installed to date performing a mix of data entry, file management and data communications functions.

(b) Datapoint

- Datapoint's entire orientation is toward distributed (dispersed) business data processing systems. Its revenues have increased from $38 million in fiscal 1974 to an estimated $150 million at the end of fiscal 1978, for an annual compound growth rate of about 40%.

- The company is widely regarded as the strongest of the smaller companies in the DDP competitive environment.

- The company offers a variety of intelligent data entry terminals and stand-alone processing systems. Recent new product introductions include the Attached Resource Computer (ARC) which links locally installed Datapoint processors together via coaxial cable and microprocessor based communications controllers.

  - Its Infoswitch product line (introduced 18 months ago) offers small to medium sized businesses a means to manage communications costs.

- All of the preceding serves to increasingly position the company to service the so called "Office of the Future" market.

- Amcomp was acquired in January 1977 and provides the company with a disk drive and magnetic tape capability.

- Datapoint emphasizes IBM compatibility such that Datapoint equipment can easily be substituted for IBM equipment in the user environment without

significant retraining of the user personnel. The Datapoint systems can be incorporated as end point nodes into a larger national distributed network for Fortune 1000/100 and larger users.

(c) Sycor

- Earlier this year Sycor became a wholly owned subsidiary of Northern Telecom Limited of Canada. The annualized revenue rate is estimated at about $100 million and has lagged its competitors growth rates in recent years largely due to difficulties with Olivetti, its major customer.

- Sycor, with over 40,000 terminals installed worldwide, is one of the original intelligent terminal/distributed data entry suppliers.

- Its initial foray into "true" DDP began in December 1977, when the company introduced its 400 family of DDP systems.

- The family consists of the Sycor 405 and 445 processors (microprocessor based) in addition to the recently introduced 404 entry-level system priced at $10,000-11,000 in a "typical" configuration.

- The 445 actually uses two microprocessors, controlling input/output, keying, display formatting, and networking. The processor has up to 64,000 characters of memory. Three programming languages are available including COBOL, BASIC, and TAL 2000 (a terminal application language for screen generation).

- Bisynchronous communications is provided as well as SDLC up to 9600 bps. Asynchronous communications are available up to 1200 bps. The system provides interactive remote job entry simultaneously and can support any post that communicates utilizing IBM 2770, 2780, 3770, or 3780 terminal systems.

  - A communications package is available with the 445 to emulate the IBM 3770 using the SDLC line protocol.

- Sycor link networking allows sharing of data among Sycor processors and peripherals within the local node.

(d) Data 100

- Data 100 reported 1977 sales of $138 million representing an annual compound growth rate of 35% over the last five years. The company has historically provided intelligent RJE work stations which are IBM-compatible and numbers Sycor and Datapoint as major competitors.

- A proposed acquisition by Northern Telecom is pending.

- Data 100's new family of remote information systems (RIS) allows the user to perform file management, standalone processing, data entry, on-line file inquiry, and batch communication functions distributed from an IBM host mainframe.

- The new Attached Applications Processor (AAP) consists of a Model 85 minicomputer which:

  - Affords Data 100 terminal users a convenient way to upgrade remote capabilities.

  - The Model 85 works with Data 100's existing terminal base and emulates IBM 3271 information display systems. It can support as many as 15 terminals.

- COBOL and RPG 2 are now available for programming data entry, file maintenance and report output applications.

- Disk storage up to 100 megabytes combined with printer capacity ranging from 62 lpm to 1250 lpm and IBM compatible tape drives (800 or 1600 bpi) permit the new Data 100 remote information system to act as a powerful node in a national distributed network for Fortune class of companies.

- Communication is primarily through remote batch and supports the following communication protocols:

  - IBM 2780 DTT.
  - IBM 3780 DCT.
  - IBM RMT/360.
  - CDC 200 UT.
  - Honeywell GRTS/355.
  - ICL 720.
  - Univac DCT 2000.
  - Univac 1004.
  - Univac NTR (9000 remote).

- The communications capability can interface up to 50 kbps. Automated data compression and expansion is also available.

(e) Raytheon

- Raytheon is concentrating its marketing in providing distributed data entry systems compatible with large IBM central hosts.
- With 1977 sales in excess of $100 million, Raytheon's recent rate of growth is in excess of 40% per year.
- Its most recent offering is the PTS/1200 system which allows for the remote location of video terminals capable of interfacing with a line of Raytheon

minicomputers. The minis can support IBM central hosts on both an interactive and remote batch basis.

