PERFORMANCE MEASUREMENT AND CAPACITY PLANNING

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EXHIBITS

I CURRENT STATUS

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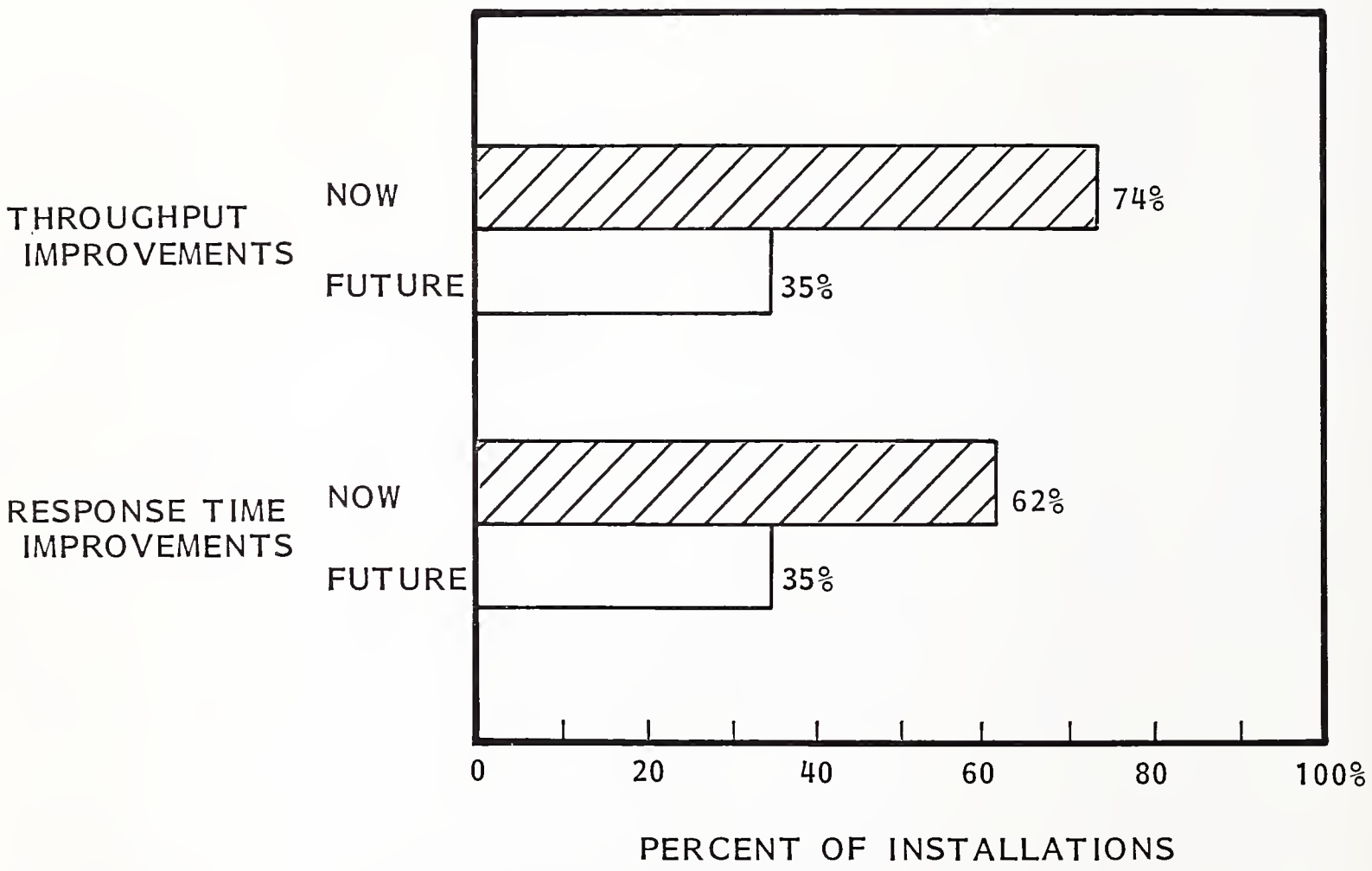
A. BACKGROUND

- The vast majority of organizations is currently struggling to establish an effective performance measurement program.
  - Too often the function is viewed as a technical process divorced from the rest of the MIS organization, as well as from users.
  - One-third of installations do not yet have regularly assigned staff for the function.
  - While a large number of performance measurement tools are being used, there is little consistent pattern to their use; many installations admit that they are not receiving full benefits even from their present tools.
    - Significant benefits are cited from the use of existing tools, as shown in Exhibit I-1. However, in many cases they are not based on reliable, comprehensive data.
- Similar problems exist in making workload projections.

EXHIBIT I-1

REPORTED AND ANTICIPATED
IMPROVEMENTS IN THROUGHPUT AND RESPONSE TIME



- Installations typically cited a successful record in making projections. However, the baseline data to make solid quantification often appeared to be lacking.

- Many firms have a "batch" view of capacity planning rather than an "on-line" view.

  . They see their computer system as being at "X%" of capacity, rather than viewing it in terms of response or turnaround times.

- Many performance measurement software tools are now offered, as well as a growing, but still small, number of capacity planning tools.

  - Unfortunately, the tools are usually used in an uncoordinated and unintegrated fashion, often complicating the problems of managing a data processing installation.

  - The knowledge and use of capacity planning tools are quite limited.

    . It is doubtful that sophisticated capacity planning can be done without using specialized tools.

- To be effective, each function of performance measurement and capacity planning will have to be integrated.

  - Software tools will have to be integrated.

  - Capacity planning must link up with MIS planning in general, as well as with overall business planning.

  - Both the operations and development sections within MIS will have to work with users.

- Performance measurement and capacity planning can be powerful facilitators of a system-wide approach to data processing.

  - Sufficient capacity is what both MIS management and user management need. Working together to ensure this can serve as a means of having them see their common, rather than differing, interests.

B. CONCEPTS

- Performance measurement and capacity planning are made up of interrelated components, as shown in Exhibit I-2. Two of these components stand out as particularly critical to the performance measurement and capacity planning process:

  - Reporting actual versus planned performance is critical for effective capacity planning.

  - Capacity planning must be based upon the business-motivated requirements of computer users.

- Performance measurement and capacity planning have become increasingly important in the last several years. There will be further pressure to improve as a result of the factors shown in Exhibit I-3.

  - Computer systems are becoming more important to many firms.

  - Accessibility (i.e., response and turnaround times) is increasingly critical.

  - Many of the factors which increase the need for planning also increase its complexity.

