SYSTEMS DESIGN FOR EPIE

# 379 - 67

AUTHOR: D. HARRIS

COMMUNITY SYSTEMS FOUNDATION
April 5, 1967

TO: Mr. P. Kenneth Komoski
Director
Educational Products Information Exchange
Institute For Educational Development
52 Vanderbilt Avenue
New York, N.Y.

FROM: Community Systems Foundation

SUBJECT: A Proposed Systems Design For EPIE

At your request, we have prepared a proposal presenting a recommended systems design for EPIE. Included is a general description of an ideal and operational system; detailed specifications and design recommendations for an operational system; a statement of implementation requirements, responsibilities, and costs; and estimates of the annual operating cost for the initial system.

We wish to acknowledge the cooperation and assistance received from other EPIE consultants too numerous to mention. The information which they contributed has been instrumental in the preparation of this report. We wish to especially thank Dr. Frederick L. Goodman, Associate Professor, School of Education, University of Michigan, for his constant guidance and assistance throughout this endeavor.

Respectfully submitted,

David H. Harris
Managing Director
THE IDEAL SYSTEM

Goals and Characteristics

In designing and implementing an information system, it becomes important to describe that system which displays upon examination ideal or perfect characteristics. In so doing, the creators of the system force themselves to state in precise terms the ultimate objectives or goals of their work. Never before has such a need existed more than it does for the EPIE system.

Months of investigation and thought have led to the unavoidable conclusion that EPIE must be created with the joint recognition that it cannot at the outset fulfill all of its goals, yet it must continually progress closer to them.

For many reasons, EPIE cannot at once be an operational and ideal information system. Implicit in an ideal system are at least the following characteristics:

1. Users of the system would have the ability to gain access to information which would always influence the attainment of a "correct" decision.

2. Users of the system would have the ability to achieve instantaneous access to information in the system as frequently as desired.

3. The processing of requests for information would be fully automated in order to permit from the viewpoint of multiple simultaneous users full and instantaneous access to information.

4. The system would continuously experience full utilization of its resources, including personnel, plant, and information.

5. The cost of operating and maintaining the system would be zero.
Achieving the Ideal

Underlying the ideal characteristics above are a number of sub-goals which would have to be met and yet cannot be at the outset.

Implicit in the characteristic of always providing "correct" information are a number of characteristics which do not exist today and cannot be created within the time constraints established for the initiation of an operational system. Objective measures agreed upon by all would have to be available to determine the "correctness" of each decision arrived at by users of the EPIE system. Should a decision be judged correct on the basis of student performance using the chosen materials? On the basis of teacher's acceptance of the chosen materials? On the basis of whether or not the system user continues to use the EPIE system after a personal evaluation of the effectiveness of past use? Should it be judged correct on the basis of one, all, or a combination of these tests? Is one test more important than another? If so, how should each be weighed relative to the others? Within a test, how should terms such as "performance" and "acceptance" be scaled? Further, is student performance computed on the basis of percentile scores on standardized tests administered at the completion of a course in which the chosen materials were used, on the basis of the stature achieved in adulthood by the student in the study area, or by some other measure? How can the contributions to student performance made by the selected materials be isolated from those deriving from other materials, or from the teacher's role, or from exposure to other students?

Clearly, one could continue to ask such questions, with each serving to reinforce the dilemma of determining the "correctness" of a decision. Yet in an ideal system, the answers to all such questions would be known and the meaning of "correctness" would be abundantly clear and universally accepted.

Operationally, the EPIE system can go a long way towards the isolation of those factors which appear to account for judgments as to the correctness of
decisions. More precisely, statistical techniques exist for explaining the variance in judgments as to the correctness of a decision or the utility of a material. However, the successful use of these techniques does not rest on the ability of EPIE to attract skilled statisticians who can perform meaningful analyses of variance. Rather it rests on the ability of educators to 1) identify the factors or variables which do in fact cause the judgments of one person to vary from another and which cause the performance of one student to vary from another, 2) define these variables in operational terms which are understood and accepted by all who must use them, 3) design techniques for measuring and scaling the variables which are easily applied, acceptable to those performing the measurement and scaling, and valid with respect to possessing the sensitivity essential to achieve the explanation of variance which is inherent in the variable being measured.

Months of work by leading educators in the fields of curriculum analysis and performance measurement have shown that the above capabilities do not exist today. Progress has only just begun to be achieved in the above activities. Without these capabilities, the skills of the statistician in performing analyses of variance, the results of which would be used to synthesize data in the preparation of information for use by EPIE users-decision makers, would be so much folly. Clearly, EPIE cannot gain by performing and encouraging the use of results deriving from statistically sophisticated analyses on qualitatively infantile data derived from the use of measurement techniques whose reliability and validity is not only unproven but untested.

To achieve the second ideal characteristic above -- instantaneous, unlimited access to information within EPIE -- several requirements would have to be met which either exceed the resources likely to be available in the near future or which cannot be achieved prior to the gaining of experience via actual operation of the system. Implicit in the ability of the system user to achieve
access to information whenever desired are the requirements discussed above
under the first ideal characteristic, plus the corollary characteristic of EPIE
possessing the pre-requisite resources for fulfilling user demands. Fundamental
to possessing such capability within EPIE is the possession of full knowledge of
the demands which will be imposed upon the EPIE system, sufficiently early to
permit the planning and acquisition of resources. Such knowledge would consist
of demand sources, frequency of inquiry, processing time requirements (workload),
user response time requirements, user location, user requirements for informa-
tion display, etc. At the very least, EPIE would have to know in advance how
many users it can expect, how many inquiries it will receive from each user,
when it will receive these inquiries, how long it has to process an inquiry be-
fore the user considers service to be non-instantaneous, how much work is creat-
ed by each inquiry, and so forth in order to intelligently investigate alternative methods of processing work and to plan and acquire the necessary personnel,
equipment, supplies, housing, forms, etc. which collectively will comprise its
resources.

Although survey techniques exist for forecasting demand and although
EPIE has gained some knowledge as to potential sources of demand by defining a
geographic pilot region, little can be done to forecast demand in the precise
terms required for ideal planning and resource acquisition, as no system such
as EPIE has been created which is sufficiently analogous to be useful in precision
planning. Thus, an operational EPIE must forego the capability of meeting all
potential demand instantaneously. Rather, it will sacrifice servicing a portion
of the demand it might receive, or not possess the capability of instantaneous,
on-demand service, or both.

Even if EPIE could forecast total demand in the terms required, this
would not be enough to achieve the ideal characteristics of instantaneous, un-
limited access to information. For to achieve such access to information which
will always lead to a correct decision, fully automated processing is prerequisite. The fulfillment of the first ideal characteristic will ultimately create a massive amount of information requiring repetitive processing in view of specific inquiries. A highly sophisticated information system of the type envisioned will require large amounts of data to achieve acceptable statistical significance in its analyses of variance. Further, it would not be feasible to perform analyses of variance on all possible combination of variables and material in advance so as to statistically pre-determine the potential appropriateness of a particular educational product in a particular environment. Rather, the ideal system will have to be designed to permit, when needed, the performance of such analyses. This will require the storage of large amounts of data in a form amenable to rapid search, retrieval, and manipulation, and the pre-programming of routines or rules for processing the data. Such tasks are ideally performed with the use of high-speed electronic computers, as they represent the most economical and reliable means for repetitive manipulation of large amounts of data in "random" or unpredictable combinations.

Another major reason for full automation is the characteristic of the ideal system permitting any user to achieve instantaneous access to information as needed. Under such conditions, the system must anticipate the presence of multiple inquiries which simultaneously require the use of one or several sets of data. Under a manual or partially automated system, this requirement could only be met by duplicating records of data in sufficient quantity to avoid the unacceptable delay of one user while another's inquiry is being processed. However, through the use of today's high speed, "time sharing" computer systems, the need to maintain duplicate sets of data for inquiry processing can be eliminated. Such systems permit many users to simultaneously share one set of data with the effective appearance of exclusive use.

However, the initial operational EPIE system cannot hope to include such
capability. For even if the "ultimate" data, analytical techniques, measurement techniques, etc. were available and ready, EPIE could not hope to have such a system operational by the Fall of 1967, as the computer programming requirements could not be met in the available time. Further, the acquisition of the necessary computer hardware, including communication devices for use in receiving, processing, and returning the results of system user inquiries could not be achieved in this time span. Also, the training of users in how to interface with such a system is a large task requiring the preparation of detailed instructional materials and considerable training time.

Thus, operational EPIE for a number of reasons cannot possess the characteristic of full (integrated) automation. However, this must be a major goal of the system if the other goals of sophisticated, reliable information synthesis (personalization) and as-need service to users (timeliness) are to be realized. The challenge to EPIE will be to transcend from a state permitting the servicing of inquiries over several days, weeks, or even months to a state wherein curriculum committees and others can utilize the EPIE system "live" as they perform the tasks of educational product evaluation and selection.

Finally, the ideal system characteristics of full resource utilization and zero cost cannot be met in an operational EPIE, no matter how sophisticated the system becomes. Yet these ideal characteristics should represent goals whose achievement is constantly being sought. Full utilization of existing resources should represent a guiding principle of never acquiring resources which are idle to a substantial degree. In particular, computers and staff should not be acquired until there is a reasonable probability that they will be utilized. Zero cost, in turn, should stand for the principle of cost minimization through effective organization, planning, scheduling, methods selection and supervision.
THE OPERATIONAL SYSTEM

Introduction and Goals

With the recognition that επειδή cannot achieve ideal status at the outset, yet can be of service to educational decision makers in the selection of materials if it becomes operational at a less than ideal level, the task at hand is to design a meaningful operational system in the face of the constraints which prohibit achieving the ideal. With the foregoing discussion in mind, the use of the term "operational system" is intended to represent a particular system which at once provides limited but usable information and service, which possesses the test of economic justification and survival, which recognizes in highly specific terms how it falls short of the ideal system, and which constantly strives to achieve the ideal through research, introspection, revision and sound management.

