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USER MANAGERS' SYSTEMS NEEDS

Robert M. Alloway

Judith A. Quillard

April 1982 (final)

CISR WP #86
Sloan WP #1301 82

Center for Information Systems Research

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INTRODUCTION

Managers need information not computer systems. The latter is a means to the former end. Managers need flexible access to relevant data and the ability to analyze that data. Computer-based information systems are intended to provide a means to make this feasible, economical, and easy for managers.

This paper assesses the current systems and the perceived systems needs of managers, with an eye towards their appropriateness for various managerial ends. We diagnose the current situation by looking at two major areas. First, what is the current installed base of systems, how many are used by managers, and how appropriate are these systems. Second, what do these managers perceive as their systems needs and how well supported are their needs. In doing this diagnosis, we classify systems into four types: monitor, exception, inquiry, and analysis.

Then, based on this diagnosis of the installed base and availability of support for managers' needs, we explore how the demand for systems is changing and will be changing in the future. We look at two components of demand, the numbers of systems and the types of systems. The logical next question is can the I/S department or function actually meet this demand. We calibrate I/S's capacity to supply new systems by comparison with the number of systems that currently are being developed.

Finally, the paper discusses the implications of our results. Indeed, our findings are dramatic. The differences in how appropriate various systems types are to managerial needs has already caused a significant shift in managers' demand mix by systems type. Moreover, the level of user demand for new systems, for each type and collectively, is simply overwhelming. This presents serious management challenges to both I/S and user departments, necessitating the implementation of significantly more systems, the development of proportionately more managerially appropriate systems, and the improved prioritization of systems demand.

THE USER NEEDS SURVEY

The managers whose responses are being used to assess I/S success were surveyed as part of a large research project, the User Needs Survey. The project is being conducted at M.I.T.'s Center for Information Systems Research (CISR), with Dr. Robert M. Alloway as Principal Investigator.¹ The purpose of the User Needs Survey is to recommend improved information systems policies and procedures. The study was motivated by the desire to better understand the managers who are end users of computer-based systems and the issues involved in fulfilling their information needs.

Thirteen companies from the industrial sector participated in the second phase of this project. As summarized in Figure 1, they differed in industrial classification, size (as measured by revenues), and I/S department budget in relation to total revenues. The companies also differed in corporate structure, in the size and structure of their I/S departments, and in the reporting relationship of the I/S department within the company.

In each company, the research team selected managers from the I/S, Finance, and Manufacturing departments to complete a comprehensive questionnaire which addressed a range of issues related to the I/S function.

The respondents were chosen to be a representative sample of both the managerial levels and the job functions in each of the three departments. Figure 2 shows that of the 944 managers surveyed, just over forty percent were I/S professionals and just under sixty percent were users. Level 1 respondents are the heads of their respective departments, and level 4 are first line managers.

THE FOUR TYPES OF SYSTEMS

To establish the base case, user managers listed and classified by type the systems they already have. A straightforward classification of application systems type was used in the questionnaire. See Figure 3.

¹ Alloway, R.M., Bullen, C.V., and Quillard, J.A., "Overview of the User Needs Survey", CISR Working Paper No. 73, M.I.T., June 1981.

INDUSTRY CLASSIFICATION FOR THE 19 FIRMS

- o Paper, fiber and wood products
- o Rubber, plastics products
- o Communications
- o Food processing
- o Tobacco products
- o Motor vehicles
- o Office equipment
- o Measuring, analyzing, and control equipment
- o Electronics

SIZE OF FIRMS

<u>Revenue Range</u>	<u>Number of Sample Firms</u>	<u>Firms' Parent Organizations</u>
over \$ 10 billion	-	4
\$ 5 billion - \$ 10 billion	2	2
\$ 1 billion - \$ 5 billion	6	5
\$500 million - \$ 1 billion	3	2
\$100 million - \$500 million	2	-
	—	—
	13	13

I/S BUDGET AS A PERCENT OF FIRMS' REVENUES

<u>Percentage Range</u>	<u>Number of Firms</u>
2% - 3%	2
1% - 2%	4
0.5% - 1%	1
0.25% - 0.5%	6
	—
	13

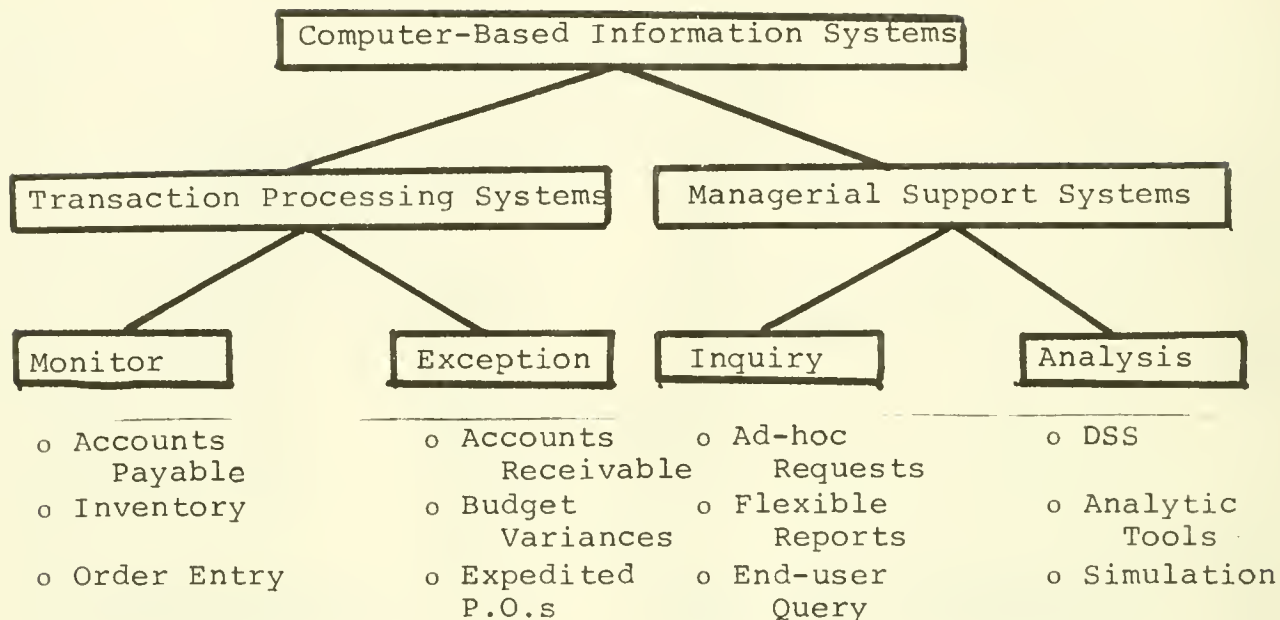
Figure 1. Companies in the User Needs Survey

<u>*LEVELS</u>	<u>I/S</u>	<u>MFG</u>	<u>FINANCE</u>	<u>TOTALS</u>
1	20	13	14	47 (5.0%)
2	34	29	23	86 (9.1%)
3	87	94	75	256 (27.1%)
4	274	146	135	555 (58.8%)
<u>TOTALS</u>	415	282	247	944 (100%)
	(43.9%)	(29.9%)	(26.2%)	

* Level 1 = Department head

Level 4 = First-line manager; average salary: \$25,000

Figure 2. Managers in the User Needs Survey



Monitor The system monitors daily detail activity producing standard reports on a fixed schedule (daily, weekly, or monthly).

Exception The system processes detail activity reports where the definition of exception conditions is fixed.

Inquiry The system provides a database with flexible inquiry capability, enabling managers to design and change their own monitoring and exception reports.

Analysis The system provides powerful data analysis capabilities (modeling, simulation, optimization or statistical routines) and the appropriate database to support managerial decision-making.

Figure 3. Description of Systems Types

The first two types, monitor and exception, fall into the category of applications traditionally called transaction processors. These systems have been the bread and butter of I/S. They help to capture, store, manipulate, and report the structured, high volume activities of daily operations. Transaction processing systems generate management reports by successive stages of increasingly summarized detail activity. The lowest level summaries are provided to supervisors and managers directly responsible for daily operations. Successively higher summaries are distributed to successively higher levels of management.

The implicit assumption in this traditional MIS approach to management information is that summarized daily activity, which is appropriate for first line managers, when further summarized is also appropriate for higher levels of management. In general, this assumption is not valid.² To the limited extent that it is valid, transaction processors do provide some relevant information to higher level managers.

Inquiry and analysis systems, however, are more managerially oriented in their intention, design and use than transaction processors. It is the difference between starting with the data and sending summary reports to the managers most likely to find them relevant versus starting with a manager's information needs and working down to the data and systems necessary to support those needs.

Flexible inquiry systems were originally developed to provide ad-hoc inquiry into transaction processing data. They have been enhanced to also provide flexible monitor and exception reporting. They require specialized software (database management systems and high level inquiry languages), hardware (disks and terminals), and are generally limited to accessing one database at a time (eg., order entry or purchasing) although progress is being made in linking databases together.

Analysis systems include a diverse mix of approaches to supporting judgemental decision-making, from problem-finding and contingency planning to selecting "best alternatives." They are necessarily customized for a particular set of decisions (eg., financial forecasting or production scheduling) and include flexible access to the required database.

There is a trend toward developing special databases to support inquiry and analysis systems. These databases contain information from sources both internal and external to the firm and

² Gorry, G.A. and M.S. Scott Morton, "A Framework for Management Information Systems", Sloan Management Review, Vol. 13, No.1, Fall 1971.

contain both "hard" and "soft" data. These "information databases" are designed to meet the information needs of the managers who use the system.³

³ Rockart, J. F. and M.E. Treacy, "Executive Information Support Systems", CISR Working Paper No. 65., M.I.T., Nov. 1980.

DIAGNOSIS OF THE CURRENT SITUATION

In order to assess how well managers' systems needs are currently being met, the User Needs Survey questionnaire collected data so that we could probe the following:

- How large is the installed base of application systems?
- What percentage of these systems do managers frequently use?
- Do managers find the systems they frequently use to be of the appropriate type?
- Do the installed systems support the most important tasks of user managers?
- What types of systems do managers find appropriate for supporting their important tasks?

In this section we will examine each of these questions in order to diagnose user managers' views of their current application systems and their important tasks which are or could be supported by a computer-based system. In particular, we will explore differences among the four types of system -- monitor, exception, inquiry, and analysis.