- The new Mark I and Mark II systems expand the range of product offerings. A typical four terminal Mark I system will lease for under $850/month on a three year lease basis whereas a typical Mark II system (16 terminals) leases for about $2600/month, both on a three year basis.

- The PTS 1200 system provides compatibility with IBM hosts through the following methods:

  - Binary synchronous communication under HASP and IBM 2780 protocols.

  - 3270 emulation.

  - SDLC supporting both batch and interactive transmission simultaneously.

- Raytheon has announced plans to provide COBOL support for the PTS 1200 minicomputers/controllers.

- Through its acquisition of word processing manufacturer Lexitron, it will be able to offer a video type word processing option to the PTS/1200.

V TECHNICAL AND MARKETING REQUIREMENTS

V TECHNICAL AND MARKETING REQUIREMENTS

A. TECHNICAL REQUIREMENTS

- During the course of hundreds of interviews with various users INPUT has become convinced that with the exception of sophisticated (Fortune) companies, most DP personnel do not have the requisite technical skills to handle the communications implications of networking and DDP.

- In order to address this issue, DDP hardware and services vendors may choose a number of possible solutions, including providing:

  - Compatibility with ACF/SNA/SDLC network architecture in order successfully to market DDP systems to centralized IBM hosts. This assumes that this network architecture and protocols will become de facto industry standards.

  - An interface with VANS. A minimum requirement is compatibility with the X.25 standards for interconnection to international teleprocessing networks.

  - Attachment to RCS networks.

- Networks are required to exhibit transparency to the end user. Data must be transferred and recovered without the intervention of sophisticated personnel.

- Data bases must eventually be distributed for many applications enabling relevant data to be located at the remote site. Unavailable data must be retrieved by the system and forwarded to the node in a transparent manner.

- Once users have their distributed data systems installed and operational, survey information suggests that turnkey packages (to be installed at nodes) would be more favorably received than at present. These packages must be capable of being integrated with the system's DBMS.

- Sophisticated users are convinced of a lack of a credible DBMS product in the marketplace. This raises concerns over the potential loss of data control and reduces the predilection to adopt DDP. All vendors (including mini manufacturers) must be able to offer a DBMS with their machines over the long term.

B. MARKETING REQUIREMENTS

- DDP has proven not to be a simple concept and represents different things to different users and vendors. This lack of a consensus gives vendors an opportunity to:

  - Define their own perspective and product concept vis-a-vis DDP.

  - Educate their customer segment accordingly.

- Although large users generally believe that DDP has cost/performance advantages, few of these respondents seem to have a complete understanding of all of the costs to be replaced (or added) by employing DDP. Vendors who aid in developing a more concrete case for cost justifying DDP will obviously facilitate its acceptance.

- Nodes are heavily applications oriented and usually without trained DP professionals. Design and market the node for transparency!

- A national maintenance and service organization is absolutely essential. Startup costs will be high and may necessitate the use of an established third party service organization. The use of telecommunications as part of a diagnostic regimen should be considered.

- DDP is gaining wide acceptance within the Fortune 1000 category of companies. Accordingly, all vendors have formed national account structures and are repeatedly calling upon the same users.

- In this marketing environment it would be useful to develop a diversity of products to satisfy current and projected data, office and communications requirements. Equipment that is marketed today for seemingly standalone applications may be an integral part of a future node within the corporate entity.

- Small users appear to be grossly ignorant of the DDP concept. Developing industry compatible products that could facilitate selling to (after educating) small users is an emerging opportunity.

- INPUT believes that the market areas that are in the vanguard of DDP are:

  - Finance.

  - Discrete manufacturing.

  - Process manufacturing.

  - Retailing.

  Strategies directed at these industry sectors in the short-term will be most productive.

- The host DP management, whether at corporate or divisional headquarters, remains the key target for the DDP "sell" in the short-term.

- Hardware vendors must recognize the importance of software. Communications, networking and software are the critical value added components for vendors in the DDP market.

APPENDIX A: DEFINITIONS

APPENDIX A: DEFINITIONS

- A Small Business Computer, for the purpose of this study, is a system that is built around a Central Processing Unit (CPU), and that has the ability of utilizing at least 20M bytes of disk capacity, provides multiple CRT work stations, and offers business-oriented system software support.

- Software Products are systems and applications packages that are sold to computer users by equipment manufacturers, independent vendors, and others. They include fees for work performed by the vendor to implement a package at the user's site.