Unquestionably, there exist as many operational systems as there are individuals or groups to design such systems. With the recognition of the necessity of designing a less than ideal system, opportunity is created to design a number of systems which cannot be measured or justified in the precise terms of the ideal. Thus, it is difficult to evaluate the superiority of one "sub-optimal" design over another. As such, the operational system to be proposed in this paper is not intended to represent the one and only operational system, but rather a system which the designers feel will adequately conform to the definition above.

Perhaps the need for creating an operational system should be stressed. From the viewpoint of those members of the education profession who have seen in επειδή a means of vastly improving the decision making process of educational materials selection, an overriding need exists now to create an operational επειδή which will be justified as long as it provides the decision makers with better information than they now possess. To this extent, an annotated bib-
liography of all available materials in a particular curriculum area would represent an improvement.

However, if the system was comprised solely of the resources necessary to prepare and maintain an annotated bibliography, it would not meet the definition of an operational system as set forth, for it would not include the resources essential to carrying it closer to the goals of the ideal system.

Those who have supported EPIE are as much committed to an initial system which has the resources to continually evaluate and upgrade itself as it has resources to serve users on a current basis. To this extent, the initial system --called PILOT EPIE-- will be one part service and one part research. That part which is service will in some ways be less important initially than the part which is research, for it will be created within fairly severe constraints of limited time, money, and knowledge. In the process, it will sacrifice the achievement of many of the characteristics of the ideal system, for its overriding goal will be a pragmatic one of achieving some form of useful service within a short period of time.

Because, the orientation of the various consultants and advisors to EPIE varies with regard to discipline, experience, working environment, and interests, no uniform opinion exists as to what should or should not be included in PILOT EPIE from a service viewpoint. Some feel a strong need to provide initially information pertaining to the content of educational materials as well as their physical characteristics and the environments in which they have been used in the past. Others feel that concern over content will prohibit creating a PILOT EPIE in the near future which provides useful information. Still others see a major need to execute some semblance of statistical analysis in order to synthesize diverse information on a product, while others either intuitively believe variance is ultimately unexplainable by such techniques or that this element of activity is not essential to providing useful information in the early
stages of EPIE. However, as the consultants come to realize that PILOT EPIE is an experimental system designed to be of some service, but also designed such that mechanisms for evaluation exist which will permit intelligent retrospective analysis of the initial design and subsequent modification, they will readily see that the initial decisions of what will or will not be included in PILOT EPIE are acceptable regardless of whose bias is met. As long as the decisions taken lead to an on-going system, the valid interests of all concerned will eventually be incorporated.

GENERAL CHARACTERISTICS OF PILOT EPIE -- A SERVICE

Introduction

From the foregoing discussion plus an exposure over many months to the various individuals concerned with creating a PILOT EPIE, several major characteristics of the service aspect of PILOT EPIE emerge which appear to be fundamental to any initial system. These characteristics and some of the as-yet unsolved design issues subsumed in them will be presented here. It is these characteristics which form the basis of the detailed design proposed in a later section.

Standardized vs. Customized EPIE

First, PILOT EPIE must be capable of providing two classes of information. One must be "standardized" in the sense of being of interest and value to many users of the EPIE system. The other must be "customized" in the sense of being particularly relevant to a specific system user. Of necessity, the former type will be more general than the latter, for EPIE will not develop the standardized information to serve one particular sub-set of system users.

As a trivial but graphic example, standardized EPIE, in reporting on the physical characteristics of overhead projectors, would list projectors with switch panels on the right-hand side of the projector as well as those with
switches on the left. It would do so because 1) it must anticipate standardized system users who are both right-handed and left-handed, 2) it will not have received information from each standardized system user as to whether he is right-handed or left-handed, and 3) it will not have learned that each system user will only consider for purchase projectors with switch panels on one side or the other. In contrast, customized EPIE, in seeking to provide information on overhead projectors to a specific inquirer, can learn in the processing of the inquiry if the decision maker is interested in considering only those projectors with switch panels on one side or the other. Although EPIE's job is not to recommend right-handed or left-handed projectors, its job is to provide to the greatest extent possible highly personalized, useful information. As such, if an inquirer made it clear that he would not consider for purchase left-handed projectors, it would be pointless to provide him with names, specifications, performance reports, producer descriptions, laboratory evaluations, etc. of projectors with left-side switch panels. In other words, whereas standardized EPIE will provide information on a full set of products, customized EPIE will usually provide information on a sub-set of the full set.

Dialogue

For customized EPIE to provide such highly customized, exception-oriented information, it must of necessity know more about its users than must standardized EPIE. To gain this information, it will be necessary to engage in a dialogue with the users of customized EPIE in order to ascertain important variables to be considered in synthesizing information for feedback to the inquirer. However, no conclusive agreement has been reached on just what variables must be ascertained or what techniques should be used to do so. Some feel that highly structured, catch-all questionnaires and check lists should be used. The advocates of this technique place little confidence in the ability of the inquirer to define on his own volition those variables which are important to him and
feel as such he must be forcefully guided in his statements of relevant information. Others feel the inquirer should be permitted to state in his own terms and on his own volition the information (variables) of importance. The advocates of this technique fear that a highly structured information collection format has the inherent weaknesses of containing irrelevant questions and not insuring the retrieval of all relevant information. Still another "school" supports a combination or blending of these two techniques.

As to how these techniques should be invoked, some feel that written questionnaires and check lists can be made to be self-explanatory or accompanied by written instructions and thus sent and retrieved through the mail without direct, personal contact. Others feel some degree of direct contact is required to retrieve information from the inquirer and, therefore, advocate the use of telephones. Still others fear that certain important elements of the educational environment surrounding the inquirer will not be recorded if field visits (on-site) are not made in the process of gathering information, and thus advocate this approach. Still others advocate combinations of the above.

At this point, the complexity of designing even a simplified operational system becomes evident. It is precisely this type of "option scheme" which must be met face-to-face, with a decision being made and an evaluation plan developed. In a later section, this issue will receive further attention and recommendations will be offered. At this point, the item of importance is that in one or more ways, PILOT EPIE must possess the capability of retrieving detailed information from and about users of the customized service in order to provide customized information.

**Limited Instructional Materials**

Next, it is agreed that PILOT EPIE must begin with a limited number of instructional materials rather than provide information on all instructional materials. This agreement has of late been made more specific by the selection
of one **curriculum class** -- Elementary Science --, one **information transmission product class** -- overhead projectors --, and one **information storage product class** -- overhead projectuals -- for inclusion in PILOT EPIE. As to what information should be contained in EPIE with respect to these classes of materials, agreement has not been reached on specific items of interest. However, there appears to be, in general, concern with the **information content**, **application environment**, and **physical characteristics** of Elementary Science materials; with the **physical characteristics** and **application environment** of overhead projectors; and with the **physical characteristics** of **sets** of projectuals (e.g., a transparency **series** vs. an individual transparency in the series).

**Active vs. Passive Information**

Below this surface of agreement, however, is division as to the specific information about each material class which should be included. In each of the above areas, the consultants are working to define the variables of importance or inclusion. It is in general agreed that PILOT EPIE will initially permit a limited number of variables to be **actively** used in the performance of information synthesis, while others will play a more "passive" role in that they will be utilized for data collection and research, but not for information synthesis. It is also agreed that the system should in some sense permit the user to declare those variables which are active and to weigh variables relative to each other in terms of importance. Since, however, the information search and synthesis heuristics are not defined at this point in time, it is not yet clear that a strong need exists to actually utilize knowledge of user variable preferences and weights.

**Information Sources**

It is further agreed that information in PILOT EPIE should be a compendium of knowledge obtained from three key sources -- producers, past users, and independent analysts or researchers. Inherent in this approach is the goal of
providing the inquirer with information developed by people of different perspectives, capabilities, motivations, and experiences. Further, there exists the belief that EPIE must not appear to represent a biased source of information, which it would if it appeared to favor one or two of these three legitimate sources of information. However, efforts to date have not produced knowledge as to the mix of information from these resources which is available today. That is, although the goal of balance exists, determination of the requirements to develop reports by these three suppliers of information in view of existing documentation and its usefulness has not been carried out.

Limitation of System Usage

Just as it is agreed that the information in the system initially will be limited to specific classes of materials, so, too, is it agreed that the use of the customized portion of EPIE will be limited at the outset. Steps to define this limited use taken so far have been 1) the decision to restrict inquirers to participating (paid) members who directly exercise or influence the decision-making process of evaluating and selecting materials, (excludes producers) and 2) the decision to restrict inquirers to individuals or groups meeting the above criterion whose school systems are within the geographic boundaries identified by those of the ERIE and RBS regional educational laboratories (Delaware, New Jersey, New York, Pennsylvania).

However, the planning of resources to service users cannot be effectively made without more explicit knowledge as to the demand on the system. Within the bounds of the user set currently defined, more explicit definition will have to be reached which seeks to protect the economic solvency of EPIE and the desire of school systems within the four states to utilize customized EPIE. In particular, plans must be based upon projected numbers and locations of users, user types, frequency of inquiry per user, response time requirements, service time requirements, etc.
Once these projections are made and resources acquired in proportion, the resources will represent limitations on the ability of PILOT EPIE to service customized demand in the short run, for the nature of the resources (e.g. - personnel, equipment) will limit the ability of EPIE to respond to unanticipated demand volumes in the short run. No such constraint will exist for standardized EPIE, for varying demand (within reasonable limits) can be met by varying the number of copies printed of the publications which will represent standardized EPIE.

Other Material Limiting Mechanisms

Other mechanisms for limiting the scope of customized EPIE have been identified. Within the curriculum area of Elementary Science, material included will be limited to products produced by major publishers and manufacturers with reasonably wide distribution channels. In particular, highly specialized publications of limited distribution but of a pedagogical nature will not be included initially. Further, pedagogical material created by private individuals rather than publishers (e.g. - teachers, curriculum committees) and non-pedagogical material useful for that purpose (e.g. - magazine articles) will not be included. This decision has been reached in the face of the non-existence of any efficient mechanism for retrieving and updating information on instructional materials other than those which are widely known, widely available, and created for pedagogical purposes. At the outset, customized EPIE will rely heavily on such sources as the McGraw-Hill Producers Input Guide for identifying the existence of educational products within the selected areas.