THE INSTALLED BASE OF APPLICATIONS SYSTEMS

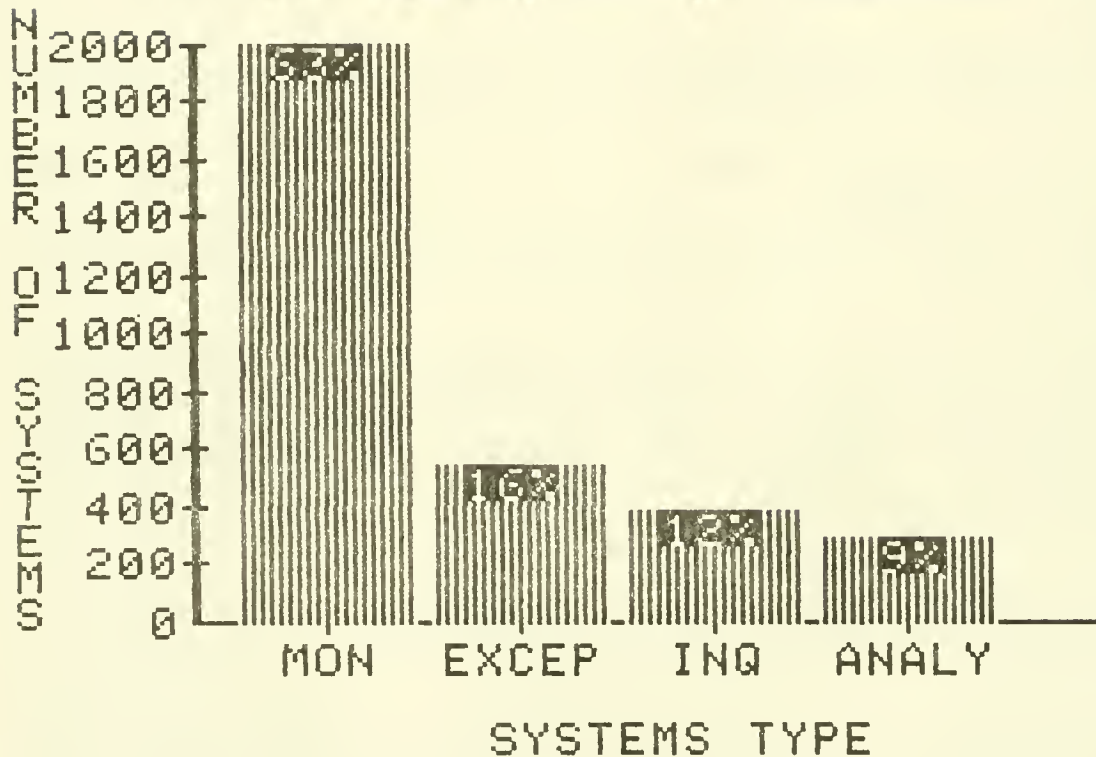
The user managers were asked to consider all the systems they currently have installed and to classify them as monitor, exception, inquiry, or analysis. This provides the breakdown of the installed base of application systems shown in Figure 4. Of the 3193 systems classified by the managers, 63% are monitor type systems, 16% are exception, 12% inquiry, and 9% analysis.

Thus, 79% of the collective experience of I/S and users is in transaction processors. This simple observation of the systems mix of the installed base has some interesting implications.

⁴ This also pervades individual orientation, skills, and the evaluation/reward system. See Alloway, R. M. and J. Nolte, "Planning Skill Development for Systems Analysts", CISR Working Paper No. 51, M.I.T., March 1980.

USER NEEDS SURVEY

TOTAL INSTALLED BY SYSTEMS TYPE



GRAND TOTAL ALL TYPES = 3193 SYSTEMS

CISR 13 INDUSTRIALS SAMPLE
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Figure 4. Total Installed by Systems Type

I/S policies and procedures, organizational structure, and expertise in developing applications are dominated by transaction processors.⁴ Thus, there is a strong tendency for any systems request that goes into I/S to come back out implemented as a transaction processor.

Users' perceived applications of computers, expectations of systems development procedures, anticipated benefits, and justification criteria are similarly dominated by their transaction processing experience. Thus, there is a strong tendency for systems requests that go into I/S to already look like transaction processors. The interaction of both I/S and user biases toward transaction processors has the same effect as a conscious conspiracy -- many inquiry and analysis systems needs are implemented as transaction processors instead.

SYSTEMS FREQUENTLY USED BY MANAGERS

The user managers were also asked to list the systems which they personally and frequently use. They then classified these systems according to the four types. Figure 5 shows these managerially used systems by type.

Not surprisingly, 79% of the systems which managers personally and frequently use are transaction processors. This reinforces the fact that transaction processing systems have dominated both I/S and users' experience with computer-based systems.

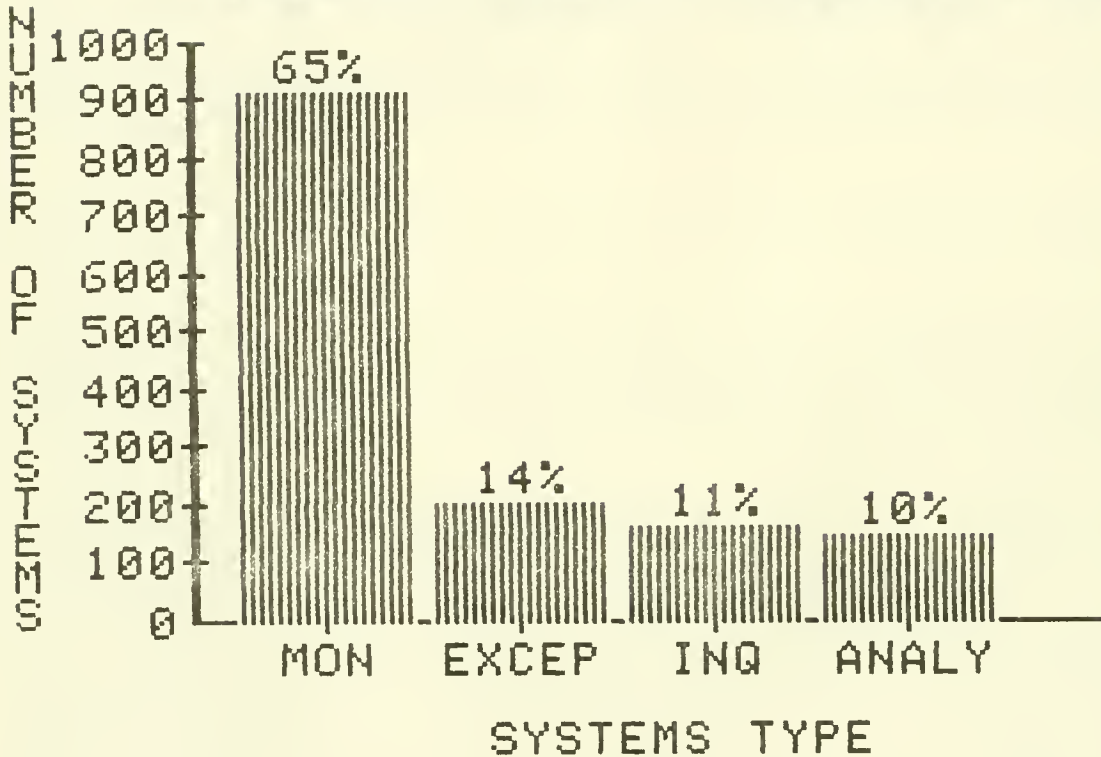
However, not all of the installed systems are used by managers. Figure 6 compares the total number of systems installed with the number of systems frequently used by managers. Of the total installed base of systems, only 44% are frequently used by managers. This reflects the fact that most of the installed systems were never intended nor designed to support managers. Most systems, especially the 79% of the installed base which is transaction processors, were built to support on-going paperwork activities. Transaction processors should be recognized for the valuable functions they do perform and not tarnished by being labeled "MIS", a function that 56% of them do not even address.

HOW APPROPRIATE ARE THE SYSTEMS USED BY MANAGERS?

Consider the 44% of the installed base which managers do use frequently. Are these systems of the appropriate type to meet

USER NEEDS SURVEY

MANAGER USED BY SYSTEMS TYPE



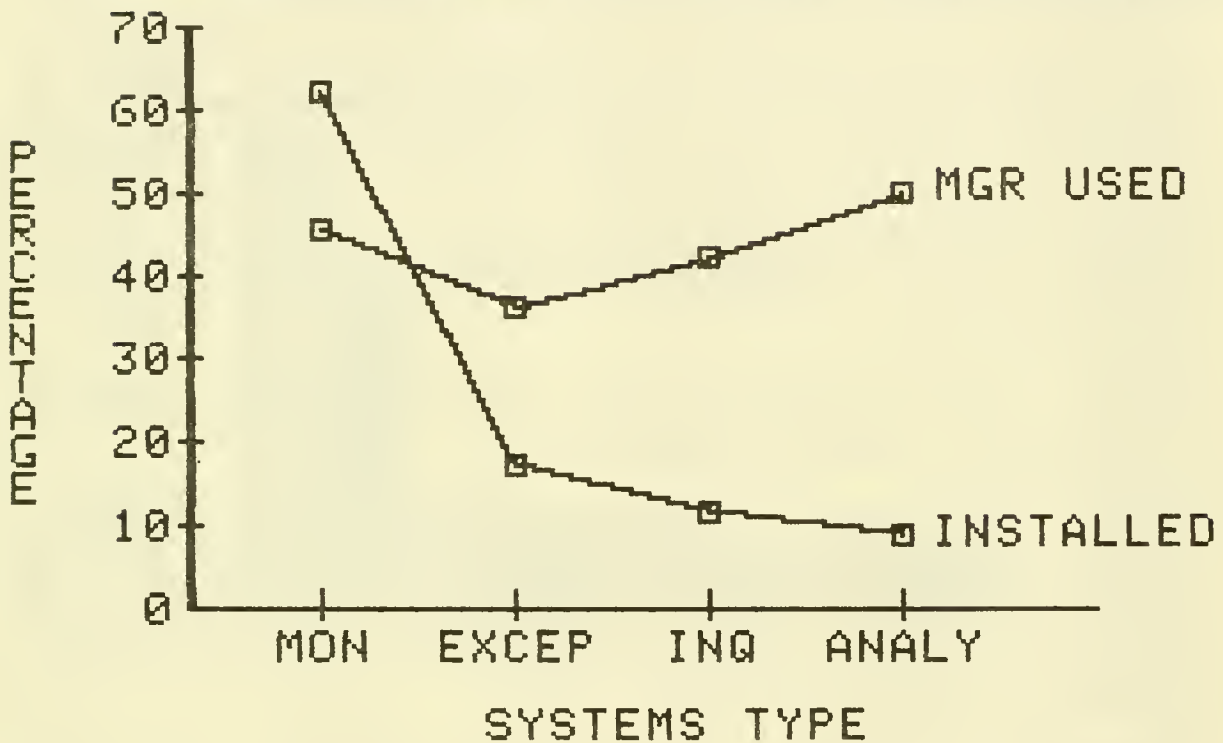
GRAND TOTAL ALL TYPES = 1403 SYSTEMS

CISR 13 INDUSTRIALS SAMPLE
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Figure 5. Manager Used by Systems Type

USER NEEDS SURVEY

MANAGER USED OF TOTAL INSTALLED



AVERAGE ALL TYPES = 44%

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Figure 6. Manager Used of Total Installed

the needs for which they are used? After classifying the actual systems type for each system they frequently use, managers were asked what type each system should be to fit the need for which it is used. When the actual and desired type are the same, that application is said to be of the appropriate systems type.

Please note that this definition of appropriate system is at the most fundamental level. If it is a monitor system and should be a monitor system, then by our definition that application is of the appropriate systems type for that manager's use. We have omitted other potential and very real detractors from the manager's point of view, such as ease of use, timeliness, and accuracy. Thus, appropriateness of systems type gives the benefit of the doubt to other aspects of systems quality. An inappropriate system type is thus not just a matter of cleaning-up a report layout, but rather a fundamental mismatch between systems type and use. No matter how good a monitor system it may be, it simply cannot perform like an analysis system.