- A Systems House integrates hardware and software into a total turnkey system to satisfy the data processing requirements of the end user. It may also develop system software products for license to end users.

- A Turnkey System is composed of hardware and software integrated into a total system designed to fulfill completely the processing requirements of a single application.

- An End User may buy a system from the hardware supplier(s) and do his own programming, interfacing and installation. Alternately, he may buy a turnkey system from a manufacturer, systems house or hardware integrator.

- A Hardware Integrator develops system interface electronics and controllers for the CPU, sensors, peripherals and all other ancillary hardware components.

He may also develop control system software in addition to installing the entire system at the end user site.

- A Minicomputer is usually a 12 or 16 bit computer which is provided with limited applications software and support and represents a portion of a complete larger system.

- Distributed Data Processing (DDP)

  - INPUT was unable to find a consensus among both users and vendors as to a definition of DDP. It appears to be a concept that is uniquely structured to satisfy individual vendor and user requirements.

  - Nonetheless, as a result of extensive work in this area, INPUT offers the following hybrid definition:

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

APPENDIX B: INTERVIEW PROGRAM AND QUESTIONNAIRES

APPENDIX B: INTERVIEW PROGRAM AND QUESTIONNAIRES

- User respondents that were contacted during the course of this study were generally the senior data processing official at the host site. They were frequently DP Managers, Vice Presidents and Directors of Management Information Services/Systems and were screened to determine their DDP qualifications.

- All interviews from which data in this study are derived were performed by means of a personal contact and included:

  - On-site interviews that ranged from two to four hours in length.

  - Telephone interviews that were up to an hour in duration.

- Copies of the vendor and user questionnaires employed during the field research are included in this Appendix and represent the form from which the great majority of the interview information was gathered.

- Questions 19 and 20 in the user interview were utilized only during the course of on-site visits and yielded excellent systems/architectural information.

1. What is the relative importance of distributed data processing in your company's marketing strategies as compared to:

a. Today (1978):

☐ Stand-Alone Direct End User Sales

☐ Unimportant (< 5%) ☐ Some Importance (5 ≤ 10%)
☐ Important (10-20%) ☐ Very Important (> 20%)

☐ Comments:

☐ OEM Sales

☐ Unimportant (< 5%) ☐ Some Importance (5 ≤ 10%)
☐ Important (10-20%) ☐ Very Important (> 20%)

☐ Comments:

☐ Systems Houses (including RCS vendors)

☐ Unimportant (< 5%) ☐ Some Importance (5 ≤ 10%)
☐ Important (10-20%) ☐ Very Important (> 20%)

☐ Comments:

b. By 1980:

☐ Stand-Alone Direct End User Sales

☐ Unimportant (< 5%) ☐ Some Importance (5 ≤ 10%)
☐ Important (10-20%) ☐ Very Important (>20%)

☐ Comments:

☐ OEM Sales

☐ Unimportant (< 5%) ☐ Some Importance (5 ≤ 10%)
☐ Important (10-20%) ☐ Very Important (>20%)

☐ Comments:

☐ Systems Houses (including RCS vendors)

☐ Unimportant (< 5%) ☐ Some Importance (5 ≤ 10%)
☐ Important (10-20%) ☐ Very Important (>20%)

☐ Comments:

2. What in your opinion is the proportion of total sales related to DDP?

a. Last Year (1977)

☐ < 10% ☐ 10 ≤ 20% ☐ 20 ≤ 30%

☐ > 30%

Comments:

b. This Year (1978)

☐ < 10% ☐ 10 ≤ 20% ☐ 20 ≤ 30%

☐ > 30-50% ☐ Other ___ %

Comments:

c. In Two Years (1980)

☐ < 10% ☐ 10 ≤ 20% ☐ 20 ≤ 30%

☐ > 30-50% ☐ Other ___ %

Comments:

d. In Five Years (1983)

☐ < 10% ☐ 10 ≤ 20% ☐ 20 ≤ 30%

☐ > 30-50% ☐ Other ___ %

Comments:

3. How much of your currently installed computer base do you feel is employed in a DDP mode (i.e., where say at least 25% of the utilization is in a distributed manner in a network)?

☐ < 5% ☐ 5 ≤ 10% ☐ 10 ≤ 20% ☐ 20 ≤ 30% ☐ >30%

4. What specific hardware offering do you have related to DDP?

a. For Delivery in 1978 ☐ Will Send Literature

Price Range for Typical Configuration(s)

☐ Configuration 1

☐ Memory _____ K ☐ Discs _____ Qty. _____ Capacity K Bytes

☐ Tape _____ Qty. _____ TR Rate bps CRTs _____ Qty.