Limitations on Product Information

Another constraint to be created is the establishment of policies which limit customized EPIE's ability or willingness to provide information on products within the selected areas. Several such policies have been formulated at a general level and are presented here.

-14-
Minimum Information Unit

First, the smallest product information unit within customized EPIE will be a purchaseable item. For example, if the materials within a series can only be purchased by buying the entire series, product information will be retrieved for the series as a whole rather than for selected components. This is not meant to imply that information about various components of the series will not be available from producer's profiles, user reports, etc., but rather that the information retrieval system will be geared towards retrieving all information on a purchaseable product provided by a particular source rather than only a portion of the information provided by that source. Further, the providers of information will be expected to relate their evaluations and reports to the total purchaseable item.

Minimum Number of Reports

Second, customized EPIE will establish "lower thresholds" on the number of reports from a particular source type on a particular product which must be available before synthesized information on the product will be provided, information which draws from reports submitted by the given source type. For example, synthesized information which draws upon reports submitted by past users of a particular product will not be used unless a specified minimum number of reports on the product have been received from past users. This policy is particularly necessary given customized EPIE's limited initial ability to carry out statistical analyses of comparative information in which the effects or limitations of sample size would "automatically" be accounted for.

Nor will this policy restrict EPIE from providing information on products for which a sufficient number of reports exist from one or more source types. For example, if the lower threshold on reports from information analysis specialists (i.e. - logical analysts) has been met, but that for past users' reports has not, the information from the analysts would be used in processing
the inquiry, but that from the past users would not. As a sufficient number of additional past user reports are acquired to overcome the lower threshold, the total supply of past user reports would be "activated" for inquiry processing. In this way, the inquirer is protected from receiving synthesized information which is unsupported by a reasonable amount of detailed information, while at the same time EPIE is not restricted from processing inquiries until sufficient information is available from all three of the major source types.

Minimum Potential Expenditure

Third, customized EPIE will seek to achieve economical utilization of its limited initial resources by requiring a minimum potential expenditure to be associated with an inquiry before the inquiry will be processed. This will be achieved by establishing a formula which takes into account the unit cost of the product (or a "typical" unit cost in the case of multiple items within a product type), the quantity being considered for purchase, and the source of the inquiry (e.g. - a county school district vs. an individual school). The latter factor is intended to represent the probable extent to which the purchase would utilize the total educational products budget of the education unit represented by the inquirer. The formula will be created with the goal of avoiding the use of EPIE's initial resources in processing inquiries which represent a very small percentage of the products budget under the control or influence of the inquirer. Thus, whereas a teacher may be permitted to submit an inquiry relating to a potential expenditure of $25, a superintendent of a county school district may have the same inquiry rejected. This policy is analogous to advising a large business not to hire a management consultant in order to save $100 by solving an operating problem. However, it also recognizes that there are different sizes of businesses, and that saving $100 may be extremely worthwhile for some of the smaller ones. Since there will always be a cost associated with the use of customized EPIE's time and resources, and since the time and resources required

-16-
to process an inquiry will not be directly proportional to the amount of potential product expenditure underlying the inquiry, this policy is necessary for the maintenance of a reasonable charging structure.

**General Information Content Retrieval**

Fourth, customized EPIE will initially operate under a policy of general rather than highly specific retrieval on the information content of a product. For example, a general science text may contain a chapter which discusses the science of meteorology. Within the chapter, alternative methods of forecasting the weather may be presented, with one such method being probabilistic forecasting. Customized EPIE will not index the contents at the "alternative forecasting methods" level, but rather at the "meteorology" level. As in an earlier example, this doesn't mean that one or more reports from past users of the text may not have commented on or evaluated the treatment of probabilistic weather forecasting. What is implied is that the normal search and retrieval methods of customized EPIE will not permit selective searching for science texts dealing with probabilistic weather forecasting.

Rather, the normal procedures may lead to the retrieval of the names of a number of texts which discuss the science of meteorology. A policy will then have to be established to determine whether at that point additional EPIE staff time is expended to "hand search" (i.e. - scan) the selected texts to determine if one or more discuss probabilistic weather forecasting or whether this task should be left to the inquirer. To date, no such policy has been formulated.

Since past user reports will be available on the selected texts, the possibility still exists that a review of these reports will produce information on a particular text's treatment of probabilistic weather forecasting, if the evaluator chose to highlight that portion of the content. At this point, however, such detailed information retrieval becomes coincidental rather than planned.
If additional EPIE staff time is expended on "hand searching", the policy will also have to determine whether additional user charges are to be assessed, either in the form of monetary charges or time charges to be applied against the users "account balance" of available time.

The establishment of such policies are design details which will require further development by those responsible for implementing PILOT EPIE. At this point, the concepts behind the policies are presented to indicate the level where design decisions have been made and those where they have not.

Flexible Information Retrieval

Another policy decision which has been reached is the decision to design a highly flexible information retrieval system. The system must be flexible in the sense that it must be capable of efficiently handling via normal retrieval procedures diverse inquiries of significant frequency. For example, EPIE anticipates receiving frequent inquiries on the use of Elementary Science kits, without reference to specific ones. It must, therefore, have a retrieval system which permits the consideration of all kits, in the sense that the search and selection process must begin with the "universe" of information on available kits within the EPIE system. Conversely, EPIE also anticipates the receipt of inquiries relating to a specific type of kit (e.g. - a botany kit), or even a particular manufacturer's kit. As such, it must also be able to cull from the information file only that information which pertains to the particular "subset" of the kit "universe" of interest.

Further, just as EPIE must be able to "slice the information pie" by product, so, too, it must be able to do so by curriculum and by information source (i.e. - producers, past users, researchers). To achieve this flexibility -- regardless of the use of automated equipment -- will require the careful design of indexing procedures and coding schemes which would challenge the
imagination of even the most experienced designers of information retrieval systems. The detailed design of indexing producers and coding schemes is outside the scope of the present design activity and will require substantial and continuing effort. However, some guidelines for the designers will be recommended in the next section.

No Product Samples

The second policy is the decision not to provide users with "hard copies" of products in which they are interested or which are represented in an inquiry response. It is felt that many problems would arise if such service were attempted, not the least of which is the high cost to EPINE of procuring samples of the thousands of products included in the system. (As an independent, unbiased information service, EPINE would threaten the credibility of its position if it were to acquire product samples by any method other than purchase).

Adaptive Information Retrieval

In addition to designing an information retrieval or indexing system which is flexible in the sense described above, the system must also be *adaptive* in two ways. First, recalling the earlier discussion of active vs. passive information, an efficient system will employ different techniques for classifying and handling these two types of information. Information considered passive will be encoded in limited ways, whereas active information will be highly encoded. Also, normal search procedures of active information may entail some use of electronic data handling equipment, such as sorters and collators, and manually operated coordinate indexing systems (e.g. - Peek-A-Boo system), whereas passive information search procedures may be constrained by standard classification indexing systems designed to organize written material stored in filing cabinets.

The design, however, must be prepared to respond to experience in using
the system, which may lead to the recognition that information which was initially active or thought to be so has become passive, and vice versa. As this occurs, mechanisms must exist for altering the way in which a particular set of information is treated with respect to coding, location, and applicable search procedures.

Second, the system must also be adaptive in the sense that information can be added to or deleted from the system without necessitating the revision of indexing procedures, the redesign of coding formats, the refiling of information, etc. In those instances where standard classification systems are used such as sequential coding (i.e. - information coded and then filed in numeric or alphabetic order), the adaptability design criteria will require projections to be made as to the amount of space, number of columns, number of unassigned positions, etc. which must be planned for in order to permit growth without redesign or reassembly.

Alternatively, coordinate indexing systems usually permit a greater degree of growth allowance without redesign than do standard classification systems, and with less need for attention to planning growth allowances. Usually inherent in one card of a Peek-A-Boo system are many unused or unassigned locations which represent a growth allowance. Further, as one desires to expand the depth of indexing information (e.g. - incorporating into the retrieval system the "probabilistic weather forecasting" level), this can be easily done in a coordinate indexing system by adding more Peek-A-Boo cards to the existing deck, whereas such expansion under a standard classification system may require the redesign and refabrication of a substantial portion of the information retrieval system. For example, if the standard classification system is superimposed upon a punched card operation, all cards will have to be repunched if sufficient unused columns do not exist to permit the lengthening of a code number.
Alternatively, if it becomes desirable to delete certain information from the system, a standard classification system may require revision if failure to do so leads to excessive unused positions, columns, file space, etc., or excessive manipulation of "dead" information. A coordinate indexing system can be designed so that the procedures for using it automatically exclude from manipulation or consideration "dead" information. Since, however, advantages of higher processing speed and error checking may be inherent in certain standard classification systems, the initial design may be a blend of the two main forms of information organization to achieve the advantages of each.

**Major Information Flow Channels**

In previous sections, sources of information and types of reports for customized EPIE have been discussed in various contexts and examples. At this point, it is desirable to state in a compact and simple manner the agreements which have been reached as to the sources of information and how it will flow. The relationships between information sources and flow are represented in the following flow diagram of inputs and outputs:
SIMPLIFIED FLOW DIAGRAM -- CUSTOMIZED EPIE

EDUCATIONAL PRODUCT
CREATORS
(Industry)

Publishers

Manufacturers

EDUCATIONAL PRODUCTS
INFORMATION
EXCHANGE
(Customized)

Independent Information Evaluators

Independent Hardware Evaluators

Product User Evaluators (Schools)

EDUCATIONAL PRODUCT EVALUATORS

SELECTORS
(School Decision Makers)

Teachers

Administrators

Curriculum Committees

Users Having Made Selection Without EPIE Information

Users Having Made Selection With EPIE Information

Code:
1 - Intended Product Utility
2 - Product Specifications
3 - Analysis of Information (Logical Analysis)
4 - Analysis of Physical Specifications (Lab Technicians)
5 - Product Information Inquiry
6 - Response to Product Information Inquiry
7 - Product Application Evaluation (Performance)
8 - Product Application Evaluation (Synopsis)
The total information flow between members of the system is not represented in this diagram, as certain informal direct communication lines will probably exist (e.g. - industry - schools). Rather, the diagram represents the major or formal communication links which EPIE considers essential to the performance of its function.