Figure 7 shows that of the 1403 systems which are frequently used by managers, 983 or 70% are of the appropriate type. This is certainly a respectable percentage.

However, it is more interesting to examine the responses according to system type. For monitor type systems, 66% are appropriate. For exception systems, 60% are appropriate. The percentage jumps to 81% for inquiry systems and jumps again to 97% for analysis systems. Although there are not very many analysis systems, almost all of them are of the appropriate type for the managers who use them.

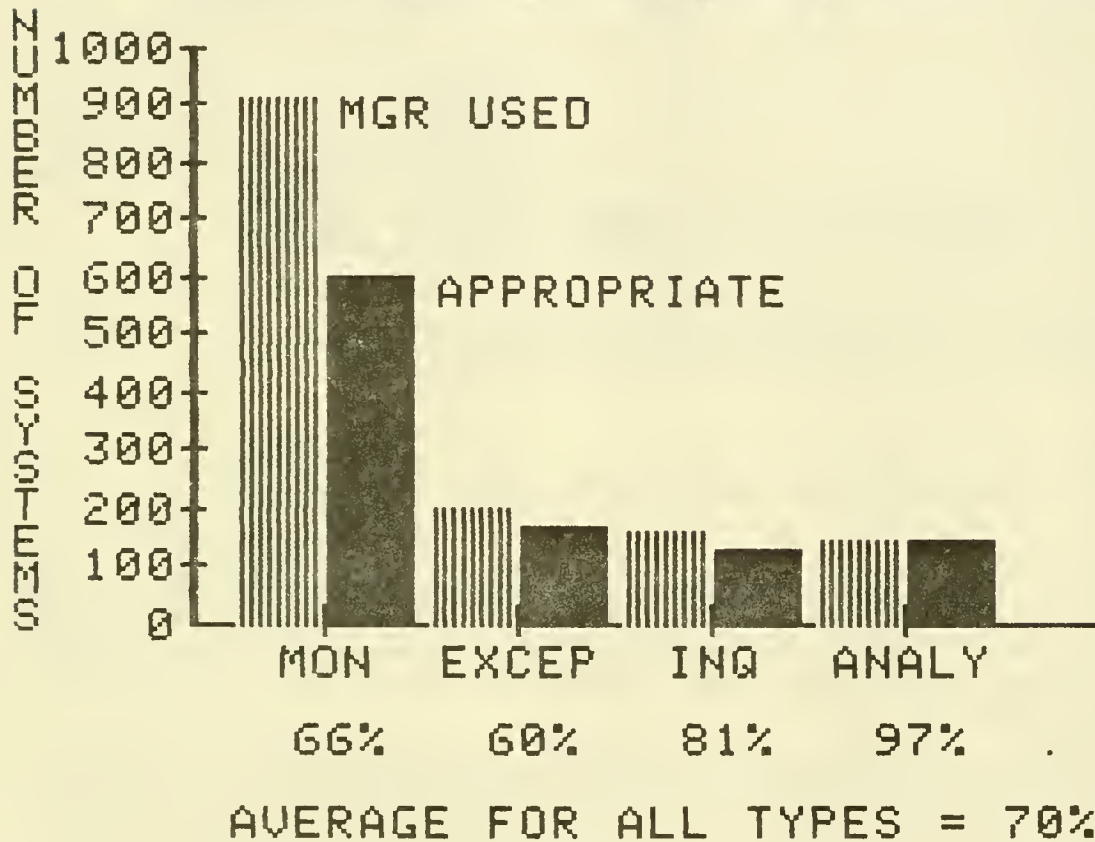
Consider for a moment the managers who frequently use the 34% monitor systems which are inappropriate:

- Inappropriate because they should have been exception systems -- paging through reports trying to pick out, without missing one, those items which are over one limit and under another.
- Inappropriate because they should have been inquiry systems -- flipping back and forth between reports trying to pull together all the relevant data on a situation.
- Inappropriate because they should have been analysis systems -- preparing spread sheets, digging through reports to post the spread sheets, running their calculators for totals and projections, and finally preparing graphs for understanding or for presentation of their findings.

Why do managers frequently use inappropriate systems? Certainly not out of preference nor without frustration, but

USER NEEDS SURVEY

APPROPRIATENESS: MANAGER USED SYSTEMS



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Figure 7. Appropriateness of Manager Used Systems

because it is the "best" source of certain information which is necessary in their jobs.

SUPPORT FOR MANAGERS' IMPORTANT TASKS

In a separate set of questions, user managers listed their most important tasks and/or decisions which are or could be supported by a computer system. For each listed task currently supported by a computer-based system, the managers classified the system by type. They were also asked which type of system would best support each of these important tasks. Finally, the managers cross-referenced these systems which support important tasks with those systems they frequently use.

These responses will be used to examine how many computer-based systems are relevant to the important tasks of managers and how appropriately they support these tasks.

SUPPORT AVAILABLE FOR IMPORTANT TASKS

Figure 8 shows the number of important tasks and decisions listed by the managers and the computer-based support currently available for them, classified by systems type. User managers listed 1307 important tasks of which 316 or 24% had no systems support at all.

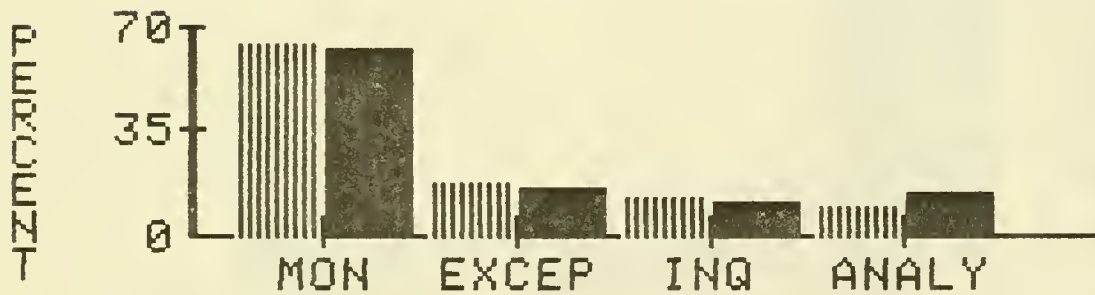
Clearly the installed base is not appropriate for the 24% which are unsupported. This alone is an important source of demand for new systems (and user dissatisfaction given the backlog in creating new systems). Monitor systems provided support for 608 or 47% of the important managerial activities although, as will be demonstrated, not necessarily appropriately.

The second portion of Figure 8 omits the 316 important managerial activities which are unsupported and re-computes the percent distribution by systems type.

Figure 9 compares systems which are relevant to managers' most important decisions with those they frequently use. Of the 1403 managerially used systems only 991 or 71% were cited in conjunction with users' important activities. In other words, while 24% of managers' important activities go completely unsupported, 29% of the systems which are managerially used are not relevant to managers' most important needs.

USER NEEDS SURVEY

IMPORTANT TASKS BY SYSTEMS TYPE



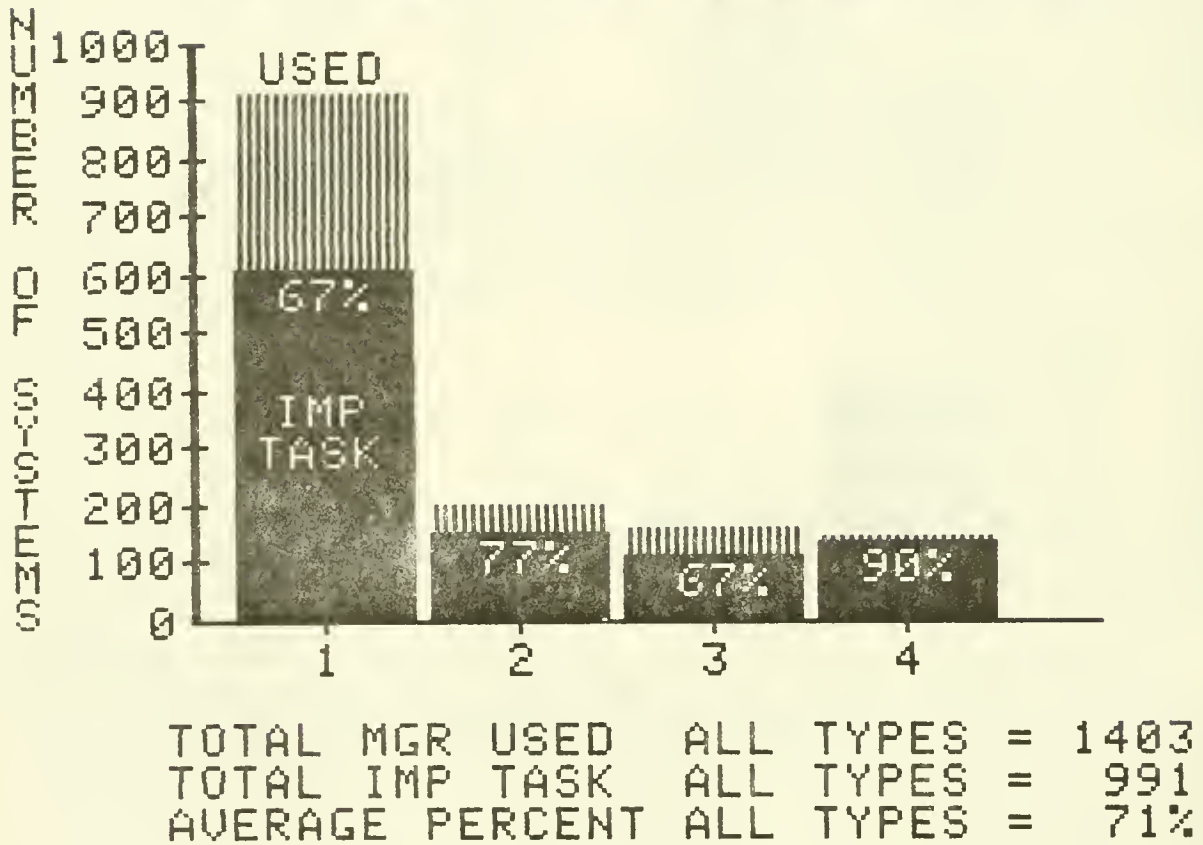
IMPLEMENTED IMPORTANT TASKS SYSTEMS
DISTRIBUTION COMPARED WITH
TOTAL INSTALLED BY SYSTEMS TYPE

CISR 13 INDUSTRIALS SAMPLE
(C) DR. R.M. ALLOWAY 1982

Figure 8. Important Tasks by Systems Type

USER NEEDS SURVEY

IMPORTANT TASK OF MANAGER USED



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Figure 9. Important Task of Manager Used

This is a reality which incites many user managers -- unjustly we think. The managerially used systems which were not cited are probably necessary for daily operations and fulfill some of the respondents' secondary needs. In fact, if these 300 "managerially unimportant" systems did not exist, many managers' most important tasks would be managing those daily operations which these systems effectively support. These systems have enabled managers to spend less time in daily operations and more time on other managerial issues.