☐ Other _____ Name _____ Qty.

☐ Sale ☐ < 10K ☐ 10-50K ☐ 50K-100K ☐ 100K-200K ☐ > 200K

☐ Monthly Rental ☐ < $200 ☐ $200-$1K ☐ $1K-$3K ☐ $3K-$10K ☐ > $10K

☐ Monthly Maintenance ☐ < $100 ☐ $100-$500K ☐ $500-$1K ☐ $1K-$3K ☐ > $3K

☐ Configuration 2

☐ Memory _____ K ☐ Discs _____ Qty. _____ Capacity K Bytes

☐ Tape _____ Qty. _____ TR Rate bps CRTs _____ Qty.

☐ Other _____ Name _____ Qty.

☐ Sale ☐ < 10K ☐ 10-50K ☐ 50K-100K ☐ 100K-200K ☐ > 200K

☐ Monthly Rental ☐ < $200 ☐ $200-$1K ☐ $1K-$3K ☐ $3K-$10K ☐ > $10K

☐ Monthly Maintenance ☐ < $100 ☐ $100-$500K ☐ $500-$1K ☐ $1K-$3K ☐ > $3K

5. To what extent are you targeting your DDP offerings to specific industries?

☐ Not

☐ Industries

☐ Banking ☐ Finance ☐ Insurance

☐ Manufacturing ☐ Other _____

_____

Comments:

6. To what degree are you being impacted by the IBM Series 1?

a. Today (1978)

☐ No Comment

☐ None ☐ Slightly (1-5%) ☐ Some (>5%)

☐ Will Increase Our Sales

Comments:

b. By 1980:

☐ No Comment

☐ None ☐ Slightly (1-5%) ☐ Some (5-10%)

☐ Significant (> 10%) ☐ Will Increase Our Sales

Comments:

7. What thrust (other than from the Series 1) do you expect from IBM in the DDP area?

a. This Year (1978)

Comments:

b. By 1980

Comments:

8. What threat do you see from the semiconductor vendors in the area of DDP?

☐ None

☐ Vendors ☐ TI ☐ Nat'l. Semiconductor ☐ Intel
☐ Fairchild ☐ Two PI

☐ Micro Processors

☐ Vendor(s) _____

_____

Comments:

☐ Mini Computers

☐ Vendor(s) _____

_____

Comments:

9. To what extent is office automation part of your DDP marketing strategy?

☐ No Comment

☐ None (don't perceive need)

☐ Have plans

Comments:

10. Who do you consider your two (2) most important competitors? Why?

a. Today (1978)

☐ _____
Name

Comments:

☐ _____
Name

Comments:

b. By 1980

☐ _____
Name

Comments:

☐ _____
Name

Comments:

11. What degree of impact do you feel the RCS vendors (i.e., ADP, NCSS) will have on your market?

☐ None ☐ Marginal (5-10%) ☐ Some (10-20%)

☐ Significant (20-33%) ☐ Major (>33%)

Comments:

12. How are you approaching the maintenance/repair of DDP systems?

☐ National Maintenance Contracts

Comments:

☐ In Remote Locations

Comments:

☐ In Competition with the Ability of the IBM Service/Maintenance Organization to Support Remote Locations

Comments:

13. a. What network architectures do you support?

☐ Own _____ Will Send Literature
Name

Type

☐ Hierarchical (2 or more levels) ☐ Ring (equal nodes)

☐ Other _____
Name

Comments:

Communication Protocols Supported

☐ Bisynch

☐ Maximum Rate _____ bps

☐ Synch

☐ Maximum Rate _____ K (cps)

☐ SDLC ☐ ASCI ☐ X 25 ☐ Other _____
Name

☐ "3270" Emulation

☐ Comments:

☐ SNA ☐ DEC Net ☐ _____ ☐ _____ ☐ _____

b. What plans do you have, if any, with regard to:

☐ IBM SNA

☐ IBM SDLC

c. What is your position on standardization of data communication networking?

Comments:

14. To what extent do you feel application packages are important to your DDP marketing strategy?

a. Industry Specific Markets (i.e., banking, manufacturing order entry).