EXHIBIT I-2

COMPONENTS OF PERFORMANCE MEASUREMENT AND CAPACITY PLANNING

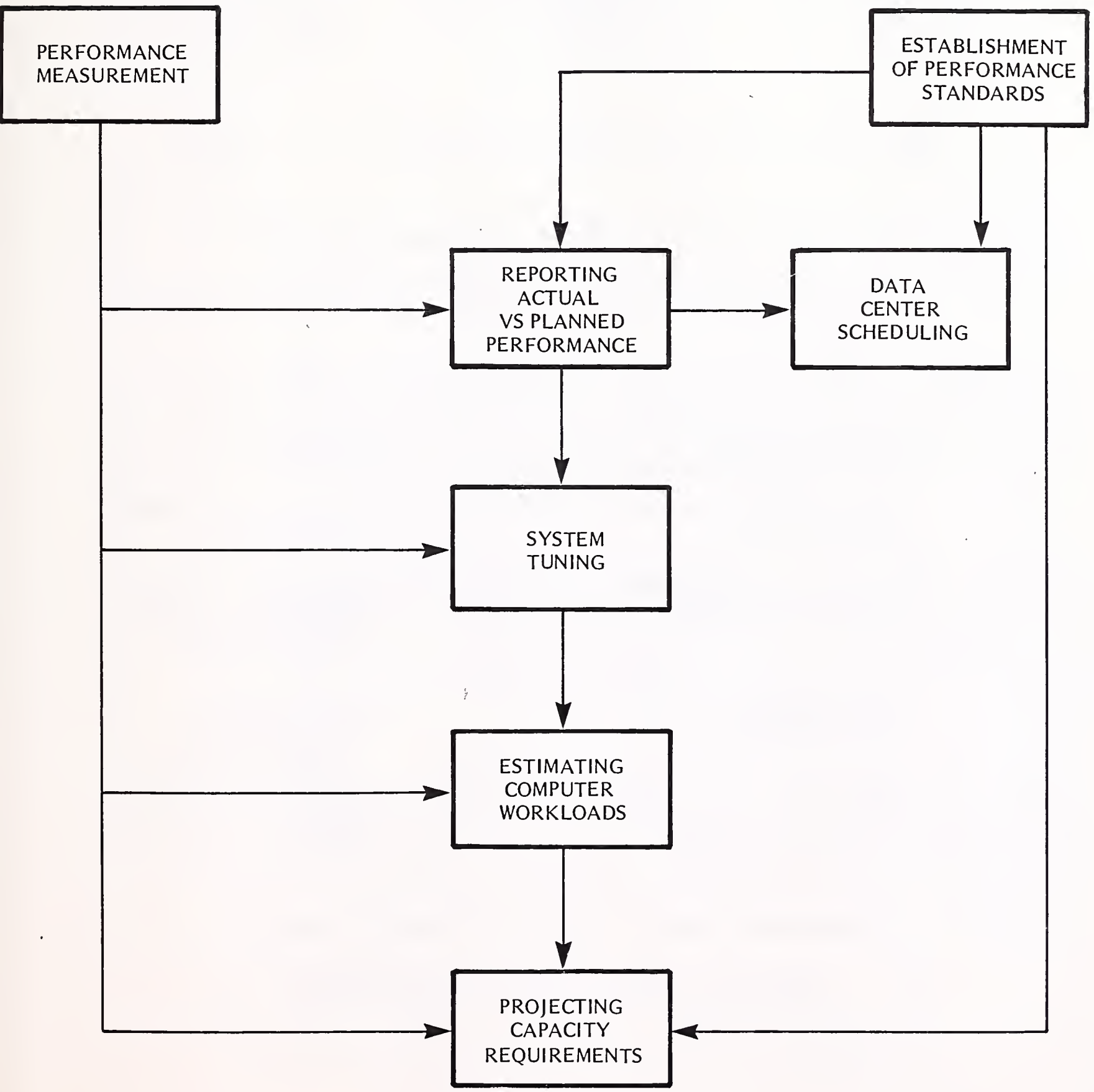
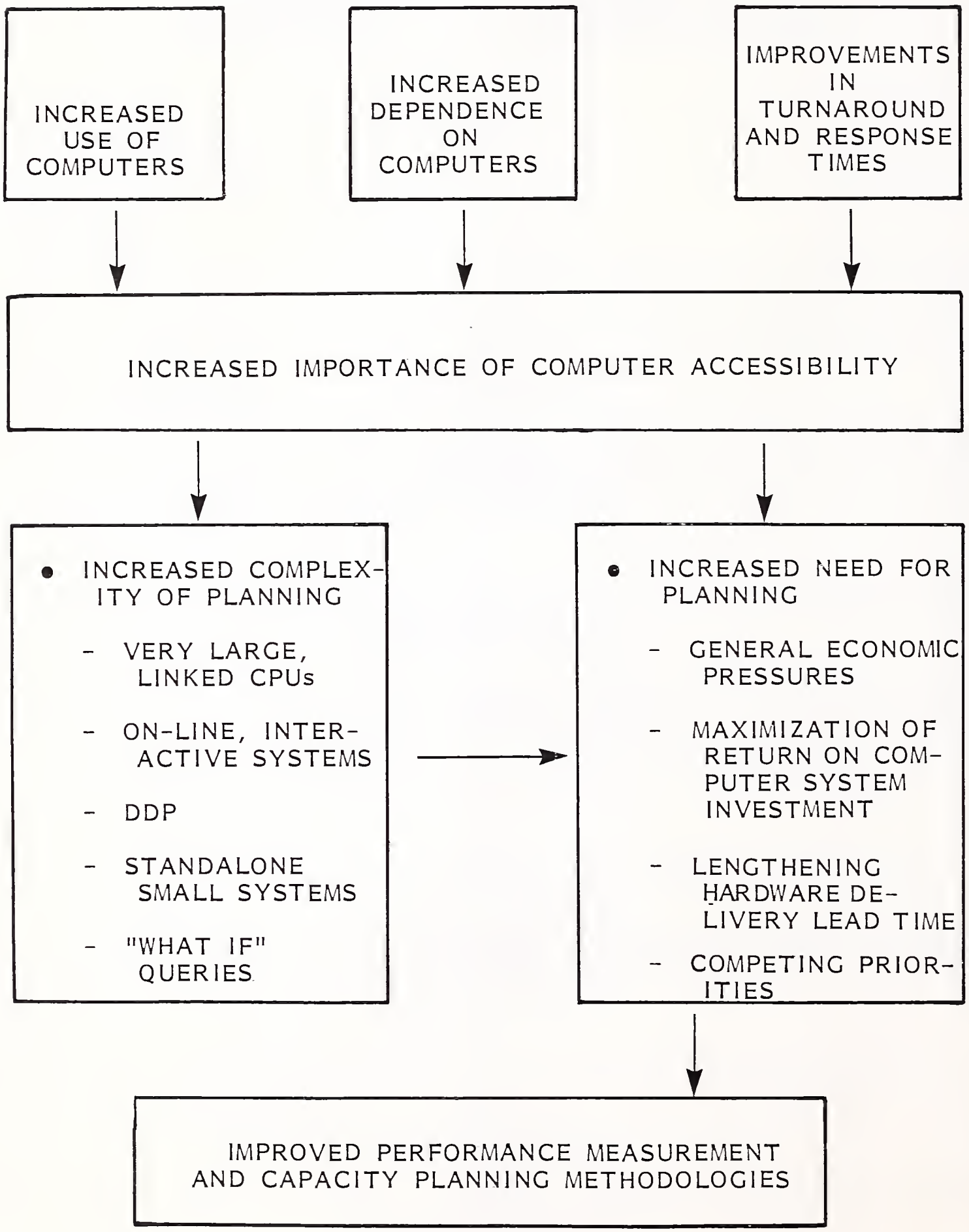


EXHIBIT I-3

FORCES DRIVING CAPACITY PLANNING



- The terms "performance measurement" and "capacity planning" are parts of an interrelated process which starts with performance measurement and ends with capacity planning. Exhibit I-4 shows this process in diagram form, with performance measurement as the foundation and capacity planning the top stone.

  - This entire process is sometimes given other names, such as performance management, to connote the integrative aspects of the process.

- Each of the steps in capacity planning, shown in Exhibit I-4, builds on the previous ones. The following is a brief overview of each step:

  - Measuring performance provides the baseline data required for setting standards or making improvements. There are numerous software-and hardware-based measuring tools to assist in this process.