The diagram also does not convey all feedback and self-evaluation processes which will hopefully ensue. In particular, EPIE will seek feedback from users of the system as to their satisfaction with its services, the extent to which it has contributed to improved product selection, and its needs for modification and improvement.

Finally, the diagram does not convey the process of iterative dialogue which is likely to ensue between EPIE and its users in the processing of inquiries. As EPIE finds that initial dialogues do not produce sufficient information to permit useful synthesis of the product information it maintains, or as inquirers find that initial EPIE responses to inquiries do not provide sufficiently precise and useful information to make decisions, additional dialogue will hopefully ensue. Particularly at the outset of PILOT EPIE, such iterative dialogue should be dominant. Over time, however, as EPIE improves its knowledge of information which it must obtain from inquirers to perform meaningful retrieval and synthesis, its techniques for soliciting such information, its statistical analysis capabilities, and its information base, and as system users learn how to precisely state inquiries and collect information using uniform techniques, the need for such repetitive dialogue should diminish.

Growth Characteristics of PILOT EPIE

Since PILOT EPIE is intended as an initial operating and not an ideal system, its designers must be concerned with defining specific ways in which it
can and should grow. Concern over this issue has been indirectly conveyed in
the previous discussion of the need for an adaptive information retrieval system.

**Continuous Evolution**

The most important growth policy to be stated is the concept of *continuous evolution*. The goal of the current system designers is not the creation
of a pilot system which will operate intact for a pre-specified time period,
finally to be replaced by a "new model". Rather, it is to create a system which
will include the resources, adaptability, and flexibility necessary to generate
improvement and expansion on a continual basis.

To some extent, however, time is bound to become a dominant factor in
regulating the evolution of EPIE. To maintain the interest of school and indus-
try, one would expect that EPIE must be committed to evidencing growth at least
once yearly. In the fall of each year, as schools begin to consider educational
product needs for the following academic year, hopefully those who have used
EPIE the previous year can continue to do so in new curriculum-product areas.
Those who have not been able to use EPIE in previous years will also, hopefully,
seek service in current curriculum-product areas.

Further, the processes of feedback from schools and self-evaluation which
EPIE plans to carry out, although continuous, will in part be time-regulated.
There is an inherent lag time between an EPIE-influenced decision and an evalu-
ation of the decisions, its effect upon the educational process, and the product
chosen. Typically, a decision reached in the winter of one year to implement
a product does not come "full cycle" until the summer of the following year,
creating a time lag of approximately fifteen months. Product Application
Evaluations from users of EPIE cannot, therefore, be used to update the inform-
ation files and retrieval procedures until fifteen months subsequent to a
product selection decision. PILOT EPIE will become at least partially time-
dependent by necessity as well as by design.
Modular Growth

Within the growth concept of continuous evolution is that of modular growth. For although EPIE must evolve continuously, it must also seek some structure to its evolution. The concept of modularity is that EPIE should expand by defining new major classes of products along product type and curriculum lines as growth units. Just as EPIE has decided to begin with the modules of Elementary Science and overhead projectors-projectuals, in the future it must select for development new product modules such as Social Science and closed circuit television—video tapes.

The primary reasons for this approach are two-fold. First, from the viewpoint of EPIE and its developers, any approach other than the selection of an educational product area in its entirety would be both chaotic to manage and of disservice to system users. Second, from the viewpoint of the users of EPIE and its information sources, an approach which dealt with only a segment of a product area could create an image of EPIE being a system with inherent bias and thus threaten its credibility and survival.

Professional Association Relationships

Thus, EPIE seeks to develop information "packages". It is doing so by establishing formal relationships with professional education associations which are particularly concerned with a product module and willing to provide guidance in its development. The relationships it has established with the National Science Teachers Association (NSTA) for the Elementary Science module, and with the Division of Audio-Visual Instruction (DAVI) of the National Education Association (NEA) for the overhead projector-projectuals module are considered instrumental in the full, objective, and competent development of the modules and in the preservation of EPIE's image as an organization dedicated to the fair representation of all interests. As EPIE seeks to develop new modules in the future, it will concurrently seek the establishment of formal
relationships with appropriate professional associations.

Qualitative Growth

Throughout this section on PILOT EPIE operational system characteristics, it has hopefully become evident that EPIE will also attempt to grow along qualitative as well as quantitative lines. Particularly within the areas of automation, depth of information indexing, statistical analysis, and information retrieval techniques, EPIE will continuously seek to improve itself and its service within existing product modules.

User Boundary Expansion

Finally, it is the goal of EPIE to expand the boundaries of its user "universe" by increasing its resources such that school users within the current geographic boundaries and without can utilize customized EPIE either for the first time or more frequently. EPIE also seeks the day when it has sufficient resources to permit individuals or groups other than school personnel, such as publishers and manufacturers, to submit inquiries.

DETAILED DESIGN SPECIFICATIONS - CUSTOMIZED PILOT EPIE

Introduction

The preceding section describes in general, qualitative terms of the major characteristics of PILOT EPIE. It also represents an attempt to define the policies and philosophy of PILOT EPIE, as well as some of the issues which are presently unresolved. In this section, the goal is the presentation of a recommended detailed design for the customized portion of PILOT EPIE. Attention is not given to standardized EPIE, as it has already been described in sufficient detail for the purposes of this report. Others have been working on the development of The EPIE Forum, which will be the major communication mechanism of standardized EPIE, and are in the best position to describe its policies, content, distribution frequency, scope of service, etc.
By way of qualification, the designers of customized EPIE wish to acknowledge that the term "detailed design" is used to designate a design description which is more detailed and quantitative than the description of characteristics of the previous section, but by no means of the detail required in all areas to achieve actual implementation of the system. In a number of design areas, details will have to be developed through intensive study and evaluation even before customized PILOT EPIE becomes operational. The purpose of this section is, rather, to give evidence to those who will be asked to lend additional financial support to the design and development of PILOT EPIE that progress is continuously being achieved in developing and refining EPIE's design. As such, this section will explore in more detail those characteristics previously described which are rationally and necessarily subject to expansion at this time.

Product Selection

To initiate customized PILOT EPIE, (hereafter referred to in this section as EPIE) an extensive array of information must be collected, processed, and integrated with the retrieval system which EPIE will use to process inquiries. As indicated earlier, two major product modules have been chosen as the basis for EPIE.

The first of these, Elementary Science, represents a curriculum area approach. That is, EPIE will develop the ability to simultaneously consider a multitude of product types within the curriculum area of Elementary Science. This will include both information storage and information transmission products. With this approach, EPIE will be able to assist inquirers who are as yet undecided as to the particular product type they wish to use in an Elementary Science course, or who are potentially interested in acquiring a mix of product types for inclusion in the curriculum.

The decision to choose Elementary Science as the first curriculum area is
based upon a number of factors. As pointed out in an internal report on an IED-initiated survey of product information needs among a sample of 109 school districts,

"Reading, although topping the list in curriculum areas, was not chosen due to its scope and complexities, the advisability of waiting until EPIE can cover the field more completely, and [until EPIE can] incorporate . . . the results of current research projects. The decision to concentrate first efforts on Elementary Science was urged by teacher associations and other professional groups, and justified by the questionnaire responses placing this subject area second in importance [after reading] to schools."

Further, a majority of the consultants to EPIE have expressed a strong interest in the choice of Elementary Science, particularly from the viewpoints of need, manageability, and availability of information.

Within the general category of Elementary Science, more precise definition of what is to be included is recommended as follows:

1. Include information on only those products which in the viewpoint of EPIE management qualify as products produced by major publishers or manufacturers. "Major" should be defined by the achievement of $1.0 million or more annually in educational products sales revenue. Exceptions for unusually innovative or educationally-worthy products produced by publishers or manufacturers of less than $1.0 million in annual sales revenues should be permitted upon recommendation by a Product Advisory Committee composed of selected members of the National Science Teachers Association.

2. Include only those products which are intended for use by "normal" kindergarten through sixth grade students at least 75% of the time. Products designed primarily for use by special student groups (e.g., the handicapped) should not be included. Definition of "normal", qualification of products, and resolution of conflicts should be carried out via consultation of the Product Advisory Committee of NSTA.
3. Include initially only those products which in the opinion of EPIE management (upon advice from consultants on the Product Advisory Committee of NSTA if necessary) are logically included in one of the following product type categories:
   a. Laboratory equipment
   b. Programmed texts
   c. Supplementary kits
   d. Individual kits
   e. Diagnostic tests
   f. Regular texts
   g. Group kits

   After the initiation of PILOT EPIE, expand the Elementary Science product type categories for the second year to include remedial kits, end-of-course tests, and survey tests.

4. Include only products which are readily available to initial users of EPIE and which might reasonably be expected to be readily available on a nation-wide basis at the commencement of the second year of operation (Fall, 1968). "Availability" includes for purchase and for examination by users of EPIE and should be further defined by EPIE management and the Product Advisory Committee of NSTA.

5. Within the above guidelines, limit the number of products to be initially included in the Elementary Science category to 500 distinct purchaseable items, being careful to avoid an imbalance in products along publisher or manufacturer lines. If more than 500 products exist which meet tests 1-4, assign priorities upon recommendation of the Product Advisory Committee of NSTA.

The second product module to be developed is that of overhead projectors and overhead projector materials (projectuals). This module was selected for
reasons similar to the selection of Elementary Science, with particular reliance placed on the recommendations of the Division of Audio-Visual Instruction of NEA (DAVI). Representatives of this group have already carried out extensive work in defining the important physical characteristics for inclusion in EPIE.