There is a definite pattern in Figure 9 by system type. 90% of the analysis systems were cited whereas only 67% of the monitor systems were cited. For important managerial needs, analysis systems are clearly more relevant.

APPROPRIATENESS OF IMPORTANT TASK SYSTEMS

For their most important needs user managers cited 991 current systems as relevant. By asking managers to designate which systems type these applications should be, we can determine systems type appropriateness. The definition for appropriateness remains the same: systems type is considered to be appropriate when the actual and desired systems type are the same.

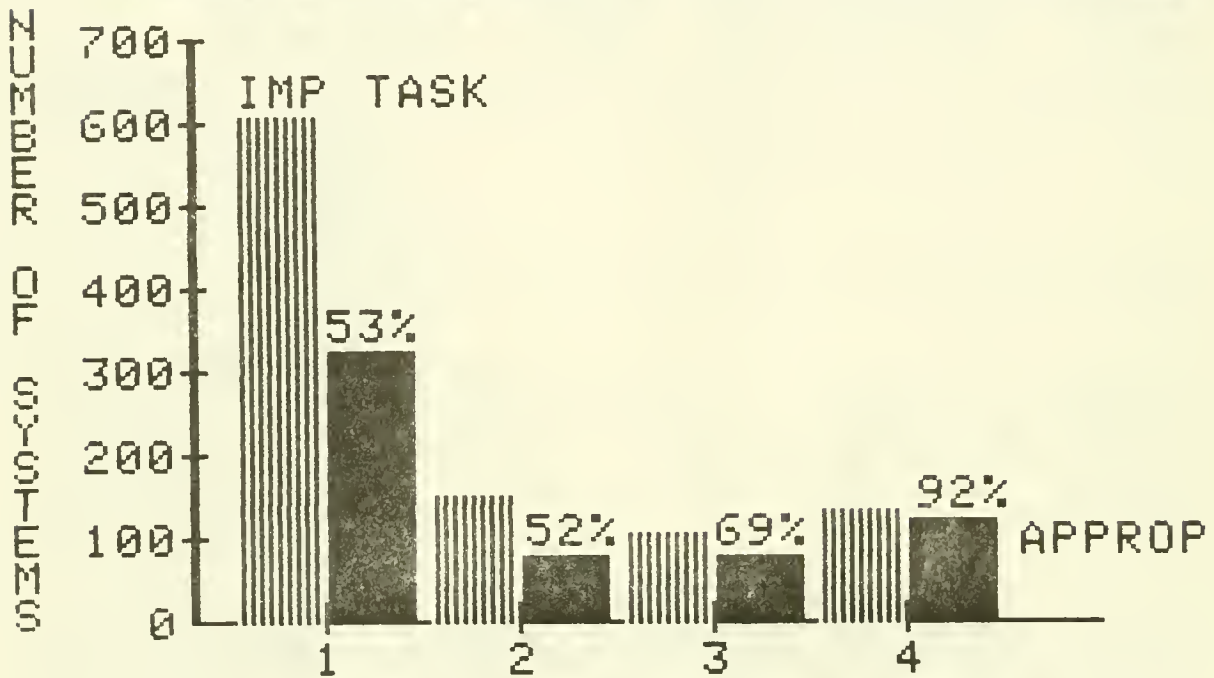
As shown in Figure 10, only 60% of the systems which are relevant to users' most important activities are of the appropriate type. In other words, 40% of the 991 frequently used systems which do relate to important managerial activities do so only partially or in an inappropriate fashion -- inconvenient, inflexible or incomplete.

Again we see that inquiry and analysis systems fare significantly better than monitor and exception systems. The majority of inquiry and analysis systems, 69% and 90% respectively, are considered by their users to be of the appropriate type. In contrast to the lower appropriateness percentages for monitor (53%) and exception (52%) systems this makes a very strong statement. User managers consider inquiry and especially analysis systems to be significantly more appropriate for their important needs than monitor and exception systems.

Exception systems are seen as particularly inappropriate for important managerial needs because, we believe, of the fixed nature of the exception conditions which are embedded in the application software. Redefining the exception conditions necessitates software maintenance, thereby constantly involving users in I/S backlog delays and red tape in a thankless quest to update inevitably obsolete reports.

USER NEEDS SURVEY

APPROPRIATENESS OF IMP TASK SYSTEMS



TOTAL IMP TASK ALL TYPES = 991
TOTAL OF APPROP ALL TYPE = 593
AVERAGE PERCENT ALL TYPES = 60%

CISR 13 INDUSTRIALS SAMPLE
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Figure 10. Appropriateness of Important Task Systems

ARE USERS REALISTIC IN DESIRED SYSTEMS TYPES?

Before we proceed we should check for realism the systems types which the users say are desirable. Have they been affected by the "hype" that surrounds the new I/S technologies? It is possible that user managers have jumped blindly onto the analysis systems bandwagon, rejecting as unsophisticated or behind-the-times all systems which are not on-line with database and color graphics.

Of the 608 monitor systems that relate to important managerial activities the breakout of desired type is shown in Figure 11. As we saw in Figure 10, 324 of these systems are considered by their users to be of the appropriate type. The remaining 47% should have been a different systems type to appropriately address their users' important needs. User managers are quite realistic. Only 13% should have been analysis systems and an equal percentage of these monitor systems would have been appropriate merely by being exception systems.

INTERMEDIATE SUMMARY

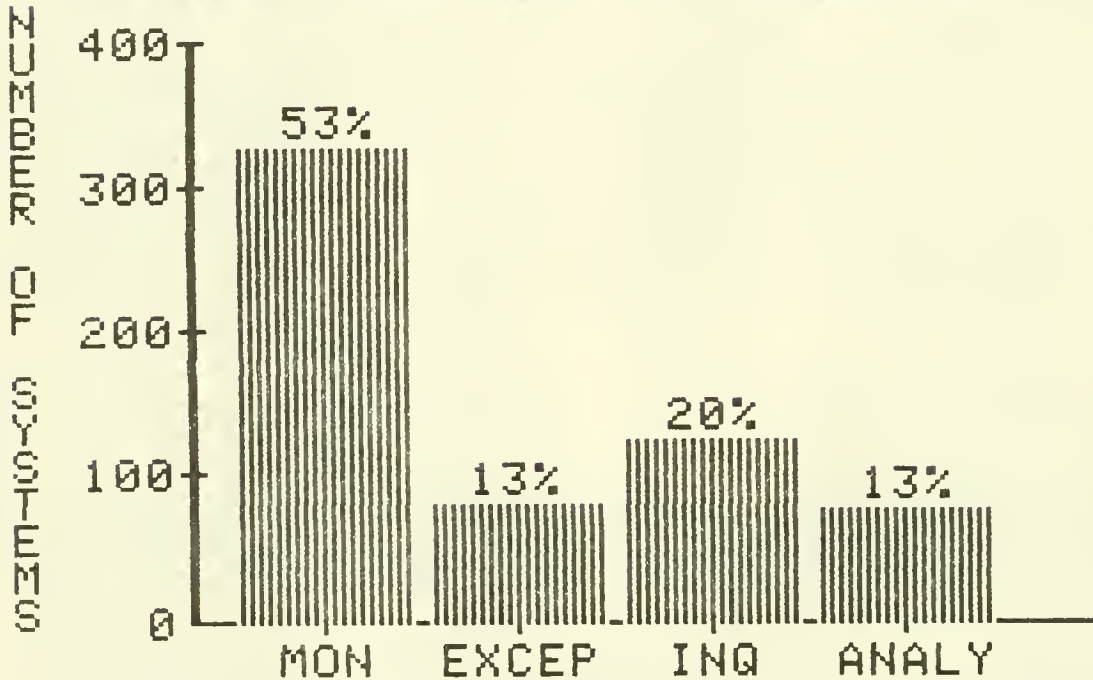
We have diagnosed application systems from two perspectives: means and ends. The total installed base and frequently used systems describe the currently available means. Managers' most important tasks describe the ends. By comparing actual and desired systems type we defined systems appropriateness. By comparing means and ends, we identified systems which are relevant to managers' most important needs. Several significant points emerged:

1. Both the total installed base and the systems frequently used by managers are 79% transaction processing systems. We should not underestimate how this biases the entire development cycle of other systems types.
 - In most companies the established standard procedures for needs identification, project prioritization, and project selection are the result of institutionalized transaction processing experience. This decreases the probability that an inquiry or analysis system project will ever be started.⁵

⁵ Alloway, R.M. and M. Jonikas, "The Project Selection Bias Against Managerial Support Systems", forthcoming CISR Working Paper.

USER NEEDS SURVEY

DESIRED TYPE FOR IMP TASK MONITOR SYS



TOTAL MONITOR SYS FOR IMP TASKS = 608
324 SYS (53%) ARE APPROPRIATE TYPE

CISR 13 INDUSTRIALS SAMPLE
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Figure 11. Desired Type for Important Task Monitor Systems

- The creation and use of inquiry and analysis systems differ significantly from transaction processors. Recognition of this simple fact has been hindered by a superficial appearance of similarity -- all four systems types are indeed computer-based. The development of inquiry and analysis systems is adversely affected by the policy requirement to follow established standard procedures which are appropriate for transaction processors.
2. Many of the systems which managers frequently use are not of the appropriate type. We should not gloss over the dissatisfaction and frustration this probably creates.
- Consider for a moment the impact of the inappropriate 30% on the reputation of I/S, specifically on systems development and project management, in these companies. It would be quite difficult for these user managers to consider the projects which created those inappropriate monitor systems as being responsive to their needs. No matter how bug-free and efficient the system, a monitor system cannot behave like an inquiry or analysis system. A well-designed and implemented, but inappropriate, monitor system contributes to the generally recognized feeling of I/S unresponsiveness to managerial needs.
3. Managers have many important tasks which could be, but are not, supported by computer-based information systems.
- Twenty-four percent of managers' most important needs which could be supported by an information system are not at all, by any type of system.
 - The distribution by systems type of current support is essentially the same for important tasks as for the total installed base of systems by type. Apparently whether a system is intended to support a managerially important activity or not makes little difference in the type of system which is developed. Presumably, this is because of the institutionalized standard procedures for systems development which reinforces I/S and users' biases, resulting in transaction processors irrespective of the intended use of the system.
4. Proportionally, more inquiry and analysis systems relate to important tasks and are more appropriate than monitor and exception.
- Seventy-one percent of the frequently used systems relate to managers' most important needs.

- There is a significant pattern of appropriateness by systems type varying from 52% for exception systems to 92% for analysis systems.

These last two points, taken together, foreshadow what we will see in the next section. There is a dramatic shift in users' demand for new systems away from transaction processors and towards managerial support systems.

THE DEMAND FOR NEW SYSTEMS

The previous section diagnosed user satisfaction with currently available systems. A dominate theme emerged -- the dramatic difference in user satisfaction by systems type. The resulting changes in user demand for new systems will be discussed in this section. First, by percentages we will investigate changes in the demand mix by systems type. Then, the level of demand will be determined from the number of new systems both requested and desired.

WHAT SYSTEM TYPES DO USERS WANT?