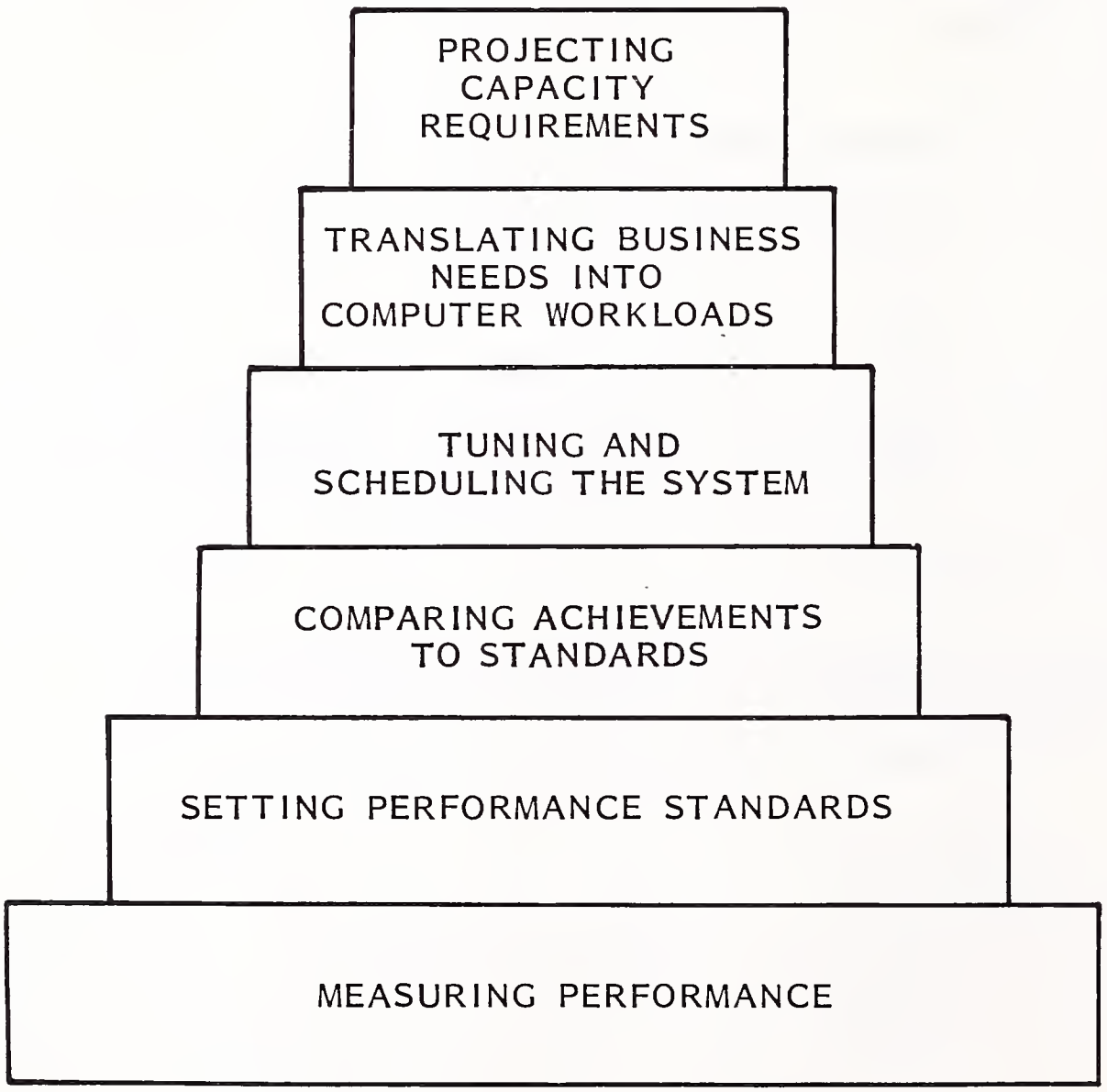
  - Once a baseline describing current performance has been defined, it is possible to negotiate setting performance standards with users. This process is in its infancy in most organizations. However, it is required in order to know how well the system is performing.

  - Comparing achievements to standards becomes relatively straightforward once the earlier steps have been completed. At this point, it is possible to begin making capacity need projections by establishing the extent to which performance standards have been met.

  - Tuning and scheduling the system make sense only if they can be compared to defined baseline performance data and to a performance standard. All too often, current tuning and scheduling take place with no real knowledge of how current achievements compare to the historic record or, more importantly, how well (or how poorly) user needs are being satisfied.

EXHIBIT I-4

BUILDING CAPACITY PLANNING CAPABILITY



- The most difficult step in preparing a capacity plan is translating business needs into computer workloads. There are several aspects to this:

  . Trends, especially seasonal variations, as shown in historic data.

  . Business plans which would modify the historic data (either in the rate of growth or seasonality). For example, an application may receive significant enhancements or additional users and require substantially more computer resources.

  . New applications being developed. Some are similar to existing applications and may consequently be planned by analogy. Others, however, may be totally new and previous experience would not be useful.

  . Finally, there may be underlying changes in the business that would have profound effects on computer requirements (acquisitions, new lines of business, geographic expansion or contraction, etc.).

  . As can be seen, at a certain point effective capacity planning must become a subset of overall business planning and information system planning.

- Finally, if all the data and analyses of prior steps have been refined adequately, it will be possible to project capacity requirements of the hardware configuration.

  . There are several recently offered software aids which promise to make the mechanics of this final step faster and more straight-forward. However, the value of capacity planning software is largely dependent upon a solid factual base enhanced by intelligent analysis.

- Hardware issues will soon become more complex as distributed processing networks and standalone minicomputers become more significant factors.

C. PERFORMANCE MEASUREMENT

- There are a large number of aids and tools to assist in collecting and presenting data on system performance. Tools fall into the general categories shown in Exhibit I-5, although there is sometimes overlap between categories for specific tools.

- It is useful to view software tools as potentially including a hierarchy of functions, as shown in Exhibit I-6.

  - Generally speaking, the batch monitor functions are towards the lower end of the spectrum (which can also be viewed as a necessary foundation).

  - The higher integrated levels are still in the process of development.

D. PROJECTING CAPACITY REQUIREMENTS

- Some installations apparently still project their requirements by assuming that the future consists of a straight line (or at the worst, a slightly curved line). Any installation which uses only regression analysis for capacity planning is in this category. Exhibit I-7 shows how people with this point of view would implicitly view workload projection and capacity planning. (They probably would also use CPU capacity resource units as their measure of capacity.)

EXHIBIT I-5

TOOL TYPES AND USES

TOOL TYPE	FUNCTION	EXAMPLES OF MAJOR USES
JOB ACCOUNTING PACKAGE	• DESCRIBES USE OF SYSTEM, BY TYPE OF USE AND USER • DATA SOURCE: SMF DATA TYPICALLY	• CHARGEBACK • BUDGETING • FIRST-LEVEL PERFORMANCE MONITORING
PERFORMANCE MONITOR (IN GENERAL)	• REPORTS ON SYSTEM PERFORMANCE	• PERMITS MORE COMPREHENSIVE PERFORMANCE MONITORING • PROVIDES BASELINE DATA FOR SYSTEM TUNING • PROVIDES HISTORIC DATA FOR FIRST-LEVEL CAPACITY PLANNING
GENERAL-PURPOSE SOFTWARE MONITOR	• DESCRIBES PERFORMANCE OF OVERALL SYSTEM • DATA SOURCE: RMF DATA TYPICALLY	• SYSTEM TUNING
SPECIALIZED SOFTWARE MONITOR	• DESCRIBES PERFORMANCE OF A SYSTEM COMPONENT • DATA SOURCE VARIES	• MONITORING AND TUNING OF PARTICULAR SUBSYSTEMS; E.G., DASD SPACE, IMS, TSO, ETC.
HARDWARE MONITOR	• DESCRIBES PERFORMANCE OF COMPLEX SYSTEMS • DATA SOURCE: SPECIAL PHYSICAL PROBES	• MONITORING AND TUNING LOOSELY COUPLED CPUs • COMMUNICATIONS NETWORK MONITORING AND OPTIMIZATION
CAPACITY PLANNING SOFTWARE	• DESCRIBES EFFECTS OF WORKLOAD CHANGE ON HARDWARE REQUIREMENTS • DATA SOURCES: (A) SMF/RMF/MONITORS (B) ESTIMATES OF FUTURE LOADS	• PROJECT EFFECTS OF A NEW APPLICATION SYSTEM • PROJECT EFFECTS OF ADDITIONAL USE OF A CURRENT SYSTEM