Recommendations for defining and controlling products within this category are as follows:

1. Include information on only those products which in the viewpoint of EPIE management qualify as products produced by major publishers and manufacturers. "Major" should be defined by the achievement of $0.5 million or more annually in product sales revenues of overhead projectors, and $0.25 million for overhead projectuals. Exceptions should be permitted as for Elementary Science, upon recommendation of the Product Advisory Committee of DAVI.

2. Include only those projectuals which are intended for use by "normal" elementary and secondary students (grades kindergarten through twelve) at least 75% of the time. Projectuals designed primarily for use by special student groups should not be included. The Product Advisory Committee of DAVI should function as described under recommendation #2 above for Elementary Science and the PAC of NSTA.

3. Include only those products which are by definition a purchaseable set of overhead projectuals. Single projectuals should be excluded. Definition of "set" should be developed by consultation with the PAC of DAVI.

4. Include only products which are readily available to initial users of EPIE and which might reasonably be expected to be readily available on a nation-wide basis at the commencement of the second year of operation. "Availability" includes for purchase and for examination
by users of EPIE and should be further defined by EPIE management and the PAC of DAVI.

5. Within the above guidelines, limit the number of products to initially be included in the overhead projector category to 50 purchaseable overhead projectors, and in the projectual category to 100 projectual sets. Avoid an imbalance in products along publisher or manufacturer lines. If more products exist within each category which meet tests 1-4, assign priorities upon recommendation of the PAC of DAVI. (Note: Information on accessory items for overhead projectors should not be included in customized EPIE, but may be in standardized EPIE.)

In addition to the above specifications, those presented in the section on general system characteristics apply. Also, it is recommended that products not be included unless they will be available for use during the academic year following that in which they are incorporated into EPIE (e.g. - products chosen for use in processing inquiries received during the 1967-68 school year must be available for use during the 1968-69 school year). Further, products taken off the market should be purged from the system immediately. Finally, it is recommended that information storage products (e.g. - texts) currently available but more than five years old require annual approval by the PAC of NSTA for continued inclusion.

Evaluator Selection and Requirements

As discussed earlier, three major sources of product evaluation information have been chosen -- producers, users, and researchers. It was also stated that a minimum number of evaluations must be available from each type of evaluator for each product in order to activate that class of information for possible retrieval.

In the case of producers, the producer of each product will be expected
to complete a profile of the product if he wishes to relate information other than that which can be objectively determined by EPICE staff (e.g. - his evaluation of the teaching style most appropriate for use of all the material).

In the case of product users, the selection becomes dependent upon such factors as product type, quantity and nature of variance-explanation variables, degree and sophistication of variance analysis, willingness of past users to provide evaluations, nature of the past use, etc. As such, intensive effort will have to be devoted over the next few months to the development of selection rules, in close cooperation with User Selection Advisory Committees of NSTA and DAVI.

However, several guidelines are offered at this point which should expedite the realization of an operational system:

1. In the case of all Elementary Science products and overhead projectals, include
   a. Evaluations by teachers who have used the product in a classroom setting
   b. Students who have used the product or been exposed to it in a formal course
   c. Curriculum design committees which have evaluated the product and selected it or recommended its selection. Evaluations of the product itself by school principals and school system administrators who have not been active in the selection of the product should not be included. However, these people will be asked to provide information about the product evaluators who fall under their supervision.

2. In the case of Elementary Science laboratory equipment, include evaluations by school personnel who have been responsible for maintaining and repairing the equipment.
3. In the case of overhead projectors, include evaluations by
   a. Audio-visual personnel who have selected, operated, and main-
      tained the projectors
   b. Teachers who have used the projectors as a teaching aid in a
      classroom setting

   The role of principals and administrators is the same as above.

4. For each product in the information system, establish a minimum re-
   quirement of 50 reports per user-evaluator category (e.g. -
   teacher, student). Further, establish an upper bound for the initial
   system of 100 reports per major user-evaluator category.

5. Develop user-evaluator selection criteria to be applied by members
   of the User Selection Advisory Committees of NSTA and DAVI in the
   approval of user-evaluators. Such factors as geographic distribu-
   tion, age distribution, experience distribution, etc. should be the
   basis for developing criteria.

In the selection of researchers to provide information, the following
recommendations are offered:

1. For Elementary Science products primarily of an information storage
   nature (i.e. - texts, kits, & tests) require 3 analyses of informa-
   tion content by logical analysts per product for active use in inform-
   mation retrieval.

2. For Elementary Science kits and laboratory equipment, and for over-
   head projectors, require for each product one analysis of physical
   characteristics, to be performed by researcher-technicians in a
   "laboratory" setting, in order to qualify for active use in informa-
   tion retrieval. Require approval of the research-technician reports
   by the Product Information Advisory Committees of NSTA and DAVI. The
   analyses of physical characteristics may be in absolute terms
(e.g. - actual lumens), but should always be in terms relative to application environments (e.g. - light intensity limits use to screen-to-projector-distances of thirty feet or less).

3. For overhead projectual sets, require for each product one analysis of physical characteristics unrelated to application environment (i.e. - evaluate only those characteristics which clearly can be measured in absolute or universal terms). The analyses are to be performed by researcher-technicians in a "laboratory" setting. Require approval of the researcher-technician reports by the Product Information Advisory Committee of DAVI.

4. Establish in cooperation with the User Selection Advisory Committee of NSTA and DAVI policies and guidelines for the recruitment and selection of researchers. Secure the assistance of the USAC of NSTA and DAVI in recruiting, screening, and selecting researchers.

Information Collection Techniques

In the section on general operating system characteristics, reference was made to alternative techniques for collecting information from inquirers of the EPIE system. The alternative techniques to be considered and the alternative mechanisms for invoking them can be represented by the following matrix:
Since PILOT EP1E is as much a research function as it is a service function, it is desirable for all of the possible combinations to be tested eventually and evaluated on a comparative basis. However, practical limitations of time and money suggests that priorities be established as to which combinations are tested first, and that certain combinations receive more initial emphasis.
than others. It is, therefore, recommended that in operating EPIE, during the first year of service, the following combinations be utilized in the specified proportion:

<table>
<thead>
<tr>
<th>Implementation Mechanism</th>
<th>Collection Technique</th>
<th>% of Inquiries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written</td>
<td>Highly Structured and Prose</td>
<td>60%</td>
</tr>
<tr>
<td>Written &amp; Telephone</td>
<td>Highly Structured and Prose</td>
<td>25%</td>
</tr>
<tr>
<td>Telephone</td>
<td>Highly Structured and Prose</td>
<td>15%</td>
</tr>
</tbody>
</table>

As to techniques for collecting information from evaluators of materials, it is recommended that written reports be the implementation mechanism and that highly structured check lists and questionnaires combined with prose statements be the collection technique.

**Nature and Scope of Input by Evaluators**

The information to be provided by product producers, past users, and researchers falls into the following categories by source:

**Producers**
- General Descriptive Information (Factual)
- Recommended Usage Information
- History of Development

**Past Users**
- Recommended Usage Information (Evaluations)
- Description of Evaluator Information

**Researchers**
- Recommended Usage Information (Evaluation)
- Testing Information (Physical Characteristics Evaluation)
- Description of Evaluator Information

Within each of these categories, a number of consultants to EPIE have been devoting considerable attention to defining the specific information which should
be collected. Because this activity is still in process, this paper will not recommend specific information to be collected. Rather, it will recommend guidelines to be followed which have been generally agreed upon by the EPIE consultants, plus some "upper bounds" on the scope of information to be included in the product selection information system.

An important distinction to be made at this point is the difference between product selection information and non-product selection information. Product selection information is that which will be available for use in deriving a selected list of products to be reported on in response to inquiries. Once a selected number of products have been chosen for reporting, the non-product selection information on those products will be used for abstracting or direct reporting to the inquirer. Often, the non-product selection information will represent a deeper dimension of a particular class of product selection information. For example, whereas the product selection information may include author's name, the non-product selection information may include information on the author's background, his affiliations, etc. Non-product selection information will also include information which the designers of EPIE feel is not likely to be required or logically used to develop a list of products most likely to be of interest and value to inquirers out of the "universe" of all possible products. For example, whether or not the author of a text received financial support for writing the text would not be expected to be important in developing a selected list of products. However, the tendency in the initial design will be towards maximum flexibility of selection, so that most information will be stored so as to permit ease of manipulation in product selection. The distinction is important, though, in that different information storage and retrieval techniques (e.g. - equipment, coding, storage media) will be used for product selection and non-product selection information, with the goal of simplifying the work associated with determining those products most likely to be of interest and value to an inquirer.
Within the product module of Elementary Science, product selection information should fall within the categories below. Next to each category is a number representing the number of sub-categories for which the product selection information system should be designed. For example, if Peek-A-Boo Cards are used, the number represents the number of Peek-A-Boo Cards to be used to record information within the stated category from a particular information source type (e.g. - producer). Since more than one source type will provide information in some of the categories below, the numbers do not represent the total number of Peek-A-Boo Cards required. The numbers given should be taken as upper bounds on the number of searchable sub-categories. Those information categories which are currently not considered to be essential to the product selection information system are not included here.

A. General Descriptive Information

1. Producer and distributor information (150)
2. Cost information (20)
3. Publication data (10)
4. Physical specifications (25)
5. Product type information (10)
6. Relation to curricular "series" (20)
7. Availability information (4)
8. Supplementary material or accessory information (15)

B. Recommended Usage Information

1. Curricular context information (40)
2. Teacher information (50)
3. Student information (100)
4. Instructional setting information (70)
5. Subject area information (50)

The number of sub-categories recommended above were developed by reviewing the
work of the EPIE consultants to date in the definition of information categories of relevance to the product evaluation and selection process. Based upon initial consideration of the need to duplicate the above information categories for producer, past user, and researcher-supplied information, plus how the product selection information system may function, it is estimated that 4000-5000 Peek-A-Boo Cards would be required to store all Elementary Science product selection information in efficiently retrievable form.

As to the product modules of overhead projectors and projectuals, the scope of information will be far less in that physical characteristics and application environment are the relevant information categories, and that the depth to which these categories will be developed will be far less than for the Elementary Science module. Consequently, the need for additional definition of information storage units (e.g. - Peek-A-Boo Cards) is not required, as the same units can be used for these modules if that approach is considered efficient. More indepth study of work organization will have to be conducted to determine if physical separation of information related to overhead projectors and projectuals is necessary for product selection.