Some I/S managers have questioned when users will recognize the difference in managerial relevance and appropriateness by systems type. The data presented in the previous section of this paper leaves no doubt -- they already have. Other I/S managers have questioned when this recognition will be reflected in the demand for new systems. They look at their known backlog and see very little demand for analysis systems. As we will demonstrate in this section, the known backlog is just the tip of the iceberg and is a poor representation of total user demand. For the companies we surveyed, the shift in user demand mix has already occurred. The game has changed from hurry-up-and-wait to catch-up ball.

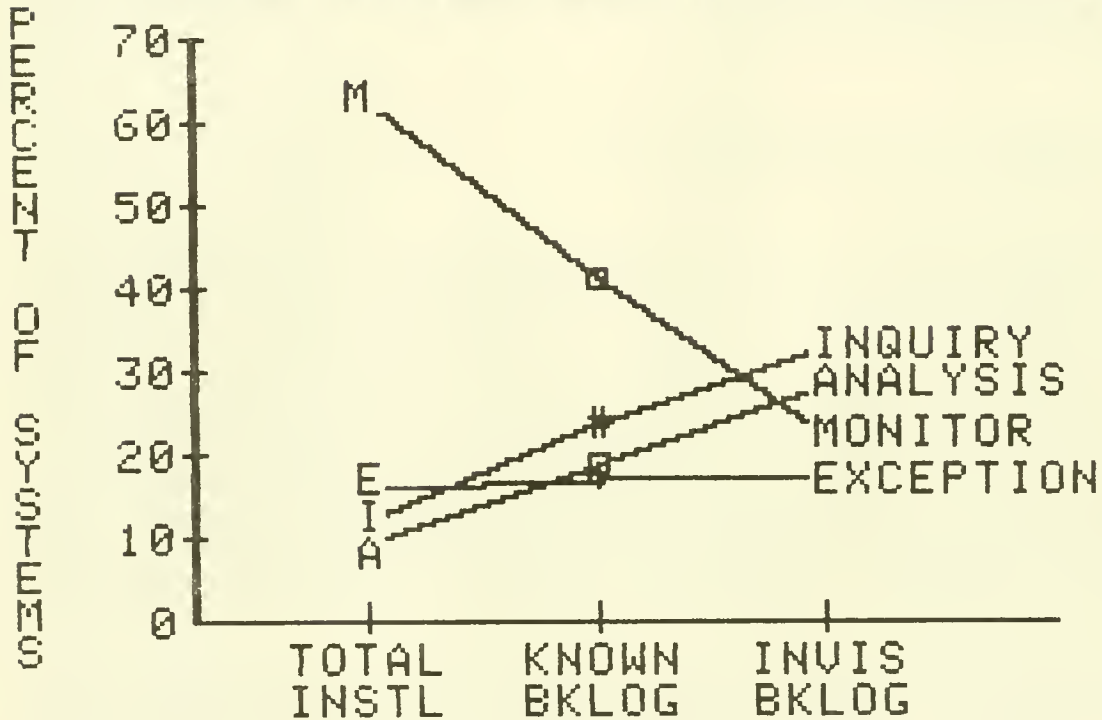
Figure 12 compares the proportion or mix of the total installed base with the known backlog and the invisible backlog. The known backlog shows a decline for Monitor systems from 63% to 41%. Conversely, the known backlog for Analysis systems has risen to 19% from the installed base of 9%. The mix of I/S systems development effort is undergoing material changes.

The invisible demand for systems consists of those systems users listed as needed but which have not yet passed the "rigors" of project approval. When they are approved, they become part of the known backlog. Prior to this step they are "invisible" to the I/S department, but, of course, not to the user managers whose needs they would fulfill.

The mix of invisible demand for analysis systems is 28%, compared to 19% for the known backlog and only 9% for the installed base. Similarly, invisible demand for inquiry systems is up to 33%. In contrast, invisible demand for exception systems is virtually unchanged and for monitor systems is down dramatically to only 1/3 the proportion in the current installed base -- from 63% to only 22%.

USER NEEDS SURVEY

KNOWN VERSUS INVISIBLE BACKLOG MIX



CURRENT BACKLOG MISREPRESENTS FUTURE

CISR 13 INDUSTRIALS SAMPLE
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Figure 12. Known vs. Invisible Backlog Mix

In fact, the known backlog misrepresents user demand both in terms of level (number of systems) and mix (proportion by systems type). User demand is equal to the known backlog plus the invisible backlog. Demand is hence 635% times greater than the known backlog.

The backlog also masks the demand mix shift by systems type. Figure 13 contrasts both the level and mix of the known backlog with the invisible backlog. In terms of level, the known backlog for monitor systems is only 34% of the invisible backlog or 293% times smaller. In terms of mix, the monitor systems are 41% of the known backlog but only 22% of the invisible backlog, thus overstating the invisible backlog mix by a factor of 186%.

Understanding the natures of monitor and analysis systems helps make this differential misrepresentation by systems type understandable. The need for a monitor system is more stable, predictable and independent of the requesting manager. Hence a backlog delay of several years is less likely to obviate the need. In contrast, the need for an analysis system is more situational, dynamic and dependent upon the individual manager. A backlog delay of several years would miss the opportunity entirely; moreover, the requestor would probably have transferred before the investment in proposal preparation paid-off.

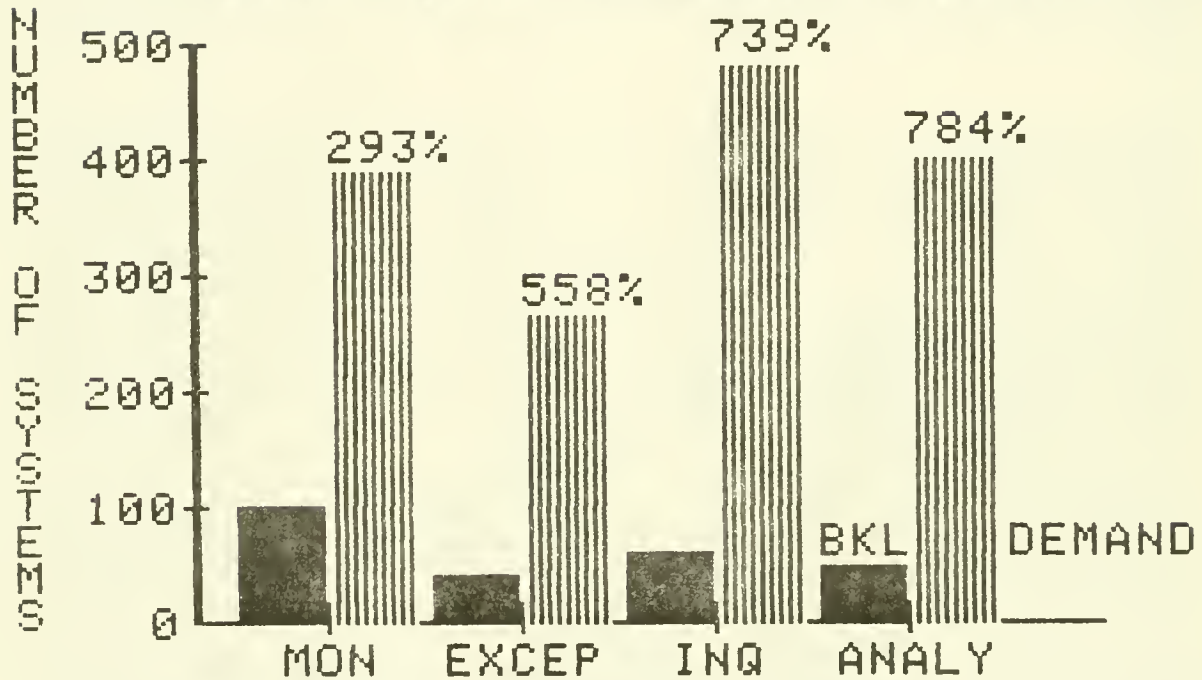
The invisible backlog reflects an even stronger shift away from transaction processing systems than does the known backlog. For the foreseeable future user demand will continue to emphasize analysis and inquiry systems over transaction processors.

The invisible demand mix summarizes the planning requirements for I/S in terms of the relative importance by systems type. This obvious mix shift emphasizes the necessity of modifying historically derived standard systems development procedures. In order to be successful and responsive to managerial needs, I/S's attention, priorities, and proportion of effort must be cut about in third for monitor systems and increased by a factor of three for analysis systems.

The known backlog misrepresents both the level and mix of user managers' demand for new systems. I/S management should plan its systems development portfolio with respect to total user demand not the known backlog. This suggests a dramatic departure from past practices. The necessity of undertaking such radical changes in procedures will be emphasized in the last section of this paper.

USER NEEDS SURVEY

BACKLOG MISREPRESENTS DEMAND



UNDERSTATES BOTH LEVEL AND MIX SHIFT

AVERAGE FOR ALL TYPES = 535%

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Figure 13. Known Backlog Misrepresents Demand

CUMULATIVE IMPLICATIONS

This section presents the cumulative implications of our previous points. First, we will look at how the current situation has most likely affected user managers' opinions of I/S. Then we will examine in more detail the implications of the huge increase in demand for new systems. This will be done by contrasting the demand with the I/S department's capacity to supply.

USERS' PERCEPTIONS OF I/S

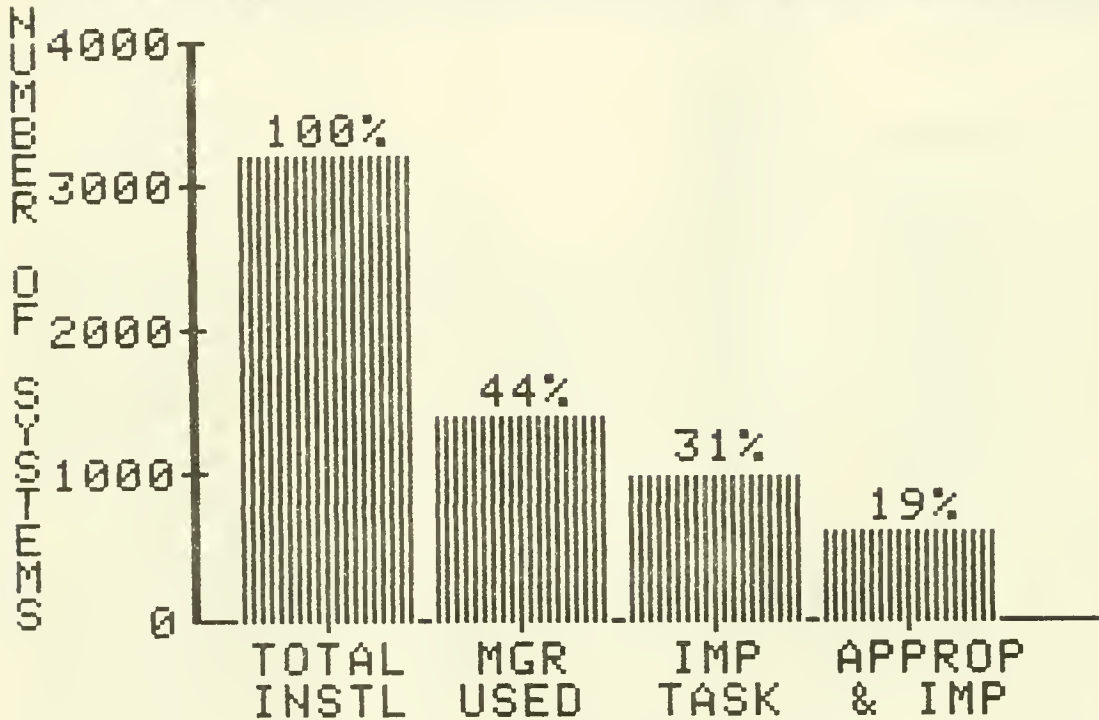
Given the current situation as presented by our data, we can deduce managers' most probable perception of I/S. Figure 14 begins with the total installed base and works down to those frequently used systems which are both relevant and appropriate to managers' important tasks. The cumulative effect is devastating. Of the 3193 installed systems, 44% are frequently used by managers and 31% relate to managers' important tasks. User managers see only 19% of the implemented application systems to be relevant and appropriate to their most important tasks.