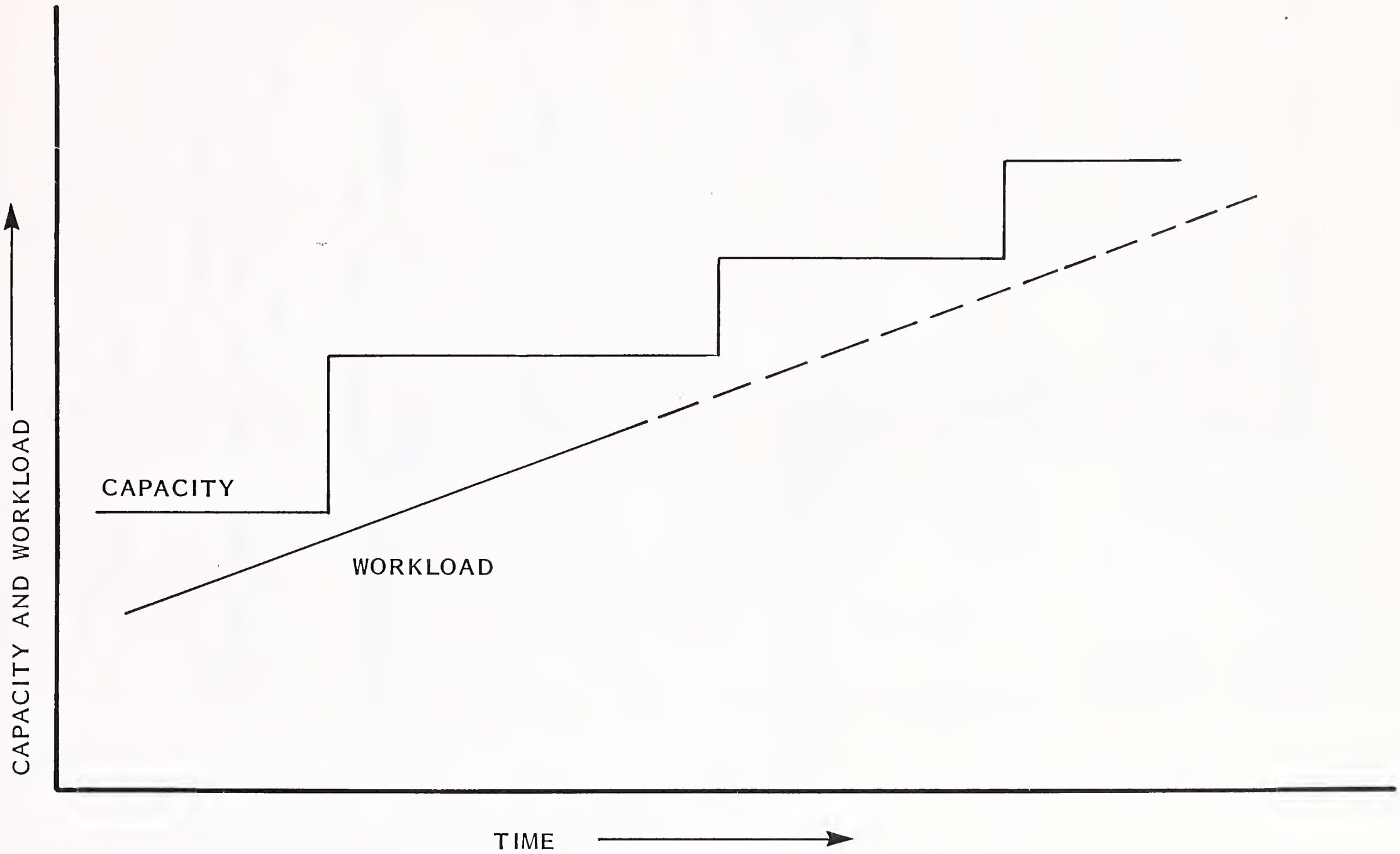
EXHIBIT I-6

HIERARCHY OF SOFTWARE
TOOL FUNCTIONS

LEVEL 6 = High, 1 = Low	FUNCTION	NOW OFFERED IN:	
		ON-LINE MONITORS	BATCH MONITORS
6	AUTOMATIC CORRECTIVE ACTION	-	-
5	AUTOMATIC WARNING FOR EXCEEDED PARAMETERS	SOME	-
4	EXCEPTION REPORTING	YES	SOME
3	FOCUSED REPORTING	SOME	YES
2	SUMMARIZED/ORGANIZED DATA	SOME	YES
1	INDISCRIMINATE/UNSELECTIVE DATA COLLECTION	-	YES

EXHIBIT I-7

HYPOTHETICAL RELATIONSHIP OF GROWTH IN WORKLOAD TO INCREASES IN HARDWARE CAPACITY



- Real life is far more complicated. Exhibit I-8 shows the kinds of curves that reflect actual conditions.

- A development that only a few installations have fully experienced, but that most will be undertaking in the future, is user-controlled, interactive decision support systems.

  - The different components of a mature decision support system are shown in Exhibit I-9. Obviously, this is an application that will consume many computer system resources.

  - One aspect that should terrify data processing operations management is the unpredictability associated with a "what if" capability that can access a detailed operations data base.

  - In one reported case, a single "what if" exercise consumed 70% of the resources of an Amdahl V-7 system.

    . The exercise was not considered wasteful of computer resources (within the boundaries of what it wished to accomplish) and was a highly important piece of analysis that bore rich fruit for the company.

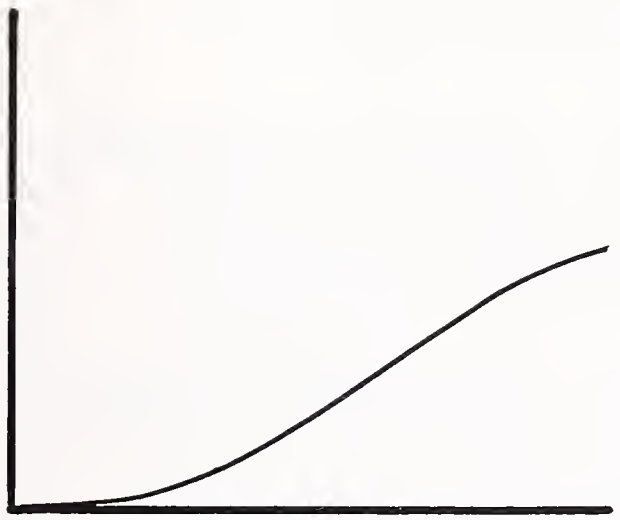
    . However, the magnitude of the request, and its potential impact on operations and on capacity planning, was unforeseen.

- Until recently, the number and kinds of software packages available to assist in capacity planning were fairly limited. The best known was IBM's SNAP SHOT, a simulation package used by IBM for marketing support.

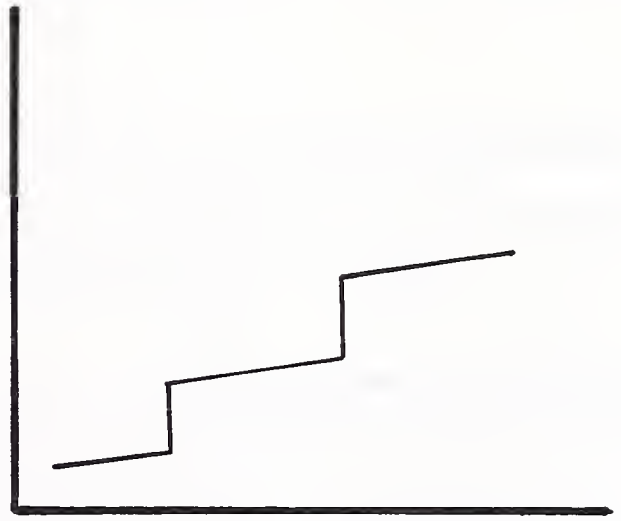
  - This meant that customers could use it only at IBM facilities and could not buy or rent it.