☐ Comments: ☐ None

b. Cross Industry

☐ Plans for word processing? ☐ No

Comments:

☐ Office Business Systems ☐ No

Comments:

☐ Other Applications ☐ No

Comments:

15. What specific software products are you offering/planning to offer to the DDP users?

a. ☐ Systems ☐ Will Send Literature

☐ Data Base Management

☐ _____ ☐ Will Send Literature
Name

☐ Does it permit data bases to be distributed?

☐ Yes ☐ No

Describe:

☐ Operating System

☐ _____ ☐ Will Send Literature
Name

☐ How does it support DDP operations?

Describe:

☐ Programming

☐ _____ Do Not Ask For Literature
Name

☐ COBOL ☐ BASIC ☐ FORTRAN

☐ Other _____

15. b. ☐ Application Packages

☐ Are you targeting your offerings to specific industries?

☐ Yes ☐ No

☐ Banking ☐ Manufacturing ☐ Insurance

☐ Retail ☐ Other _____

Examples:

☐ _____ Industry

☐ _____ Industry

☐ What are your cross-industry offerings?

☐ None

☐ Management Information Systems (MIS)

Describe:

☐ Word Processing

Describe:

☐ Other _____

Describe:

CATALOG NO. ☐☐☐☐☐

USER QUESTIONNAIRE

1. How would you characterize distributed processing in the context of your company? (may check more than one box)

- ☐ As a central host with:
  - ☐ Communications functions off-loaded on communications processor
  - ☐ Data entry and output processing on programmable terminals
  - ☐ Remote minis whereby:
    - ☐ Application is split between host and nodes
    - ☐ Complete applications accomplished at nodes
    - ☐ Interactive problem solving is done at node
  - ☐ Data base centralized
  - ☐ Data base distributed between host and nodes
- ☐ As a network of computers with:
  - ☐ Data base and applications distributed throughout the network
  - ☐ Other (explain)

- ☐ Other (explain)

2. What DDP systems are installed/planned?

	YEAR	MAKE/MODELS	MEMORY SIZE(BYTES) /	STORAGE SIZE	QUANTITY	HOST (H) REMOTE (R)	HARDWARE COST PER SYSTEM
INSTALLED	1978						
PLANNED							

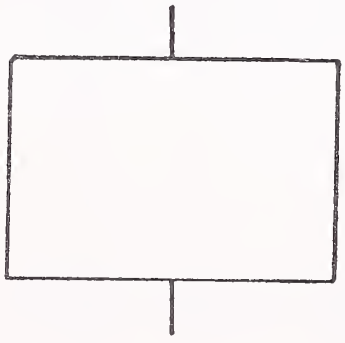
CATALOG NO. ☐☐☐☐☐

3. What % of total hardware cost is expended for distributed hardware?

☐ No

	1978	1982
CENTRAL HOST	%	%
DISTRIBUTED HARDWARE		

4. How does your organization fit into the corporate structure today? (draw organizational diagram)



(Respondent)

MIS ☐

DP ☐

5. What impact do you feel distributed processing {is having / will have} on the relationship of DP/MIS to the corporate organization?

6. Are you a member of an ☐ industry ☐ association ☐ adhoc or permanent committee looking at aspects of DDP?

☐ Yes ☐ No

☐ Name

7. a. Who in the corporation {is / was} involved in deciding to go to distributed data processing?

b. Please describe how the decision was made:

8. How does the decision process vary from that used for centralized processing?

☐ Doesn't

☐ Comments:

9. Who made the final product selection decision?

☐ Title _____

10. Could you compare the development cycle time for going to DDP to your experience with that of centralized processing?

	TIME	
	DDP	CENTRALIZED
PERFORM COST/PERFORMANCE TRADEOFF		
SYSTEMS DEFINITION		
VENDOR ANALYSIS ELIMINATION AND SELECTION		
PROGRAM DEVELOPMENT, INTEGRATION AND DEBUGGING		

11. What {are / were} the cost savings expected vs realized in implementing your DDP system?

APPLICATION	SAVINGS	
	ANTICIPATED $	REALIZED $

12. When developing the cost justification for DDP, how do you handle the following:

1. Labor of non-EDP personnel who operate the remote equipment

2. Communication costs when a dedicated line is not used

☐ Lines are dedicated

3. Cost of remote equipment

4. Space required by remote equipment

5. Management costs of remote installations

6. Other

13. What applications are performed in a distributed manner?

	NAME	100% PROCESSING AT NODES			PART AT NODE	100% TRANSFER TO HOST			PART AT HOST
		ON-LINE	INT	BATCH		ON-LINE	INT	REM BAT	
ACTUAL		%	%	%	%	%	%	%	%
PLANNED									