This does not imply that the remaining 81% of the installed base is completely irrelevant and inappropriate. Rather those systems undoubtedly support other necessary corporate functions. They were not necessarily intended to provide support for managers' most important tasks. This exhibit does not reflect the recent mix of I/S system development by type, inasmuch as many monitor systems were developed years ago and most inquiry and analysis systems are fairly recent. Moreover, when originally developed, many monitor systems directly and appropriately addressed important managerial needs, such as payroll and accounting, so successfully that they are no longer important managerial needs.

Even accepting this litany of extenuating circumstances, this is how most managers perceive computer systems and why they believe I/S is unresponsive to their managerial needs. Millions of dollars have been spent developing, running, and maintaining existing systems. Only 19% of the installed base is relevant and appropriate to important managerial activities. Although analysis systems are dramatically more relevant and appropriate to managerial needs, these types are such a small percent of the total installed base as to be considered atypical I/S applications. Moreover, as was shown in Figure 8 on page 16, 24% of important managerial activities

USER NEEDS SURVEY

CUMULATIVE IMPACT ON USER PERCEPTIONS



FROM 3193 DOWN TO 593 SYSTEMS

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Figure 14. Cumulative Impact on Users' Perceptions

which could be supported by a computer-based system have no systems support of any type.

A search for the cause of user dissatisfaction with I/S need go no further than this mismatch between user managers' important needs and the installed base of applications.⁶

While Figure 14 may well represent the perceptions of the majority of user managers, we believe that this perspective is unfair. The total installed base was not intended nor designed to support managers' important tasks and as such should be excluded. When judging how successful I/S has been in providing relevant and appropriate systems, managers should include only those systems which they frequently use. These are the systems which should provide relevant and appropriate support to managers.

Figure 15 restates the comparison of relevance and appropriateness with managerially frequently used systems as the basis. This shows that 42% of all the systems frequently used by managers support important tasks and are of the appropriate systems type. This is a much fairer assessment of I/S than the 19% from Figure 14. We believe this is the proper perspective. However, as noted previously, it is not the most probable one. To the extent that user managers perceive only the 19%, the I/S department has a significant image problem. Failure to distinguish among systems types and intended uses confounds this problem. For example, calling everything that runs on a computer an MIS reinforces the 19% viewpoint.

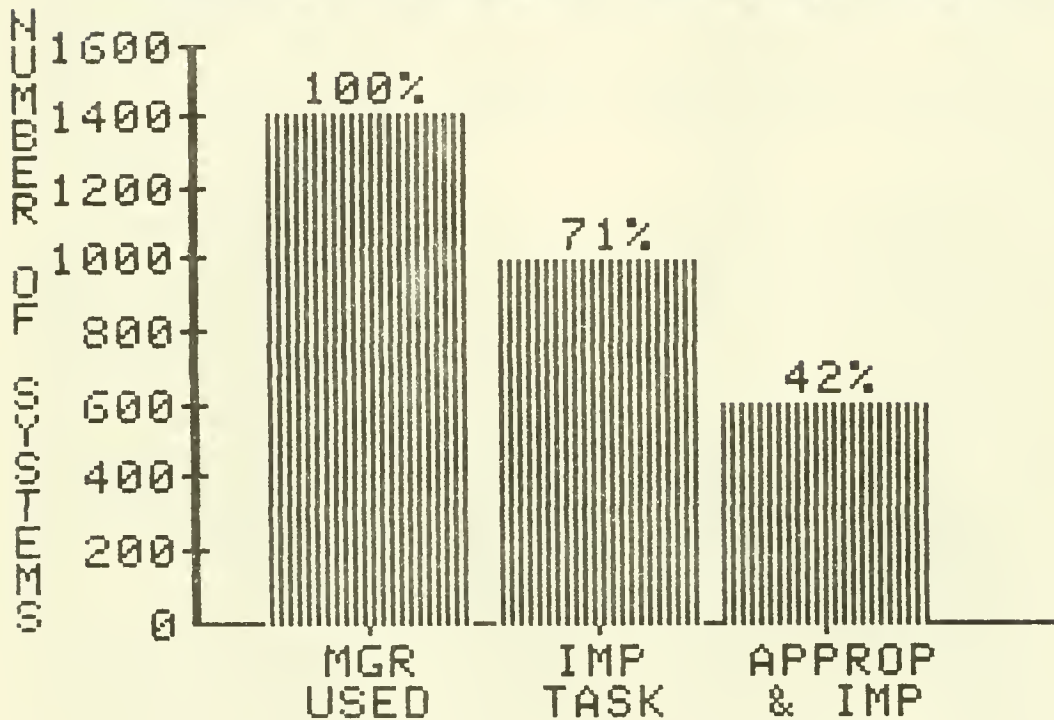
Figure 16 breaks out the 42% relevant and appropriate systems by type. The differences are dramatic. There are 908 monitor systems frequently used by managers, but only 36% of them are both relevant and appropriate. In contrast, 83% of the analysis systems are relevant and appropriate to managers' important tasks. There are not very many analysis systems implemented (114) but their importance to a successful I/S department is undeniable.

This distinction by systems type is critical to understanding systems relevance and appropriateness, user demand for new systems, and to creating a successful new systems development strategy. It is imperative that I/S shift its mix of delivered systems. The users' perspective must be changed from 19% to

⁶ See Alloway, R.M. and J. A. Quillard, "Top Priorities for the Information Systems Function", CISR Working Paper No. 79, M.I.T., Sept. 1981, where inquiry and analysis systems are identified as top priority criteria for improving the success of I/S.

USER NEEDS SURVEY

PROPER PERSPECTIVE FOR MGR'L USERS



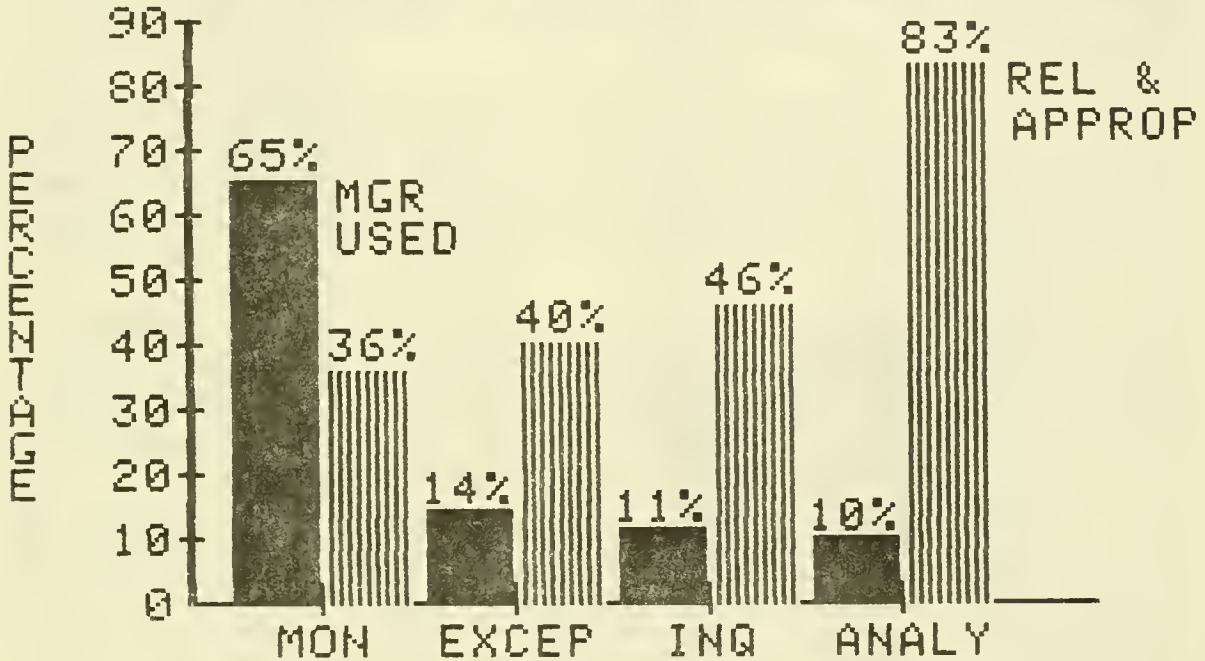
FROM 1403 DOWN TO 593 SYSTEMS

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Figure 15. Proper Perspective for Managerial Users

USER NEEDS SURVEY

RELEVANCE-APPROPRIATENESS BY SYS TYPE



TOTAL MANAGER USED ALL TYPES = 1403

AVERAGE RELEVANT & APPROPRIATE = 42%

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Figure 16. Relevance and Appropriateness by Systems Type

42% and the 42% level of relevant-appropriate systems must be improved dramatically.

DEMAND VERSUS SUPPLY

We have examined the level and mix of user demand. Now we will introduce the supply capacity of the I/S department to investigate the overall relationship between supply and demand and supply/demand ratios by systems type.

In Figure 17 no attempt has been made to standardize new systems by size or number of man-months required to create them. Just like the installed base of 3193 systems, some are larger or more complex than others. The count of new systems also includes systems replacements but not enhancements or maintenance.

The known backlog of all systems, 240, is so large (43% of the systems currently in development) that it results in the commonly observed 2 to 3 year backlog in most I/S departments. Systems development personnel are already flat-out dealing with the 557 systems currently being developed.