EXHIBIT I-8

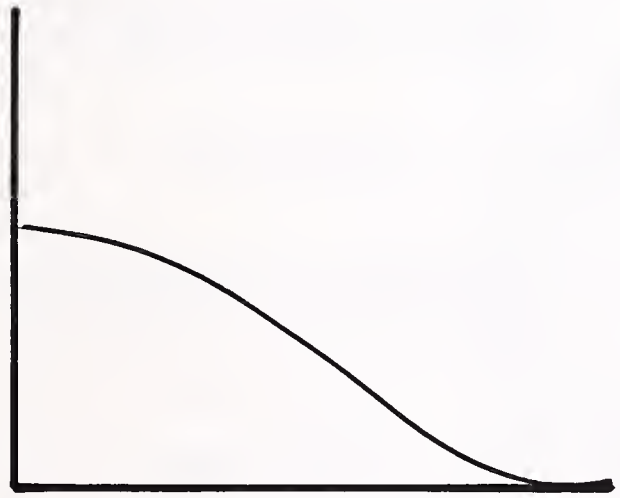
CAPACITY CURVES (SCHEMATICS)



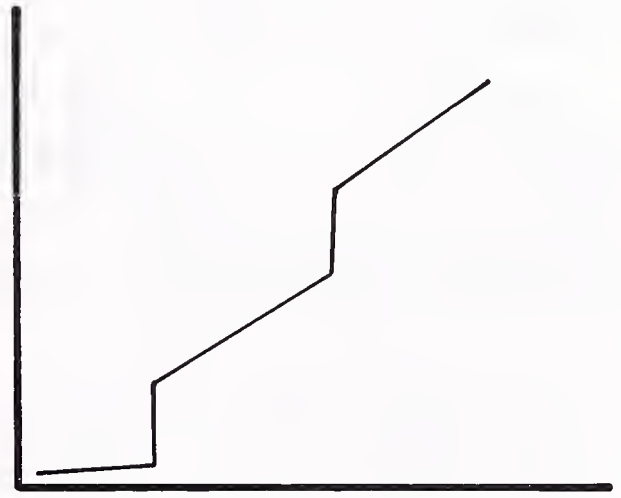
NEW APPLICATION (OR OLD APPLICATION WITH GROWING NUMBER OF USERS)



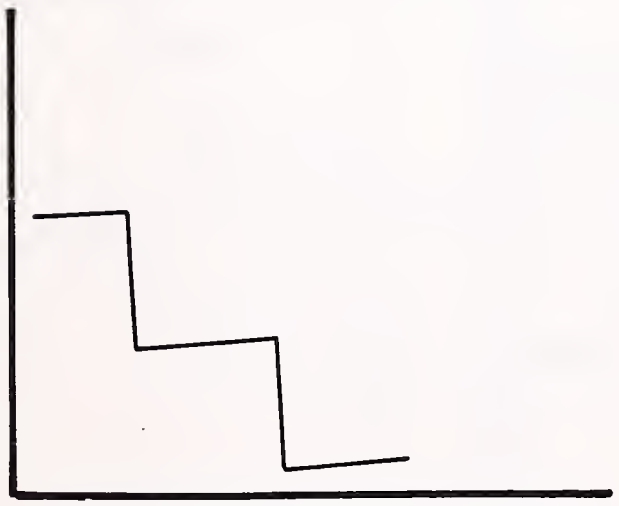
NEW FUNCTIONS INTRODUCED TO OLD SYSTEM



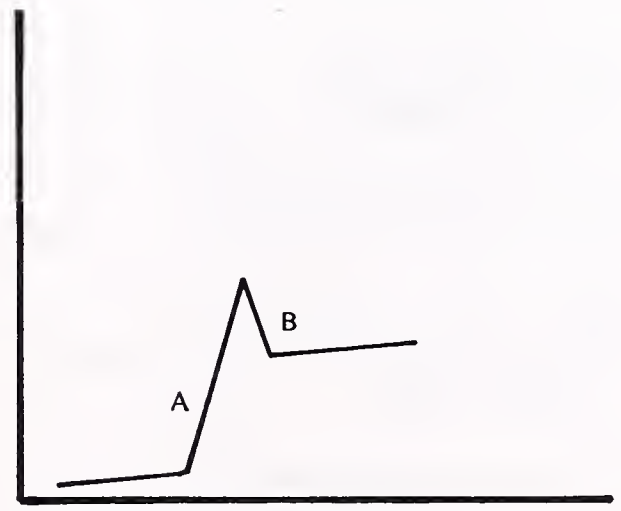
APPLICATION PHASING OUT



AS ABOVE, WITH THE NUMBER OF TERMINALS ALSO INCREASED



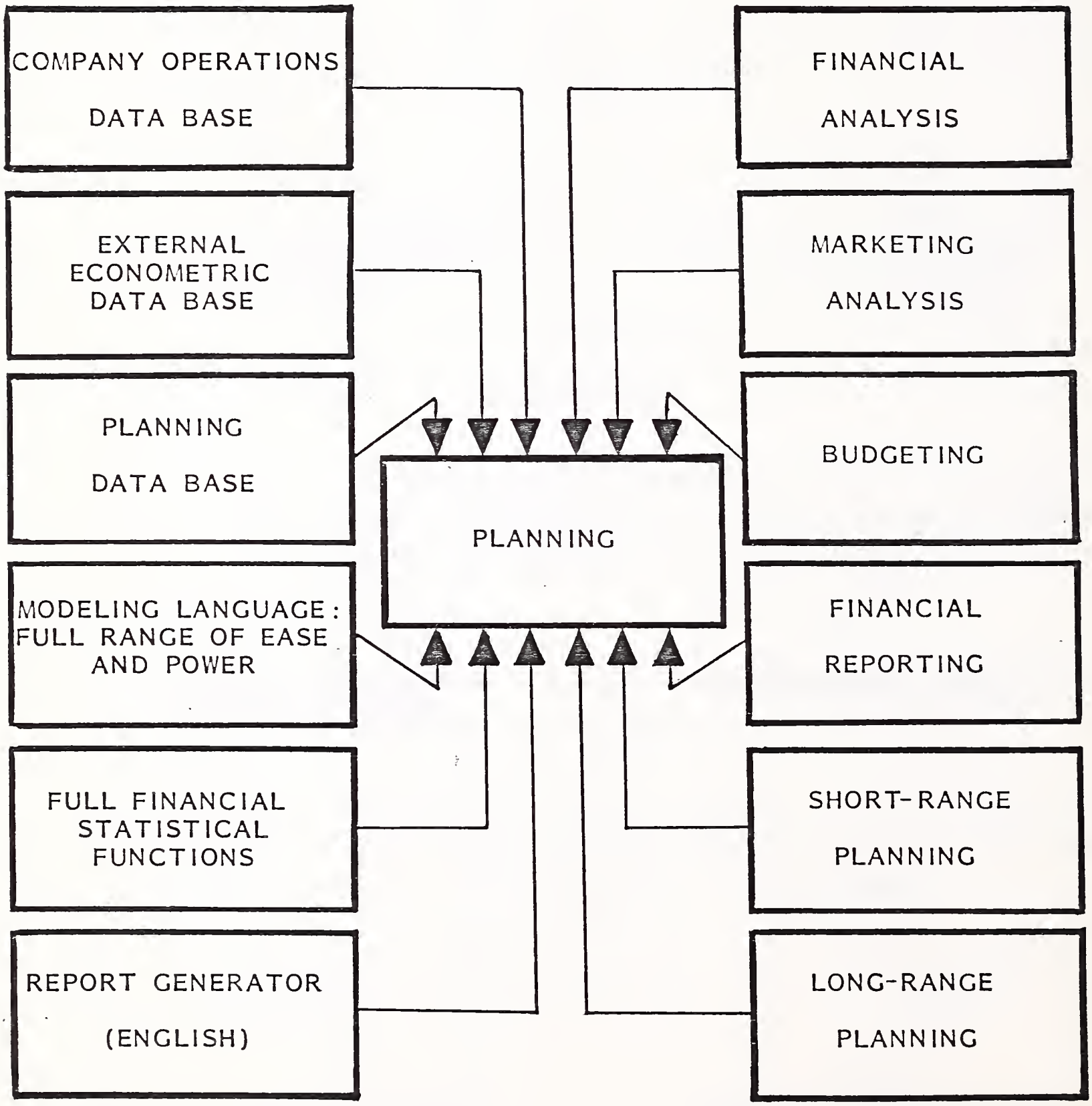
FUNCTIONS/USERS OFF-LOADED ONTO STANDALONE MINIS



NEW DEPARTMENT ADDED
(A) INITIAL LEARNING CURVE, HIGH ENTHUSIASM
(B) MORE EFFICIENT USE, OCCASIONAL USERS DROP OFF

EXHIBIT I-9

INTEGRATED FINANCIAL REPORTING
AND DECISION SUPPORT SYSTEMS



- Even more of a limitation for many customers is the detailed amount of data that must be collected, the special trip to an IBM site often required, and the lengthy run times.