As to non-product selection information, attention has not been devoted as yet to a careful analysis of the number of information units required. This is not a key factor in evaluating the information storage mechanisms appropriate or the resources required to store and retrieve this information. It is currently believed that this back-up information will be filed by product in standard filing cabinets, with the need for additional classification to be determined during further detailed design. The biggest design effort to be expended on non-product selection information is in the summarization and presentation of this information for reporting to inquirers.
Nature and Scope of Information By Inquirers

The information to be retrieved from inquirers will conform to that provided by evaluators. Just as producers will provide information about the cost of products, the inquirer will be expected to state how much he is willing to spend if he has a limited budget and if it would be of little value to report in detail on products he cannot afford. Likewise, the sources of the product selection process will be dependent upon his ability to state his requirements, preferences, and application conditions in terms conforming to those in which products have been evaluated. The extent to which he does this will influence EPIDE's ability to provide synthesized information on products likely to be found of value. It is recognized that all inquirers will not respond with equal scope and attention to EPIDE's requests for information. Thus, it is recommended that the following guidelines be applied initially in the determination of whether sufficient information has been obtained from inquirers:

1. If a "pass" of the product selection information using the information provided by the inquirer fails to yield at least 5 products for reporting or 10% of the total products potentially reportable, which ever is smaller, require the inquirer to assign priorities on the information he has provided. Beginning with the lowest priority information, remove information from consideration in additional passes until the above requirement is met. Once the requirement is met, determine how the "values" of the detailed information for the selected products differs from the "values" initially specified and report the differences to the inquirer. The total products potentially reportable is the sum of the products in the EPIDE system within the product type(s) if specified by the user, or the sum of all products within EPIDE and the appropriate product module if unspecified.
2. If a pass of the product selection information using the information provided by the inquirer fails to yield 25% or fewer of the total products potentially available for further analysis and reporting, require the inquirer to submit additional information if he has not completely responded to EPIE's request for information, or if he has responded in terms uninterpretable by EPIE. Invoke this requirement until such time as the above requirement is met, or until EPIE feels all information has been provided, or until the inquirer declares himself unable or unwilling to provide additional information. If all information has been provided or if the above requirement has been met, proceed normally. Otherwise, response to the inquiry should be limited to reporting the descriptive (factual) information on the products selected with the available information, with no evaluative information to be provided.

**Demand Servicing Constraints and Staffing**

In an earlier section, reference was made to the need for accurately forecasting the demand upon customized EPIE in order to plan for and acquire sufficient resources for processing inquiries. Also mentioned was the extent to which the demand has been defined (forecasted) so far. The selection of resources based upon demand forecasting is dependent upon the following factors:

1. Number of inquiries
2. Frequency (spacing) of inquiries
3. Inquiry service time
4. Inquiry response time requirement
5. Inquiry acceptability incidence

Little basis exists at this time for accurately forecasting the values of the above demand factors and their effects upon resources. Even an in-depth survey of potential system users would not be particularly helpful at this time because
of the uniqueness of EPIE and the low probability of potential users being able to describe their usage.

The alternative, therefore, is to define EPIE's resources by estimating what may be reasonable values for the demand factors. Clearly this process could become extremely complex if in-depth consideration is to be devoted to predicting such values as the distribution of service times based upon analysis of inquiry acceptability incidence; inquiry source, type, and product module relation distribution; need for repetitive dialogue, etc. In the belief that such analysis would be an academic exercise of little value and accuracy at this time, the analysis has been limited to producing the following specifications for computing initial (first year) resource requirements.

1. Inquiries will be received from 25% of the school systems within the ERIE and RBS regional laboratories.

2. Each school system submitting inquiries will submit an average of 5 inquiries per school system.

3. 10% of the inquiries submitted will fail to qualify for processing.

4. School system inquiries will be received during September, October, and November of 1967, with EPIE responses required by January, February, and March as follows:

<table>
<thead>
<tr>
<th>Responses</th>
<th>% of Total Inquiries</th>
<th>Inquiries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Month Due (End)</td>
<td>% of Total Inquiries</td>
<td>Month Rec'd</td>
</tr>
<tr>
<td>January</td>
<td>30%</td>
<td>Sept.</td>
</tr>
<tr>
<td>February</td>
<td>60%</td>
<td>Sept.</td>
</tr>
<tr>
<td>March</td>
<td>10%</td>
<td>Sept.</td>
</tr>
</tbody>
</table>

-42-
5. Each accepted inquiry on the average will require 3 man-days of EPIE staff time for information collection, inquiry processing, and report preparation (excluding general supervision).

6. Each unaccepted inquiry on the average will require 0.2 man-days to determine its unacceptability.

7. Accepted inquiries will be processed over the allowable turn around time such that work is distributed as uniformly as possible.

Based upon these specifications, the requirement for full time people to process inquiries from September 1 to March 1 is as follows:

<table>
<thead>
<tr>
<th>Month</th>
<th>Number of Full Time Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept.</td>
<td>8.5</td>
</tr>
<tr>
<td>Oct.</td>
<td>62.9</td>
</tr>
<tr>
<td>Nov.</td>
<td>88.7</td>
</tr>
<tr>
<td>Dec.</td>
<td>92.5</td>
</tr>
<tr>
<td>Jan.</td>
<td>52.2</td>
</tr>
<tr>
<td>Feb.</td>
<td>7.7</td>
</tr>
</tbody>
</table>

On the average (i.e. - if the total workload could be uniformly distributed over the six months) 52.1 full-time people would be required from September to March. However, as can be seen, the anticipated staggering of inquiries coupled with different response time requirements leads to a staff range requirement of 7.7 - 92.5 full time people per month. Obviously, such a variance cannot be realistically achieved. It will, therefore, become necessary to implement a more uniform staff level from September to March, at the sacrifice of full personnel utilization in the months of relatively low demand and extended response time (delay) in the months of high demand. Some flexibility should be sought through the use of part-time and temporary help. Further, consideration will have to be given to the utilization of this staff during those months when inquiries are not being received and processed. Hopefully, EPIE's developmental work
can be concentrated during these months and utilize the staff. Further, effort should be made to gain school cooperation in extending the number of months over which inquiries will be submitted and processed.

As to the demand upon standardized EPIE, this is expected to be received from members of the approximately 25,000 school systems throughout the nation. Since standardized EPIE will be initiated via a subscription newsletter for which the majority of the demand will be known prior to the printing of each issue, the only recommendation required is the printing of actual subscription issues plus a safety allowance of 10%. Resources required should be determined in cooperation with a professional printer and mailing service, and a service arrangement established, until operation of standardized EPIE has existed long enough to make a meaningful determination of the economic feasibility of in-house printing and mailing. With subscription rates of $25/year, no problem is anticipated in being able to cover the cost of printing and mailing service.

**Product Selection Information System Design Criteria**

Earlier sections have discussed alternative information organization schemes for purposes of storage and retrieval of product selection information. In particular, standard classification systems and coordinate indexing systems have been discussed as to their relative advantages and disadvantages. Further, the application and advantages of Peek-A-Boo systems have been referred to by discussion and example.

However, the designers are also aware of the potential advantages to be gained in using standard classification systems, particularly in view of the relatively large number of Peek-A-Boo cards required to operate a coordinate-index product selection information system (4000-5000).

At this point in time, two major alternative approaches exist which should be explored in depth by EPIE's systems design group. One is a pure coordinate indexing system operated manually, the other is a combined standard
classification-coordinated indexing system operated mechanically through the use of punched card equipment. As the major guiding principle for the exploration of these two alternatives, it is recommended that both systems be designed such that they possess equal feasibility and adaptability. Specifically, flexibility and adaptability should be equal in terms of ability to:

1. Add or delete products from the system.
2. Carry out product selection search and retrieval on equally detailed levels describing the source of evaluations.
3. Carry out product selection search and retrieval at the evaluator descriptive level specified by the inquirer or essential to achieving a list of selected products according to the policies recommended.
4. Carry out product selection search and retrieval on equally detailed levels of evaluation.

Although a coordinate indexing system is inherently more adaptable than the standard classification portion of a punched card standard classification-coordinate indexing system when it comes to expanding the number of categories within a particular information type and level, the latter should be considered sufficiently adaptable if it is apparent that the number of categories which can be achieved surpasses any reasonable estimate of the maximum number likely to be required. For example, within the information type and level of "teacher subject matter competence" (e.g. - "products recommended by producers for teachers of 'average' subject matter competence", or "teachers of 'average subject matter competence recommended these products for use with students whose attitudes towards the subject matter are 'mildly interested'"), if five categories of "teacher subject matter competence" are established initially and two columns are designated on a punched card for recording "teacher subject matter competence" in numerically coded form, allowance exists for recording up to 99 different categories. Even though the coordinate indexing approach is
more adaptable in that more than 99 categories of "teacher subject matter" competence can be incorporated without redesign or alteration of other Peek-A-Boo cards, while the designation of the 100th category would require a third column on the punched card which may already be in use, the latter should be considered equally adaptable in practical terms.