14. To what extent will your DDP system impact your use of outside remote computing services?

☐ Don't know ☐ Don't use RCS

☐ None

☐ Decrease

☐ 0 ≤ 25% ☐ 25 ≦ 50% ☐ > 50%

15. Are there any DDP applications you would consider placing with a computer services vendor? Why?

☐ Applications

☐ Reasons

☐ Availability of distributed network

☐ Availability of distributed applications software

☐ Ability to implement application quickly

☐ Other:

16. Which network architectures are being considered ☐/used ☐ for distributed processing?

ARCHITECTURE	LINE DISCIPLINE			
	SDLC	BYSYNCH	X25	OTHER
IBM SNA				
DEC DEC NET				
IBM CICS				
HON _____				
UNIVAC DCA				
OTHER _____				

Don't know ☐

17. Is your network design as:

☐ Two level hierarchy - host and slave nodes

☐ Autonomous nodes

☐ Other (describe)

18. Are you {using / planning to use} any specialized (VAN, etc.) network services?

☐ Yes ☐ No

VENDOR	1978			1980		
	LINE SPEED BPS	EXPENDITURES PER YEAR MONTH	% OF TOTAL COMMUNICATIONS COSTS	LINE SPEED BPS	EXPENDITURES PER YEAR MONTH	% OF TOTAL COMMUNICATIONS COSTS
AT&T						
TYMNET						
TELENET						
SBS						
OTHER						

CATALOG NO. ☐☐☐☐☐

INPUT

FOR ON-SITE VISITS

19. Obtain or create a one page description of the distributed processing system:

Background:

Design/Development:

Installation:

Problems/Experience/Satisfaction:

Future Plans:

FOR ON-SITE VISITS

20. Obtain or create a block diagram of DDP systems showing:

☐ Geographic locations ☐ Business functions ☐ Applications performed

☐ DDP equipment employes ☐ Communications network

21. In developing a distributed system how is:

A. System definition handled?

- ☐ Strong centralized control
- ☐ Analysts decentralized
- ☐ Other (describe)

☐ Why?

B. Software development handled?

- ☐ Programming specifications centralized
- ☐ Programmers centralized
- ☐ Programming decentralized
- ☐ Other (describe)

☐ Why?

C. Hardware procurement handled?

- ☐ Centralized specification
- ☐ Centralized procurement ☐ Across division lines
- ☐ Procurement decentralized
- ☐ Other (describe)

☐ Why?

D. System maintenance handled?

1. Hardware

☐ Centralized contracting

☐ Decentralized

☐ Other (describe)

☐ Why?

2. Software

☐ Network software (describe)

☐ Systems software (describe)

☐ Applications software (describe)

22. Software development for DDP system

1. Application Development

☐ In-house

☐ Vendor supplied

APPLICATION	VENDOR	PRODUCT NAME	COST

Comments:

2. Programming Languages

	LANGUAGE NAME	VENDOR FOR HOST	VENDOR FOR MINIS
CURRENT ('78)			
FUTURE ('80)			

Comments:

3. Data Base Management Systems

☐ None

	LANGUAGE NAME	VENDOR FOR HOST	COST	VENDOR FOR MINIS	COST
CURRENT ('78)					
FUTURE ('80)					

DBMS compatibility for minis in network ☐ required, ☐ desired, ☐ not necessary

Comments:

4. Network Software

☐ In-house

	VENDOR	NAME	COST
CURRENT			
FUTURE			

Comments:

23. How do you (intend to) handle data bases in the distributed system?

1. Distribution: ☐ Centralized ☐ Distributed ☐ Combination

2. Updating: ☐ Transactions against central data base only ☐ At nodes only

☐ Replacement at nodes from central data base

☐ Other: Describe

3. Size

APPLICATION	CENTRALIZED MILLION BYTES	NODES THOUSAND BYTES
TOTAL		

24. What are the major forces impacting your future use of DDP?

☐ Communications:

Comments

☐ Office Automation:

Comments

☐ Network Architecture:

Require IBM compatibility ☐ Yes ☐ No

☐ SNA ☐ SDLC ☐ Emulation ☐ Other _____

Comments

☐ Software Compatibility:

☐ Languages _____

☐ DBMS _____

Comments

Government Restrictions:

☐ Federal ☐ Foreign ☐ State ☐ Other _____

Comments:

Agency: ☐ Congress ☐ FCC

Function: ☐ Data Privacy/Security ☐ Communications

☐ Other (explain)