- IBM responds, quite correctly, that the result is a very precise picture of machine requirements.

- There are now software alternatives that bear serious looking into. The modeling package, Best/1 (by BGS Systems, Waltham, MA), for example, has found considerable acceptance since first being offered in 1978.

  - It follows a modeling, rather than simulation, approach. RMF/SMF data are combined with models of hardware configurations to develop a baseline case, as shown in Exhibit I-10.

    . This means, at least theoretically, that there is a trade-off between precision and ease of use.

    . To some extent, this is like the distinction between precision and accuracy in scientific experiments: What good does it do to take measurements to a precision of .0001 if the accuracy of the instruments is .01?

    . The analogy in capacity planning is whether simulation that may give results to, say, $\pm$2%, is preferable if underlying key business or workload estimates vary by $\pm$20%.

    . The importance of these theoretical issues will vary from installation to installation depending on the accuracy of the characterization of workload.

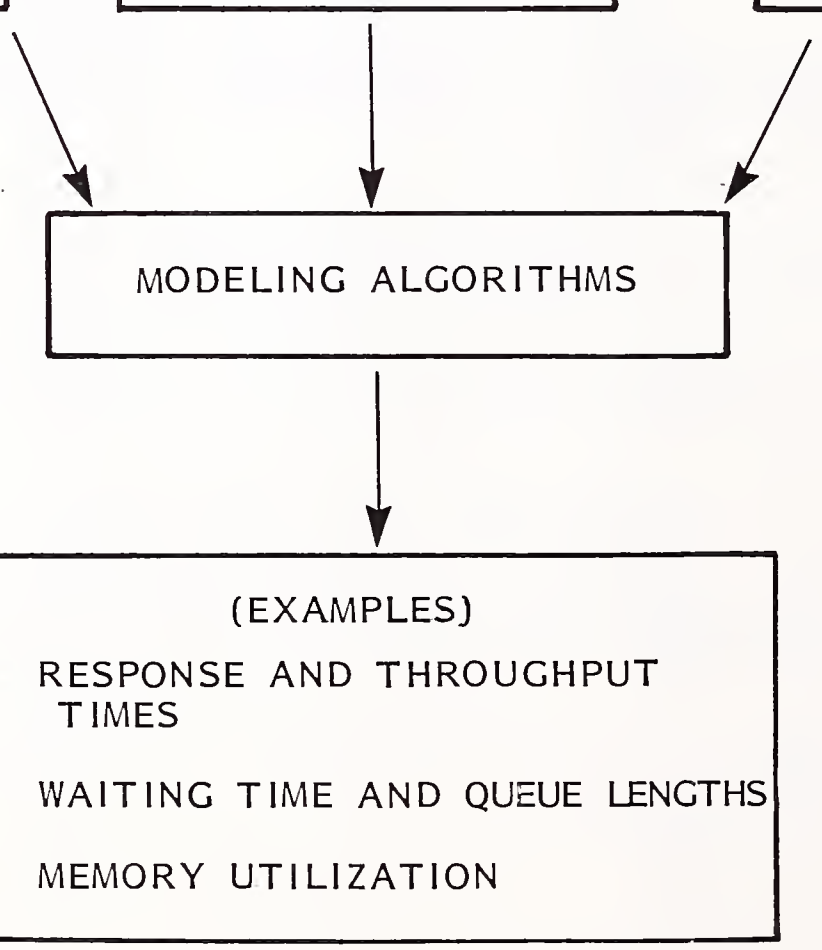
  - The attractions to its users of a product like Best/1 are practical and operational:

EXHIBIT I-10

THE MODELING APPROACH TO CAPACITY PLANNING (AS EXEMPLIFIED IN THE BEST/I PACKAGE)

INPUTS:

- WORKLOAD HISTORY
  - RMF DATA
  - SMF DATA
  - OTHER LOG DATA (E.G., IMS)
  - OTHER MONITOR INPUT
- WORKLOAD VARIABLES
  - JOB ARRIVAL RATE
  - AVERAGE/MAXIMUM LEVELS OF MULTIPROGRAMMING
- HARDWARE PERFORMANCE CHARACTERISTICS
  - EXISTING CONFIGURATION
  - OPTIONS



OUTPUTS: (EXAMPLES)

- RESPONSE AND THROUGHPUT TIMES
- WAITING TIME AND QUEUE LENGTHS
- MEMORY UTILIZATION

  - It can be purchased and used completely under the control of the data processing installation.

  - In some cases only a few days are required to begin to develop (perhaps crude) answers.

  - Since significant amounts of machine resources are not needed, very valuable interactive "what if" exercises are possible.

  - Non-IBM hardware can be modeled.

  - Much of the data collection to develop the baseline model can be automated in MVS installations.

- Best/1 has been used in this discussion because it is the most established package available for acquisition (and judging from its sales growth and customer list, it has found good acceptance).

  - Another product, Questor, with somewhat similar characteristics has more recently been marketed by Boole and Babbage. (The software was developed by Performance Systems, Inc., Rockville, MD, which also developed the simulation package SCERT.)

- It should be reemphasized that as attractive and valuable as such software tools can potentially be, they are processing only numeric assumptions and estimates.

  - To be adequate predictors, these estimates must be founded on business realities and a correct description of current operations; e.g., the complexities and ambiguities illustrated in Exhibit I-8 must be reflected in both the baseline case and estimates for the future.

  - One of the chief virtues of simulation and modeling is to allow planners to identify variables that have the greatest effect on capacity needs;

e.g., for some application/hardware settings a 20% increase in application complexity may have more impact than a 20% increase in volume (while other situations may be vice versa).

- Identifying sensitivities should be one of the chief goals in planning of all kinds.

11 RECOMMENDATIONS

II RECOMMENDATIONS

A. STRATEGIC RECOMMENDATIONS

- Determine the appropriate level of effort: The most important management decision is the level of effort that should be devoted to performance management and capacity planning. There are two principal factors here: resources availability and organizational acceptance.

  - The resource constraint is an obvious one, but it might be overlooked or slighted. On the most basic level, a small organization should not try to do all the things that a large company might attempt.

    . Resource constraints can be useful if they encourage a focused attack on problems and an identification of high-priority areas.

    . Other recommendations, below, will describe methods of focusing efforts.

  - Potential organizational acceptance is a less obvious issue, but can be the prime determinant of the program's success. To be quite frank, not all organizations are good candidates for a thoroughgoing program of performance measurement and capacity planning. This can be due to:

    . Personalities and "politics."

. The nature of the business.

. The level of organizational advancement of the MIS department.

- The dominant personalities in some businesses are extremely mercurial and resistant to planning. Often very effective because of their instincts for commercial success, they nevertheless offer an inhospitable climate for orderly, long-range planning. The best approach in this environment is to stay flexible and always have a considerable amount of excess hardware.

- Similarly, the nature of some businesses is quite variable, obeying no predictable pattern.

- Finally, the state of organizational advancement of the MIS department itself is a critical determinant of what can be expected from a program of performance management and capacity planning.

- Train data processing personnel: The state of knowledge in performance measurement and capacity planning is in flux and constantly advancing; most staffs are now inadequately trained. There are many sources of knowledge; the right ones to use will depend on the organization's current level of knowledge, geographic location, goals, budget, etc. Exhibit II-1 lists and evaluates the main sources.