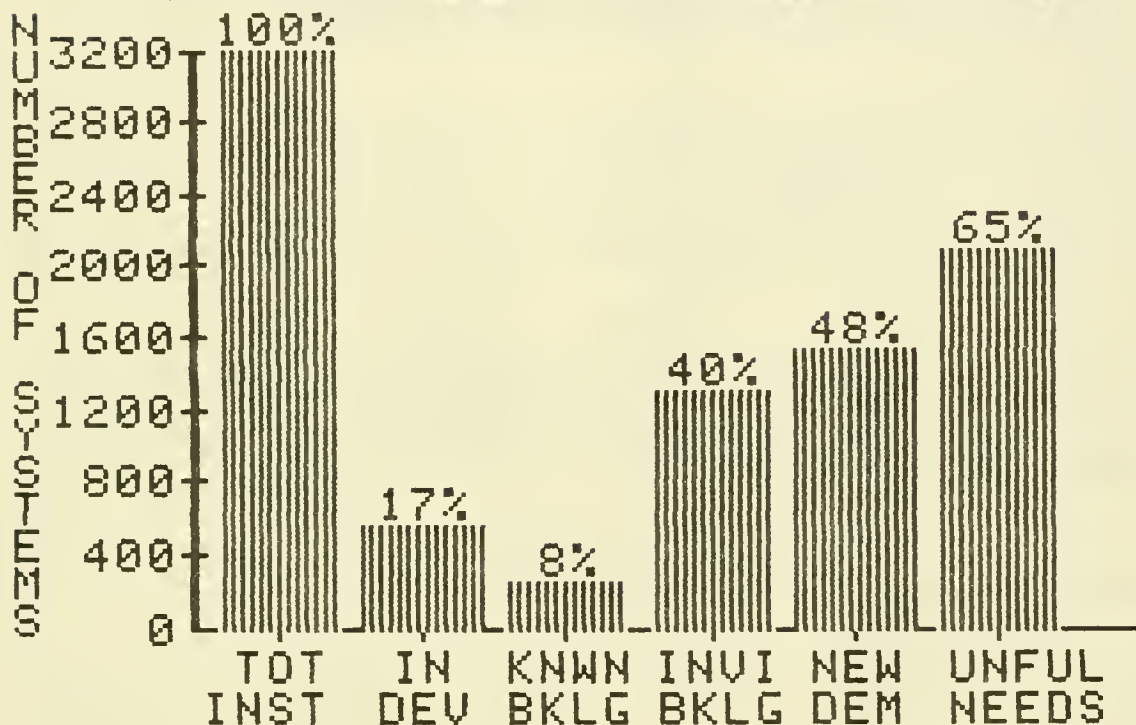
The invisible backlog for all systems, 1284, is staggering (535% of the known backlog or 230% of systems currently in development). The invisible backlog number is not as reliable as the known backlog because these desired systems have not passed the "rigors" of proposal preparation and approval. However, this figure is probably in the right ballpark.

The size of the invisible backlog implies that the known backlog will never get any shorter. No matter how fast I/S can create new systems the users will keep the known backlog full. For example, even if I/S expands its capacity to supply new systems by 100% via productivity tools, the known backlog delay will not decrease. Users will eagerly convert their invisible demand into known backlog projects.

The length of an I/S department's known backlog is not an indication of anything other than the users' planning horizon and perceived stability of need. In fact, it is the length of the known backlog itself which causes it to misrepresent actual user demand. The known delay tends to filter out users' more dynamic needs, which are usually best supported by inquiry or analysis systems. Thus the known backlog overstates transaction processing and understates managerial support systems. Its length is not an indication of either the success or failure of an I/S department; rather, it indicates users' willingness to predict their long-term needs.

USER NEEDS SURVEY

SUPPLY AND DEMAND FOR NEW SYSTEMS



UNFULFILLED NEEDS TOTAL 2081 SYSTEMS
OR 374% GREATER THAN SUPPLY CAPACITY

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Figure 17. Supply and Demand for New Systems

New demand for all systems, 1524, is simply overwhelming -- 273% of the systems currently in development. If we include the work-in-process inventory of 557 new systems currently being developed, total demand is 2081 systems, 374% of I/S's capacity to supply or 65% of the total installed base of applications. Sixty-five percent may not sound like much until one contemplates the many years and the cumulative systems development effort to date. It is impossible for any I/S department to actually fulfill this level of demand. Priority setting is as important in determining success as the number and the quality of systems developed.

Conversely, user departments will be hard pressed to fulfill their needs even using a variety of suppliers -- I/S, end user programming, and software vendors (package and custom).⁷ Users' prioritization of needs is as important in fulfilling their information needs as the number and the quality of systems implemented.

User management must fulfill its responsibilities in prioritizing individual systems and levels of effort by systems type. I/S should not be forced into the position of indirectly determining corporate capabilities and strategy via its selection of systems projects.

SUPPLY/DEMAND RATIOS BY SYSTEMS TYPE

The demand mix by systems type reveals a dramatic shift from the total installed base. In Figure 18 the installed base mix is indexed to 1.00 to highlight the factor changes by systems type. The extremes in factor shifts, analysis up 3.11 times and monitor down to .35, demonstrate the magnitude of the changes necessary within I/S and in the relationships between I/S and users.

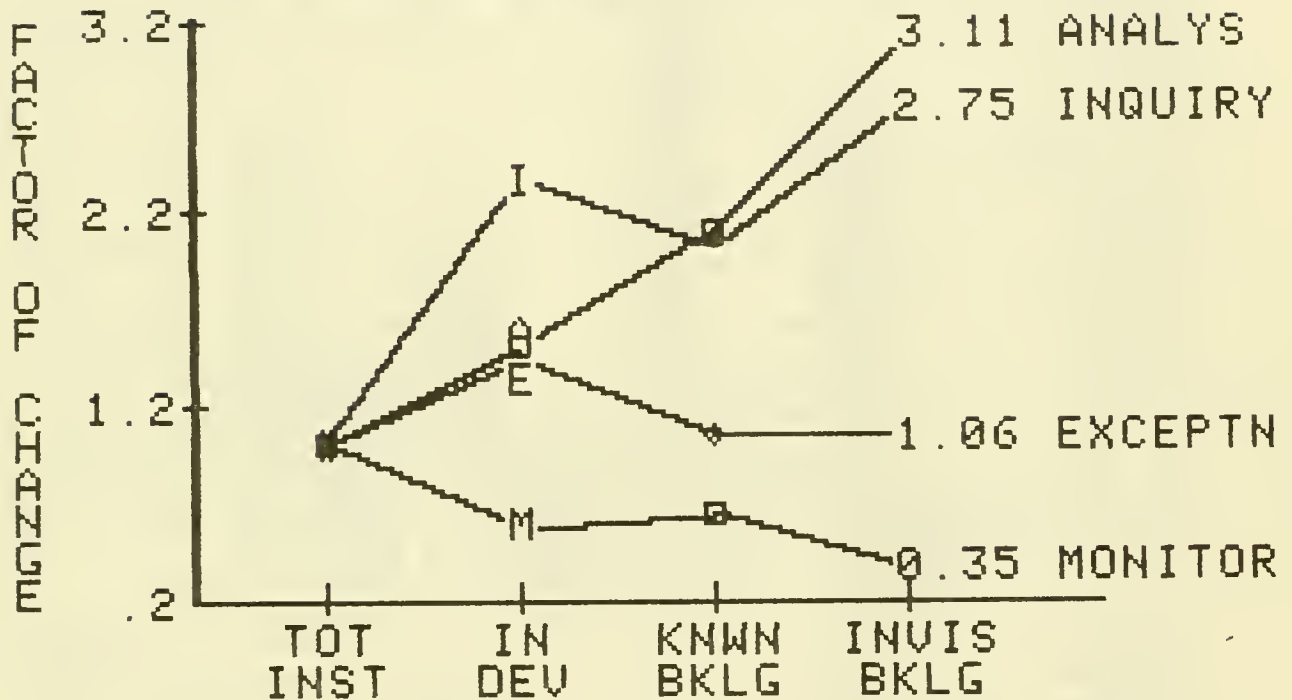
Fortunately, these I/S departments have already begun to respond to this mix shift in demand. The proportions currently being developed show a marked departure from the installed base. Inquiry systems are up over 2.37 times and monitor systems are down to .57. These shifts in the supply mix of new systems are definitely in the right direction.

However, the increase in analysis systems to 1.51 has a long way to go to reach 3.11. Users are expecting increased implementation of managerially-oriented systems types in the near

⁷ Alloway, R. M., "Outside I/S Services", forthcoming CISR Working Paper.

USER NEEDS SURVEY

SHIFT IN USER DEMAND MIX



TOTAL INSTALLED BASE INDEXED AT 1.00

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Figure 18. Shift in User Demand Mix

term and I/S should already be able to perceive this shift. If standardized procedures and ingrained attitudes based on transaction processing experience result in the implementation of monitor systems where inquiry or analysis systems are needed, requested, and expected, user dissatisfaction will surely increase.

This dramatic mix shift in user demand must be matched by an equally dramatic shift in supply mix. To achieve the corresponding shift in supply requires pervasive changes to I/S's internal structure and procedures. This includes training programs and personnel evaluation criteria,⁸ project design and procedures for different system types,⁹ and defining success and setting priorities for I/S.¹⁰

In Figure 19 the current supply capacity is compared with new demand (known backlog plus invisible). The demand for 385 more monitor systems is itself sufficient to keep the entire I/S department very busy for the foreseeable future. I/S cannot simply stop creating monitor systems in order to meet the dramatic growth in demand for other system types. I/S must continue to create monitor systems. It is a question of priorities: how many of the monitor applications in the backlog are already committed; how many are necessary foundations for other systems; how many in the invisible backlog can be obviated by installing inquiry or analysis systems; what priority should be assigned to each monitor system given the demand for all system types?

Hopefully, as some of the demand for 478 more inquiry systems is fulfilled the proportion of I/S effort expended on "little systems" (special report requests) and maintenance of existing systems will decrease. Flexible inquiry systems have the desirable characteristic of converting users into "programmers" and "maintenance personnel". As users' information needs evolve with respect to an inquiry systems' database, they revise their ad-hoc queries and modify their stored report commands accordingly.

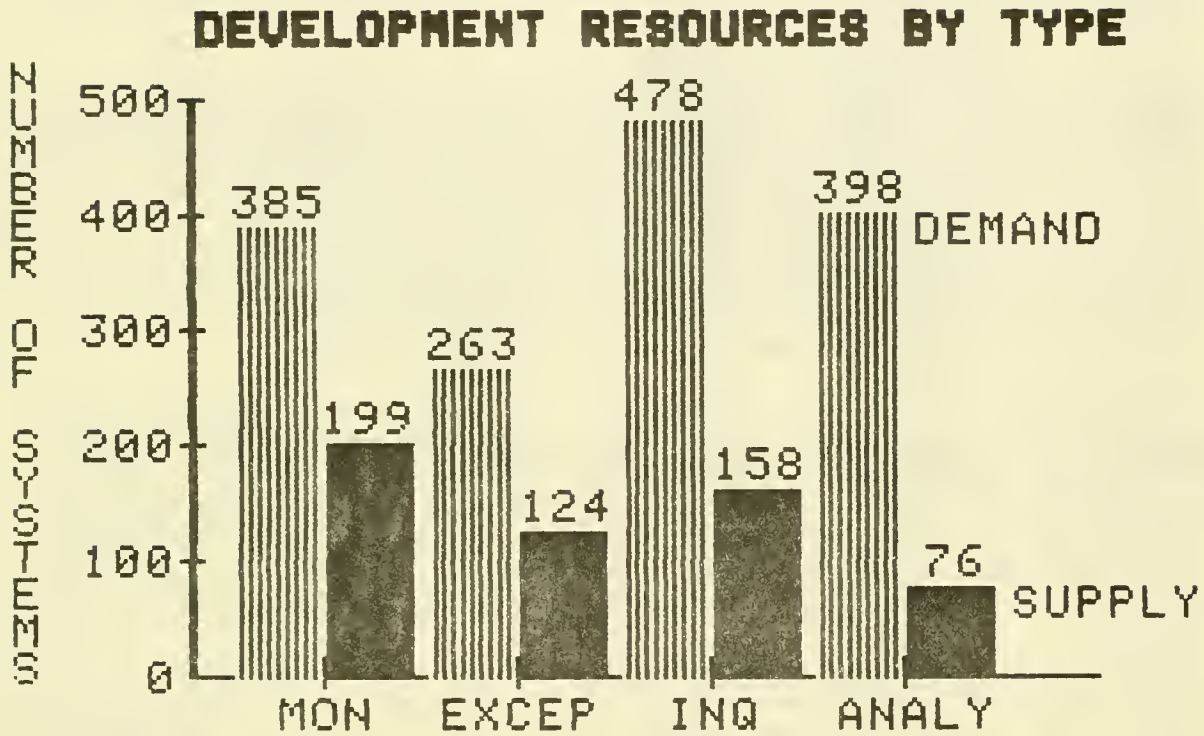
In fact, the general approach of converting users into "programmers" will have to be heavily pursued in any serious attempt to fulfill total demand for inquiry or analysis systems. The demand for analysis systems is 524% greater than

⁸ Alloway and Nolte, "Planning Skill Development for Systems Analysts", op. cit.