In exploring the two alternative approaches, the relative advantages and disadvantages of each should be considered as follows, given the above design criteria which "normalize" other inherent advantages or disadvantages:

<table>
<thead>
<tr>
<th>System Type</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure Coord. Index, 1. Manually Operated</td>
<td>1. Less need to predict maximum number of categories within an information type and level.</td>
<td>1. Search and selection relatively slow.</td>
</tr>
<tr>
<td></td>
<td>2. Search procedures very simple.</td>
<td>2. Probability of selection errors higher.</td>
</tr>
<tr>
<td></td>
<td>3. Less costly and time consuming to design.</td>
<td>3. Potentially more direct labor expenditure.</td>
</tr>
<tr>
<td></td>
<td>4. Less capital expenditure.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Requires less skilled system operators.</td>
<td></td>
</tr>
<tr>
<td>Combined Coord. Index. Standard Classification, Machine Operated</td>
<td>1. Potentially faster search and selection.</td>
<td>1. Potentially excessive redundancy in card handling (i.e. - sorting, stacking, collating, refilling, etc.)</td>
</tr>
<tr>
<td></td>
<td>2. Probability of selection errors lower.</td>
<td>2. Greater capital expenditure</td>
</tr>
<tr>
<td></td>
<td>3. Potentially less direct labor.</td>
<td>3. Need for higher skilled system operators.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. More costly and time-consuming to design.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Search and selection procedures more complex.</td>
</tr>
</tbody>
</table>

As can be seen, the major challenge in designing a mechanized combined system is felt to be the design of efficient search, selection, and refiling procedures which will avoid excessive card handling. Too many punched card systems which are ostensibly more efficient than manual systems lose whatever advantage they may have by incorporating poorly designed search and selection procedures. As to achieving acceptable design flexibility and adaptability, initial efforts indicate this can be accomplished. For a description of a
Punched Card Combined Coordinate Indexing - Standard Classification Product Information Selection System, see Appendix B.

Finally, with full knowledge of the challenge implicit in the task of designing a mechanized combination, standard classification-coordinate index system, it is recommended that this alternative not be considered feasible for inclusion in initial customized PILOT EPIE unless seven months of elapsed time are available for systems design, testing, and deburring prior to the commencement of actual service.

Synthesis Procedure Criteria

As mentioned earlier, once the product selection information system has produced a selected number of products for inclusion in an inquiry response, the non-product selection information system must be activated to prepare the actual response. Extensive attention has not been devoted to date to creating detailed design specifications for this portion of customized EPIE. However, the following recommendations are offered to guide the design:

1. Reports should inform the inquirer of the extent to which the products selected conform to the analysis specifications which he provided.

2. Products selected on the basis of past user evaluations should be supported by information describing the past users (e.g. description, number of reports on file, etc.)

3. Reports should inform the inquirer of the values of those "recommended usage" variables not specified by the inquirer for use in product selection.

4. The system should incorporate efficient procedures for searching and updating information. This may require the use of punched card equipment for periodic updating of summary data.
IMPLEMENTATION REQUIREMENTS, COSTS, AND RESPONSIBILITIES

Since the major purpose of this paper is the presentation of a systems design for PILOT EPIE, intensive effort has not been devoted to an in-depth analysis of implementation requirements. However, the major implementation activities to be performed are listed for purposes of documenting the areas which will require further exploration and planning. The activities to be carried out are as follows:

1. Acquire the product information which will be stored in customized EPIE. This will require the preparation of reports by producers, past users, and researchers and/or the collection of information by EPIE staff. It will also require determination of specific information requirements, value scales, and evaluation guidelines.

2. Determine the appropriateness of the design specifications set forth in this report and modify as necessary.

3. Within the final design specifications, extend the systems design set forth in this report to a level sufficient to achieve operational status. The major areas of activities for the systems design group are:
   a. Indexing-filing methods.
   b. Information organization.
   c. Coding procedures.
   d. Information handling procedures (e.g. - search, selection)
   e. Synthesis decision rules.
   f. Forms design.
   g. Controls design.
   h. Training procedures and materials.

Throughout this report, references have been made to specific activities within the above general areas. These are considered activities
of highest priority.

4. Based upon the outcomes of the detailed systems design, determine requirements for housing, equipment, supplies, and personnel. Guidelines for inquiry processing personnel levels have been provided in this report.

5. Acquire and train the necessary personnel.

6. Conduct additional promotion of potential system users via progress reports and engage in an education program on how to use customized PILOT EPIS.

7. Carry out a trial run of the initial operating system for purposes of testing and debuzzing.

3. Develop a formal organization structure for coordinating and administering PILOT EPIS.

As to implementation responsibilities beyond general administration, it is recommended that full time system analysts be acquired, initially, as the Systems Design Group plus appropriate technical supervision, with responsibility for performing the detailed systems design as set forth in step #3 above. In addition, this group should have responsibility for the analytical activities to be performed under steps #2, 4, and 7 above, plus operational responsibility for step #6. Analytical responsibility for steps #1, 5, 6, and 8, should rest with other staff groups (i.e. - the Information Acquisition Group and the Education - Training Group), but they should work in close cooperation with the Systems Design Group, as their activities are inter-related. As to implementation costs, the following recommendations and estimates are offered:

1. Acquire six full-time systems analysts plus one full-time technical supervisor for the Systems Design Group, at a one year direct labor cost of $93,000. This staff should be planned for an initial period of one year, with additional requirements to be determined at the
end of that period. Subsequent to the implementation of an operational system (time estimate = six months) they will engage in further systems design and analysis of the operating system.

2. Acquire 3 full time analysts plus one full time supervisor for the Information Acquisition group, at a one year direct labor cost of approximately $42,000. This group would be responsible for implementing step #7 above, and would be assisted in the design work by educators currently consulting to EPIC, at an additional cost of approximately $22,000. The preparation of reports by past users and researchers is estimated to cost $220,000 to initiate an operational system. Total first year information acquisition cost = $284,000.

3. Acquire three full-time analysts plus one full-time supervisor for the Education-Training Group, at a one year direct labor cost of approximately $34,000. This group would be responsible for implementing steps #5 and 6 above.

4. Allow for miscellaneous implementation expenditures (e.g. - travel, supplies, office space and equipment, seminars, secretarial help, reproduction service) of $56,000.

5. Maintain a general administrative staff of 2 people, at a one year direct cost of $27,000.

TOTAL IMPLEMENTATION COST = $494,000.

OPERATIONAL COST ANALYSIS AND RECOVERY RECOMMENDATIONS FOR CUSTOMIZED PILOT EPIC

Operating Cost:

In computing the annual operating cost of the recommended operational system for customized PILOT EPIC, a number of alternative methods and levels of detail could be utilized. The one chosen is based upon the following assumptions.

1. The cost computed applies only to the initial operating system.
recommended in this report, excludes implementation cost, and is applicable for one year.

2. No allowance for first year research on the operating system is included, as this is considered to be within the activity of the implementation staff subsequent to the implementation of the operating system.

3. The direct labor cost of the inquiry processing staff exclusive of supervision, will approximate 60% of the total first year operating cost.

4. The first year inquiry processing staff will require on the average 55 full time people, to be used in non-inquiry processing functions when available.

5. The average direct labor cost per inquiry processing person will be $5,000 per year.

Based upon these assumptions, the total first year operating cost, exclusive of implementation and research, but including all other labor, equipment, supervision, etc., is $458,000.

Cost Recovery

The goal of the cost recovery recommendations below is the minimization of the possibility of EPIE suffering a severe financial loss. The recommendations are based upon assumptions stated earlier as to the number of school systems which will utilize EPIE initially (25%), the number of anticipated inquiries per participating school system (5), and the average time required to process an inquiry (3 man-days), plus the following:

1. School systems participating in EPIE should be assessed a flat first year membership fee which permits up to five inquiries.

2. Additional inquiries should be permitted at an additional charge, provided EPIE is able to accept the inquiry (i.e. has sufficient
available resources to do so - see acceptance rule in recommendation #3 below).

3. Charges to school systems should be aimed at recovering first year operating cost and not first year implementation and research costs. The latter should be financed by other sources.

4. Charges should also recover 10% of planned first year operating cost for contingency.

Having considered these assumptions and the cost to be recovered from school systems, the following recommendations are offered.

1. Assess each school system wishing to participate in customized EPIE, $1000 membership fee.

2. For each accepted inquiry in excess of five, charge a school system $100 per additional inquiry.

3. For school systems which have submitted five accepted inquiries, allow additional inquiries according to the following rule:

   ACCEPT

   If the cumulative number in inquiries submitted by the school system at the time of inquiry (inclusive of the one being submitted) is less than or equal to,

   \[
   \frac{5(500 - \text{actual number of current subscribers})}{\text{Actual Number of Current Subscribers}}
   \]

   REJECT

   Otherwise.

CONCLUSION

It is hoped that this paper represents a definitive statement of a realistic program for developing an initial information service to schools. A subse-
quent paper will concern itself with the definition of a program of research and self-evaluation. Although such a program equals in long-range importance the development of a service program, the urgency of establishing the service program has taken priority with respect to program definition.
APPENDIX A

A major issue being faced at this stage in the development of EPIE is the selection of variables for inclusion and operation within customized EPIE. This process has been assisted to date by the development of a conceptual model for clarifying variables which are thought to influence product evaluations. In the belief that this conceptual model will continue to serve as a device for logically grouping variables, its basic elements are herein described.

The conceptual model is built upon the assumption that evaluators of a product will differ in their evaluations and that these differences can be explained or accounted for by identifying various causes of the differences and the effects of each cause. If this is true, EPIE as an information system will gain perhaps the most important capability of all -- the ability to predict how a given product will be perceived to fair in a given "situation". For by identifying the "situation" surrounding a particular inquiry in terms compatible with the definition of "situations" surrounding existing or historical product applications, EPIE will be able to "match" inquiries to products so as to identify either those products likely to gain acceptance and success in the inquiry "situation" or those products which may not and the reasons why. The extent to which EPIE can function in this manner will directly influence its effectiveness and image as an objective source of information, acting in a "staff" capacity to the "line" decision maker.

The relationship envisioned is not unlike that of the guidance counsellor to the student. Just as the effective guidance counsellor enhances the quality of the students decisions on future academic and professional endeavors by clarifying alternatives, providing information, and by assisting the student in learning how to evaluate potential courses of action, so, too, EPIE in its most effective form will serve as a source of pragmatic information displayed.
in forms amenable to administrative evaluation, and as a "guidance counsellor" in improving decision-making skills.

Four basic classes of variables have been chosen to represent the "situation" or causes of differences in evaluation. These are physical characteristic variables, information content variables, environmental application or interaction variables, and evaluator variables.