- Educate non-data processing management: Managers outside MIS must understand the importance of the general issues involved. This is necessary for two reasons:

  - The positive contribution and support they and their staff can provide will be critical.

  - The capacity planning group within MIS will be constantly requesting planning information and workload data from user departments. Much

EXHIBIT II-1

SOURCES OF INFORMATION
ON PERFORMANCE MEASUREMENT
AND CAPACITY PLANNING

SOURCE	COMMENT
INTERNAL DISCUSSIONS WITHIN THE COMPANY	The most important source after a minimum level of knowledge is attained.
INFORMAL DISCUSSIONS WITH COLLEAGUES IN THE COMPUTER COMMUNITY	Especially important for MIS management; must evaluate sources carefully.
PERFORMANCE/PLANNING SOFTWARE USER GROUPS	Can be on the leading edge. Danger: may be too oriented to technical details.
HARDWARE MANUFACTURER USER GROUPS	Good, especially for informal contacts and information exchange with other users.
PROFESSIONAL SOCIETIES	Valuable, if not too theoretical or rarified.
VENDOR BROCHURES AND SALES SEMINARS	A sometimes overlooked way of getting really good information from the front lines (they have seen it all); quality and depth vary.
SEMINARS	Good, if a particular seminar is based on extensive exposure to the field; some can be too general.
SOFTWARE DESCRIPTIVE REPORTS (e.g., ICP, DATAPRO SOFTWARE, EDP PERFORMANCE MANAGEMENT HANDBOOK)	Sketches of software products, very valuable for an initial review; all are basically non-evaluative. The Performance Management Handbook provides greater depth and a good overview section.

greater cooperation will be obtained if it is founded upon informed consent.

- Direct capacity planning from the top: MIS top management should take an active role in developing and evaluating the performance measurement and capacity planning program.

  - The key issues should not be considered technical: "War is too important to be left to the generals."

  - A well run, effective capacity planning program will strike to the heart of an enterprise's affairs.

  - MIS management will often, especially at the beginning, be called upon to mediate between operations, development, and user groups.

  - MIS management will be held directly accountable for failures in capacity planning.

B. ORGANIZATIONAL RECOMMENDATIONS

- Treat capacity planning as a generalized function: Performance measurement and capacity planning are linked in that one is a foundation for the other.

  - However, some of the components of the capacity planning process require a high degree of knowledge in the following areas:

    . Particular application systems.

    . The organization's goals and functions.

    . Techniques in management and control.

- No one area in the MIS department, least of all the systems programming area, will be able to produce the full package of skills required. Exhibit II-2 shows a quantification of the types of knowledge required in these widely differing areas.

- Set up a task force: Because performance measurement and capacity planning are linked, generalized functions, a suitable organization structure may have to be specially developed.

  - The typical approach of viewing the program as primarily technical is not satisfactory, except as an expedient for getting started.

  - A better approach is to view capacity planning as a "task force" enterprise, as shown in Exhibit II-3, with individuals specializing by function, but working as a unit.

    . Personnel need not be full time. In many respects it is more desirable that they be part time (but at least one-third time) so that there is additional cross-fertilization. A part-time role is also desirable from a cost and backup standpoint.

  - The task force could report to the director of planning, since the "higher" attributes of capacity planning tie into planning in general, as shown in Exhibit II-4.

    . Smaller organizations could have the capacity planning unit report directly to the MIS director.

- Ensure intra-MIS coordination: MIS management should ensure that the development unit of MIS keeps operations informed of all its activities that would affect workload, whether new systems or major modifications.

  - The capacity planning task force can provide a forum for this activity.

EXHIBIT II-2

AREAS OF KNOWLEDGE REQUIRED TO CARRY OUT

PERFORMANCE MEASUREMENT AND CAPACITY PLANNING

PERFORMANCE MEASUREMENT AND CAPACITY PLANNING COMPONENTS	EXTENT OF KNOWLEDGE REQUIRED IN				
	HARDWARE	SYSTEMS SOFTWARE	PARTICULAR APPLICATIONS SYSTEMS	ORGANI-ZATIONAL GOALS AND FUNCTIONS	GENERAL MANAGEMENT CONTROL AND TECHNIQUES
PROJECTING CAPACITY REQUIREMENTS	4	3	4	3	1
TRANSLATING BUSINESS NEEDS INTO COMPUTER WORKLOADS	1	2	5	5	5
COMPARING ACHIEVEMENTS TO STANDARDS	1	2	5	5	3
TIMING AND SCHEDULING THE SYSTEM	5	5	3	1	1
SETTING PERFORMANCE STANDARDS	1	3	5	5	5
MEASURING PERFOR-MANCE	3	5	2	1	1