⁹ Alloway, R. M., "Temporary Management Systems", Institute of International Business Working Paper, Stockholm School of Economics, September 1977.

¹⁰ Alloway and Quillard, "Top Priorities for the Information Systems Function", op.cit.

USER NEEDS SURVEY



SUPPLY CAPACITY ALL TYPES = 557

USER DEMAND FOR ALL TYPES = 1524

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Figure 19. Development Resources by Type

what is currently being developed. Without "user-programmers", I/S simply does not have the capacity to fulfill even a respectable percentage of this demand for analysis systems, especially while simultaneously developing 193% more monitor, 212% more exception, and 303% more inquiry systems. In addition to developing systems itself, I/S should play a facilitative and supportive role for user-developed systems. High level user-oriented languages, access to databases, and relevant training must be provided to users.¹¹

Figure 20 provides two perspectives on the same issue, the supply/demand ratio by systems type. The top graph compares the growth rate of new demand with the supply/demand ratios for corresponding systems types. The bottom graph compares the supply mix and demand mix by systems type. This mismatch in supply and demand is managerially unacceptable. User and I/S management can no longer fail to distinguish between systems types in their thinking, planning, and project selection/prioritization, and resource allocation decisions.

I/S should initiate a major shift in resources, structure and procedures to provide more inquiry and analysis systems. This is necessary but not sufficient. The procedures for creating analysis systems are basically different from the procedures for creating transaction processing systems.¹² I/S must change its management policies and procedures accordingly to increase the supply of this type of system in its application portfolio.

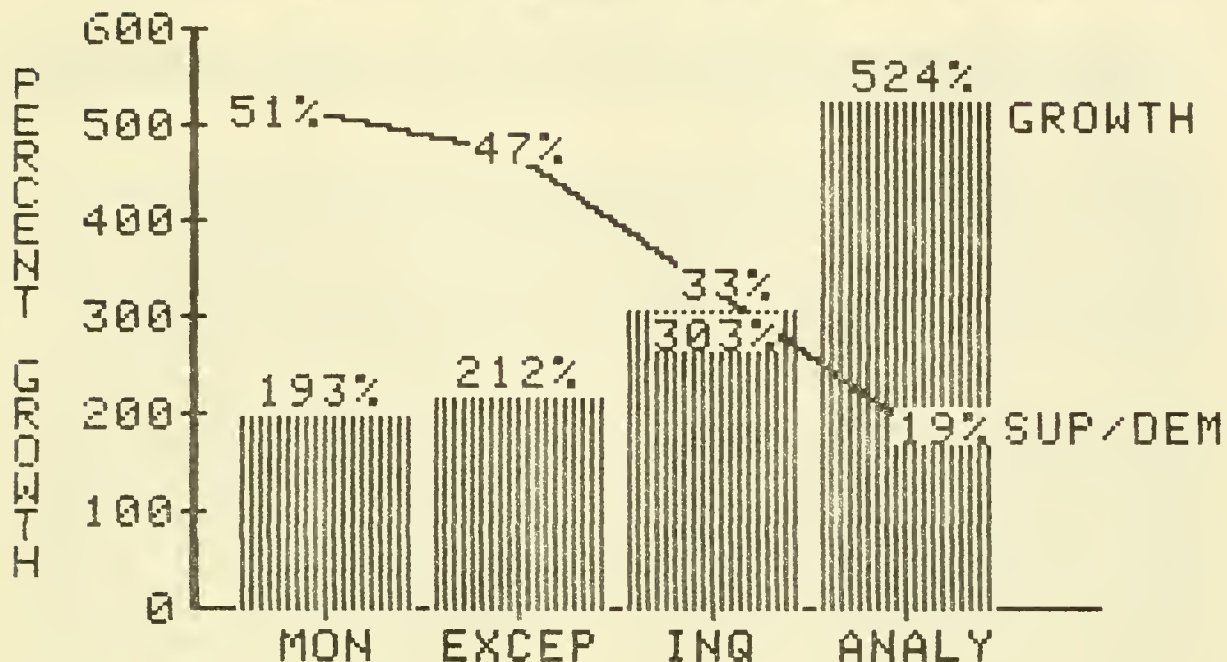
It is like a company adding a new product line. Changes in customer demand, due to shifts in consumer preference or new technological capability to supply old needs, must be recognized for the long term viability of the company. New procedures and departments must be created in marketing, manufacturing, field services, etc. Growth in the new product line must be planned, supported, and protected. Competition between existing product lines and the new product line for resources and management attention must be resolved based upon potential profit potential.

The necessity for I/S to realize and respond to the demand for analysis systems should be clear from their high appropriateness ratings, especially for managerially important activities. Failure to respond will leave I/S in the

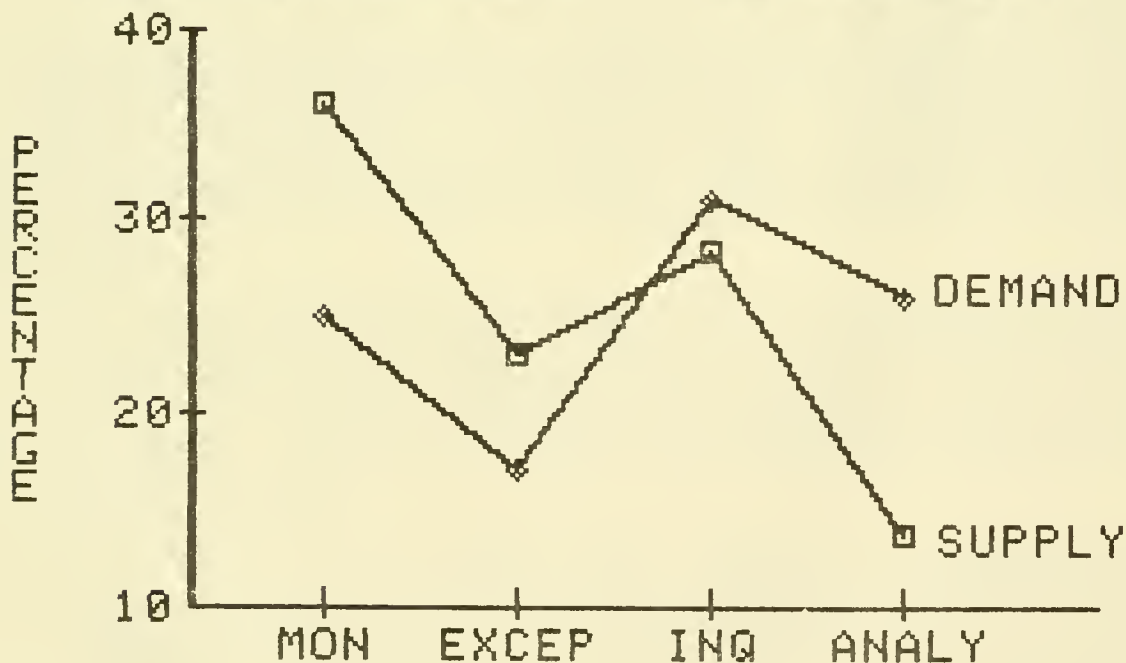
¹¹ Rockart, J.F. and L. S. Flannery, "The Management of End User Computing", CISR Working Paper No. 76, M.I.T., Sept. 1981.

¹² Keen, P. G. K. and M. S. Scott Morton, Decision Support Systems: An Organizational Perspective, Addison-Wesley, 1978.

GROWTH RATE & SUPPLY/DEMAND RATIOS



NEW SYSTEMS SUPPLY AND DEMAND BY TYPE



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Figure 20. New Systems Demand by Type

unenviable position of being perceived as both unresponsive and irrelevant to managers.

SUMMARY

To summarize, we are advocating change -- not incremental change in how systems needs are fulfilled, but dramatic, fundamental changes. The implications of our research results call for changes in I/S policies and organizational structure, changes in the relationships between users and I/S, and changes in the systems development process, tools, and responsibilities.

And most fundamental of all, changes are needed in the way both I/S and user managers think. Their thinking is dominated by the transaction processing systems which comprise 79% of the total installed base. Yet only 19% of this base is both relevant and appropriate to managers' most important tasks. Why? Because systems development policies and procedures do not differentiate by systems type. People still think that "all systems are created equal". That a distinction should be made is evident from observing that 36% of frequently used monitor systems are relevant and appropriate for managers' most important tasks versus 83% for analysis systems.

The I/S departments we surveyed have already begun by cutting the proportion of monitor systems by 57% and increasing inquiry and analysis systems by 237% and 151% respectively. I/S is being responsive to the changing mix in user demand but they have a long way to go. Even for these I/S departments which have responded to the mix shift, supply capacity is still less than new demand by 303% and 524% for inquiry and analysis systems.

As we have demonstrated, demand for new systems cannot be fully understood by inspecting the known backlog. The known backlog is a biased filter, understating new demand by over 5 times and misrepresenting mix by understating managerial support systems by over 7 times. The realistic basis for planning systems portfolio balance is supply and demand, not supply and the known backlog.

Techniques exist to improve the relevance and appropriateness of systems development efforts. The decision support systems (DSS) advocates have considerable experience in successful analysis systems development. Flexible database management systems, very high level languages, and user friendly query tools are proliferating in the marketplace. Procedures for information resource centers and end-user programming are becoming better understood. These techniques should not supplant, but should be used in addition to, our existing knowledge and procedures for transaction processing systems. These techniques are no more radical today than minicomputers

were a few years ago. And like minis, management can learn to use them effectively.

What is the answer to such pervasive and fundamental changes? When push comes to shove -- money! We should re-allocate our scarce I/S resources to match supply to demand -- if not by level at least by mix.

Whatever the overall level of new systems development resources, the allocation of these scarce resources must be improved. The systems development portfolio balance between transaction processing systems and managerial support systems is a strategic business decision, balancing cost displacement against opportunity fulfillment. The project approval procedures must differentiate by systems type, applying corresponding project evaluation criteria and allocating resources to meet the given strategic goals and portfolio balance.

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