Physical characteristic variables are those variables which describe the physical characteristics of the product -- its weight, dimensions, type of print, use of colors, tensile strength, etc., depending upon the product. Such variables can account for different product evaluations. For example, if 100 past users of an overhead projector applied the projector in identical situations, with the one exception of 70 users being right handed and 30 being left handed, and the 70 right handed users all evaluated the projector as "excellent" while the 30 left handed users all evaluated the projector as "fair" (using the same evaluation procedure), one may suspect that a physical characteristic accounted for the different evaluations. If upon examination the projector was found to be constructed with the switch panel on the right side, one may intuitively conclude that the location of the switch panel was the "situation" variable accounting for the different evaluations. Further, using statistical techniques, one could both quantitatively represent the relationship between this variable and the evaluation and forecast the probability of a future left handed user, operating in a "situation" identical in every respect to the "sample" left handed users, finding the projector "fair" by the same evaluation procedure.

In the case of information transmission products, such as projectors, blackboards, television sets, audio sets, etc., physical characteristics probably become a dominant factor in evaluations. However, in the case of products which are primarily of an information storage nature, such as maps,
textbooks, audio tapes, video tapes, transparencies, slides, etc., one would suggest that the information content of the product itself would strongly influence the evaluation. Thus, a second major class of variable exists to describe the situation — the information content variables. These variables would describe what information is contained in a particular product, both explicit and implicit. That is, a product may contain an historical account of the Civil War, but "beneath the surface" may also be the author's expression of his views on the injustices done to Negroes in the United States and on the responsibilities of a Federal Government in matters of civil rights. In this case, a set of evaluators may arrive at differences of opinion about the product based upon their satisfaction with the information presented.

This class of variables would include those which describe how information is presented as well as what is presented. Many educators feel the method and quality of presentation can influence a product's acceptability as much as what it says. For example, an evaluation may show that highly accurate pedagogical information has been presented in a style of writing which is awkward, that the author's vocabulary exceeds the level which student users of the material can be expected to possess, and that the grammatical structure is filled with errors. Such an analysis would undoubtedly influence an evaluation of the material. Following the concept of explaining differences in evaluation, another evaluation by an evaluator identical in every measurable respect to the first may find the style, vocabulary, and grammatical structure of the material perfectly acceptable, and as such differ in his evaluation from that of the first evaluator. In this case, one would conclude that the "how presented" information variables explained the differences in evaluation.

It must also be remembered that all information storage products are themselves physical entities and as such have physical characteristics as do information transmission products. Thus, causes of differences in evaluation
may lay in the physical characteristics of a product as well as the information characteristics. No clearer example could exist to demonstrate the continuing importance of physical characteristics in evaluating products which are primarily of the information storage type than that of the highly educational film which continuously breaks when in use because inferior materials were used in its manufacture.

Yet these variables alone may not account for all differences in product evaluations. Another factor thought to be of major contributory importance in differing product evaluations is the evaluator himself. As EPIE anticipates the evaluation of individual products by more than one person, it must be aware of the "bias" or differences attributable to the evaluators themselves. Major differences in motivation, experience, intellectual levels, and analytical skills are expected to exist between the three major groups of evaluators -- producers, product users, and researchers or analytic specialists. Even within one of these major groups further differences are also anticipated, particularly in the product user class. Comprised of teachers of different educational and sociological backgrounds, principals, purchasing agents, superintendents, curriculum specialists, and students, this groups is expected to produce evaluations which differ at least in part because of evaluator (as opposed to material) characteristics. Thus, any information system which attempts to explain differences in evaluation must anticipate the possibility of evaluator effect or "noise".

In some instances, the evaluator may simultaneously be a direct user of the material in an instructional setting, as in the case of a teacher or a student. When this occurs, it is felt by leading educators that characteristics of the teachers and students themselves will effect not only the evaluation of products, but the academic performance of students under their usage. Thus, intertwined in the evaluation process and effecting its outcomes, are teacher
and student characteristics, either because they perform the evaluation, or because they are a part of the setting in which the product being evaluated was used. In the latter case, the effects they impose upon differences in evaluations are classed as environmental application or interaction variables.

Specifically, such factors as the teacher knowledge of subject, his self-pedagogical image, his methodology of teaching, his experience, the student's sociological-cultural-economic background, the student's aptitude and experiences, etc. are thought to be variables of significance in terms of the performance and evaluation of educational materials. In addition, other variables for possible inclusion in the environmental application or interaction class are those which depict the environment surrounding the teacher and student, such as community structure and policy, physical plant, the educational institutions attitudes towards and experience with "innovative" instructional materials (e.g. kits, television), and the classroom size.

Within this class of variables, the particular ones of importance and the "scope" implicit in them will depend upon the products being considered and the questions being asked. For example, an inquiry directed towards the acquisition of instructional material to supplement a curriculum in sex education would probably generate the consideration of "community attitude towards sex education" as an interaction variable of importance. On the other hand, an inquiry directed towards the acquisition of overhead projectors for multi-curriculum application may require the inquirer to provide EPIE with information on the location of projectors in relation to the projection screen (distance), the size of the screen, and the room lighting conditions, in order to search for projectors which are intended for use under the stated interaction conditions or which have been used under like interaction conditions. Thus, environmental application or interaction variables are those variables which in some manner correlate the educational product with the educational environment in which it has been,
may be, or is intended to be applied.

It is also important to note that in certain instances, the concern may be with the interaction of an information storage product with an information transmission product, as in the case of movie films and projectors. As this interaction takes place within the application environment, the variables which describe the interaction (e.g., film sprocket holes to projector sprocket fit) should be considered as environment application or interaction variables.

The diagram below is intended to represent the model concepts discussed above:

```
PRODUCT EVALUATION CONCEPTUAL MODEL

INTERACTION VARIABLES

PRODUCT APPLICATION ENVIRONMENT

INFORMATION STORAGE PRODUCT
   Physical Variables
   Information Content Variables

INFORMATION TRANSMISSION PRODUCT
   Physical Variables

EVALUATORS
   Evaluator Variables

INTERACTION

EVALUATION
```
APPENDIX B

Partial Description of a Punched Card Combined Coordinate Index - Standard Class

Product Information Selection System

The basic information storage unit of the system should be a 12 row, 80 column punched card (e.g. - IBM card) which can be processed on sorters, collators, key punches, tabulators, etc. A specific number of beginning columns should be reserved for the entry of standard classification system code numbers or alpha-numeric entries (e.g. - 74328, AR293) which identify each card. In many instances, each card will represent those products which have been rated for a particular position on a value scale for a particular category of product selection information, according to a particular evaluator type. For example, if a nine-position scale were designed for recommending the subject matter competence which teachers should have, nine separate cards would be used for recording the information provided by each evaluator type. Depending upon conformance to the policies on the minimum number of reports required/evaluator type, the system will permit the retrieval of information on up to three user type levels (e.g. - past users; past users who are teachers; past users who are teachers with an "average" subject matter competence), in any combination. This can be achieved by having the standard classification entry on each card designate the following information (# of card columns required for maximum needed adaptability also shown):

1. The product module represented on the card (e.g. - Elementary Science vs. Overhead projectors-projectuals) 1

2. The general classes of product information (e.g. - general descriptive vs. recommended usage) 1

3. The major class of product information within the general class

B-1
(e.g. teacher information within recommended usage)

4. The minor class of product information within the major class (e.g. - teacher subject matter competence information within teacher information)

5. A value on the rating side for the minor class of product information (e.g. - "average" vs. "secure" subject matter competence).

6. The major information source type (e.g. - past users vs. producer)

7. The minor information source type within major (e.g. - students within past users)

8. The subminor information source type within minor (e.g. - subject matter interest within student)

9. The "value" or rating of the subminor information source type (e.g. - "low" subject matter interest)

10. 

13 columns

Liberally, the storage of this information would require 15 columns on the cards (minimum = 13). The remaining 65 columns are available for designating specific products. Since there are 12 rows on the cards, there are 12x65 or 780 row-column intersections remaining to be used in designating specific products. Thus, within a product module, the system can accommodate up to 780 products on each card. This meets the product limitation specifications set forth for the Elementary Science module. If more than 780 products are permitted later, a second card can be created which duplicates the standard classification information on the first card, with product #781 up to #1560 indicated by the 780 row-column intersections on the second card. The second card would have
to be designated as such (e.g. by putting a (1) in the unassigned column #15) so that the analyst will know that a hole at a particular row-column intersection designates a different product than that designated on the first card by a hole at the same row-column intersection.

The card layout below is an example of the design discussed above:

**Card Layout Showing All Elementary Science Products Which Have Been Recommended By Students of Low Subject Matter Interest For Use By Teachers of Average Subject Matter Competence**

![Card Layout Diagram](image)

<table>
<thead>
<tr>
<th>Column</th>
<th>Code</th>
<th>Code Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Elementary Science Product Module</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Recommend Usage (Product Evaluation) (1st Level)</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>Teacher (2nd Level)</td>
</tr>
<tr>
<td>4-5</td>
<td>01</td>
<td>Subject Matter Competence (3rd Level)</td>
</tr>
<tr>
<td>6-7</td>
<td>05</td>
<td>Average (3rd Level Value)</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>Past User (Evaluator) (1st Level)</td>
</tr>
<tr>
<td>9</td>
<td>4</td>
<td>Student (2nd Level)</td>
</tr>
<tr>
<td>10-11</td>
<td>12</td>
<td>Subject Matter Attitude (3rd Level)</td>
</tr>
<tr>
<td>12-13</td>
<td>02</td>
<td>Low (3rd Level Value)</td>
</tr>
<tr>
<td>14-15</td>
<td>00</td>
<td>Columns Unassigned (Put 1 in Column 15 if Need 2nd Card)</td>
</tr>
</tbody>
</table>
In other instances, a similar layout will be used to record information about products. For example, one card may designate a specific price range on Elementary Science products. If the inquirer stated that he only wished to consider products within this price range, the card could also be pulled. When overlaid with these cards of the "recommended by - recommended for" type, products meeting the inquirers "recommended by - recommended for" specifications but outside the desired price range would be blacked out. Regardless of the particular information on a card, the same design principles explicated here should be applied in carrying out a further analysis of this design alternative.