KEY: EXTENT OF KNOWLEDGE REQUIRED – 5 = HIGH, 1 = LOW

EXHIBIT II-3

CAPACITY PLANNING: FUNCTIONAL RELATIONSHIPS

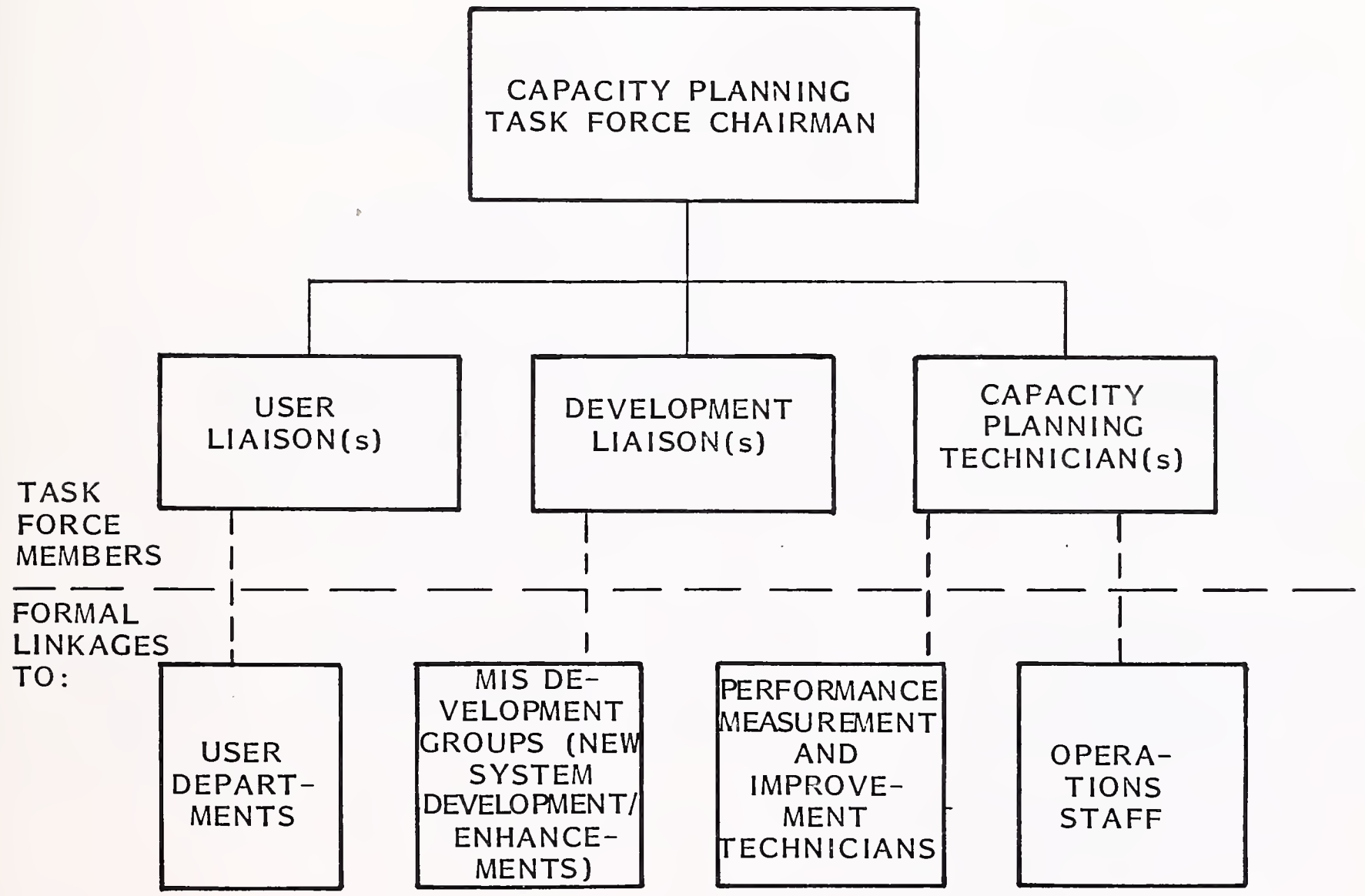
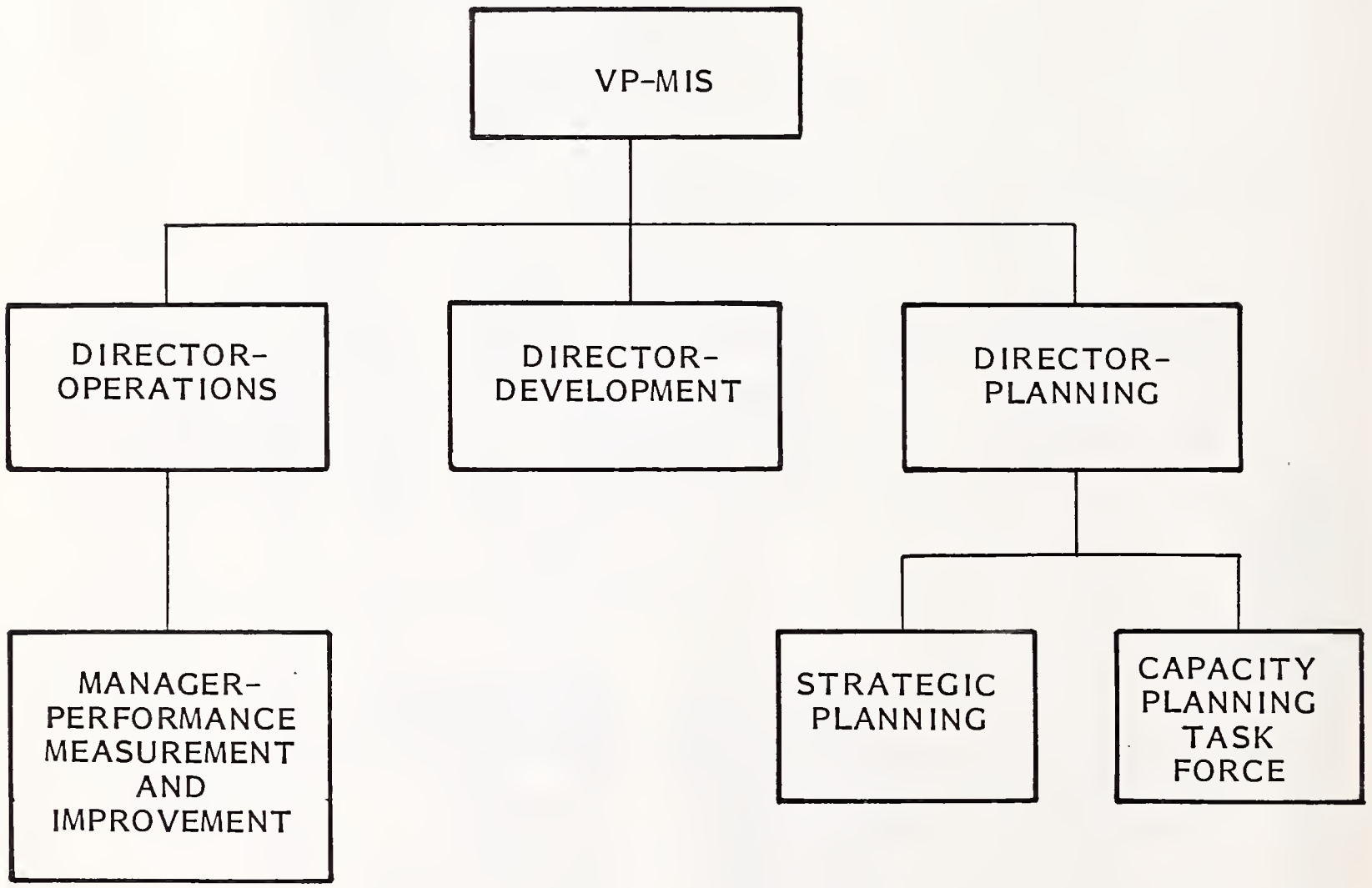


EXHIBIT II-4

RECOMMENDED STRUCTURE



- Whatever life cycle development methodology is employed, there should be key checkpoints early in the design process for estimating workload.

  . Newer methodologies, such as BEST/I and CRYSTAL from BGS Systems, will permit design-based metrics to be converted into workload estimates.

C. IDENTIFYING USER INTENTIONS AND SATISFACTION

- Learn users' business plans: Show top management that MIS needs to know user plans early so that data processing implications can be identified.

  - The MIS function must learn how to look at business plans from the users' viewpoints, even more in the future than in the past.

- Identify critical response times: Not all response time requirements are equally important. Learn which ones really are critical from a dollars and cents, as well as an internal politics, standpoint; and learn how to diplomatically ensure that this point of view becomes part of the decision-making and priority-setting processes.

- Contain "what ifs": Decision support systems can be highly useful applications but can stop data processing dead in the water if they get out of control. Consider the following alternatives to true real-time interactive systems.

  - Dedicated minicomputers with an extracted data base of company data.

  - Overnight, or at least delayed, turnaround.

  - An outside timesharing service.

- The first two options are good entry approaches to set the terms of supply; the latter can be a form of load-shedding.

- Provide understandable reports to users: Performance reporting to users should be straightforward and results-oriented. Eliminate data processing jargon. Think about what the user is really interested in and report that.

  - This may take a bit of initial effort. However, in many cases MIS management will find itself better informed also.

- Establish an MIS "report card": MIS will regularly report its perception of planned versus actual service to users. Have users do the same. The MIS department may discover some communications problems at the least, and perhaps radically different perceptions of reality.

D. TACTICAL RECOMMENDATIONS

- Plan workload shedding: No one can be consistently successful in planning. Therefore, MIS management should have contingency plans for dealing with excess workloads (assuming that the easy way out, buying more equipment, is not available). This can take several forms:

  - Transfer prime-time batch to overnight.

  - Lengthen response time, using the following criteria:

    . Least dollar impact.

    . Largest job.

    . Weakest sponsor.

- Transfer work to minicomputers.

- Use commercial timesharing.

- Send work out of house (e.g., to a service bureau run by a disaster recovery service).

- Retain deep tactical capacity reserves: In order to keep a margin for the unexpected, retain some slack in the system. The credit MIS management thinks it is getting for postponing equipment purchases may actually be quite small (top management may not believe its claims). Whatever credit is gained by running a tight ship will be nothing compared to the problems caused by a capacity crisis. Examples of discreetly established reserves include:

  - Keeping marginal (sheddable) batch jobs in prime time.

  - Deemphasizing routine fine tuning.

  - Not improving service beyond levels contracted for.

  - Having stand-by arrangements with hardware monitor consultants in order to provide extra tuning.

  - Targeting discrete functions for rapid removal to minicomputers.

- Use good tools: Make sure that suitable tools are available (and used).

  - Everyone should consider acquiring a general-purpose software monitor. Internally processed RMF data may be too unwieldy.

  - Capacity planning tools are a must for those who have the factual base and staff to support them.

- Tools will continue to improve, but if a tool is worthwhile now, don't delay action in the hopes that a better one will come along.

- Never improve service unilaterally: If the service improvement is unneeded and unexpected, the MIS department will receive little credit.

  - More importantly, the higher level of service will become the new "standard" and it will not be possible to slip back to the old "adequate" service level.