The design and development of a data processing training information database.

Usha Venkataraman

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THE DESIGN AND DEVELOPMENT OF A
DATA PROCESSING TRAINING INFORMATION DATABASE

by
Usha Venkataraman

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May 2, 1980
(date)

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ABSTRACT

This study describes the design and development of a prototype information storage and retrieval system for data processing educational programs using the TIPS (Training Information Processing System) database. The system has been designed to accumulate information in a single database about data processing training programs offered in the USA, and provide for dissemination of information on the course offerings to users. The users will have the option of requesting information directly from the system by means of a nationwide data communications network. Any part of the database-stored record would be searchable, including subject categories, titles, program descriptions, program suppliers, dates, locations, and fees. Feedback information in the form of course evaluations would also be available for those who need such information. A unique minicomputer-based system has been developed to catalog and retrieve information in minutes.

It has been amply demonstrated in the study that there is a severe need for a data processing training information retrieval system. Given this fact, the system designed here has all the essential characteristics to meet the current and future needs of data processing professionals.

Another purpose of this study has been to suggest that the success, in terms of developing a centralized system which would accumulate and disperse timely information on data processing educational programs, requires an efficient and economic method of collecting and generating the data. A database management system seems to offer an ideal vehicle for the collection and distribution of the vast amounts of data involved.
CHAPTER I

Abstract: The thesis will describe the design and development of a prototype information storage and retrieval system for data processing educational programs using the TIPS (Training Information Processing System) database. The system would accumulate information in a single database about DP training programs offered in the USA, and provide for dissemination of information on the course offerings to users. Feedback information in the form of course evaluations would be available for those who need such information. Any part of the database-stored record would be searchable, including subject categories, titles, course descriptions, course suppliers, dates, locations and fees. A unique minicomputer based system is being developed that would help catalog and retrieve information in minutes.

Background and Introduction: It is the opinion of many DP professionals that manpower development efforts in the data processing field have grown rapidly over the past decade (1). This is true in the small and medium-sized companies as it is in large firms where it is not uncommon to see full-time training professionals as part of the DP staff. Ever since the early 1970's when the vendors of hardware stopped offering educational services free of charge to their customers, companies were forced to set aside sizable budgets for DP manpower training. At the same time new
Innovations in technology created a great need for highly skilled personnel. To help employees meet the great demands being made on them, companies have been increasing the magnitude of their DP educational programs. Too often, DP training co-ordinators are under constant pressure to create a trained employee as quickly as possible, with the result that they find it difficult to concern themselves with expenses and effectiveness as much as they should.

Another problem facing the training co-ordinator is that, despite the widespread availability of educational programs, the majority of his time is spent in trying to find information about the right program for his people. Based on information supplied by some training co-ordinators it seems likely that between 30% and 80% of their time are wasted because previously generated information is unavailable to the training co-ordinator at the right time.*

It would be very easy for an inert training co-ordinator to skip through 10 brochures, pick one which looks 'pretty good' and offer the courses listed in it as part of his organization's training program. But in following this approach the training co-ordinator is really designing the educational program around the brochure instead of designing

* Informal discussions with a few local training directors indicate that they rely on pamphlets and brochures for information on DP training; they also spend a considerable amount of time to find suitable vendors who offer quality programs at nominal costs.
it around the specifically-identified skill needs of his DP staff.

Most professionals in the data processing field seem to realize that DP education is one of the most pressing problems facing them today (14).* Even so, a majority of the companies engaged in DP education efforts do not, and cannot, economically maintain an up-to-date and comprehensive collection of training literature in which they are interested. For this reason, all these organizations must look outside for a commercially available database to expand their information coverage. Up to this time there has been no known effort to pool information on DP training programs. It is hoped that TIPS database, with its capabilities of information collection, literature searching and reporting will prove to be an indispensable tool for satisfying the needs of DP organizations.

The TIPS database would be responsible for the nationwide collection of information on all available programs --- inhouse as well as publicly scheduled --- used in DP training and education. The contents of the database would be derived from a number of sources namely, professionally run training companies, consulting firms,

* This observation is based on the responses to a questionnaire in Computerworld where readers were asked to list the most critical issues in data processing.
 accredited institutions like business schools and colleges, association sponsored programs, and vendors of hardware and software. The purpose of the system will be to help users find appropriate resources for their specific educational needs and to provide available evaluative data accumulated from other users on the effectiveness of such programs. The aim of the system would be to provide users with information which will help them find and select the training resources most appropriate to their needs and to do this without any biases.

Scope: The system would contain past, current, and future information on training programs. Data input to the system would have the following schedule: a) from the sponsors of educational programs on a monthly or on a prescribed basis; and b) from the users as information is required or, in the case of evaluations, as they are received. The system input will cover literature for a period of two years -- the most recent twelve months in the past and the next twelve months in the future.

Goals of the system: The system will provide query services, both general and specific, based on the training information available in DP technology and related disciplines. The services provided would be primarily reference and referral. Responses to queries will be in the
form of computer printouts or hardcopy listings of display screens. The time between receipt and fulfillment of a request can range from a few minutes to a day depending upon the type of request. The system will process only one request at a time.

The system's objectives would be accomplished through 1) preparation of course titles for publication in popular DP periodicals, 2) preparation of other recurring course outlines on specialized subjects of wide interest, 3) preparation of comprehensive, one-time demand searches, produced by a computer search through the database, in response to requests submitted by users, and, 4) publication and distribution of the output from selected literature searches on a wide basis.

**Equipment:** The proposed system is expected to be implemented on a DEC PDP-11 minicomputer as an on-line, real-time system using the DBMS-11 database. A line printer and a video terminal are to be used as peripherals to the minicomputer. Users will have the option of requesting information directly from the system by means of a data communications network that is proposed to be set up.

**Literature searches:** A demand search would usually be conducted for an individual request and would therefore be tailored to the unique information requirements of this
user. Sometimes, however, a demand search would be conducted on a course topic of potentially wide interest (ex: computer security, DP manpower selection). Such a search may be selected for further processing in order that it may be widely distributed. The search then would become known as a literature search. Results of literature searches would be announced in several DP journals as well as listed in the monthly technical bulletin published by the system.

Responses to individual search requests may be in printed computer paper or displayed in the CRT terminals. The listings themselves may be arranged in a number of ways depending upon the user's needs. These include listings by course title, subject category, name of the sponsoring organization in abbreviation, start date, or geographic location. The report would be carefully reviewed for probable success or failure of the search. If the information retrieved appears to meet the requester's needs, the report would be forwarded to the user with an explanatory letter. If, in the searcher's estimation, the search results are poor, he may try another approach and re-formulate the search, or he may contact the user and discuss the problem with him. A specially designed search request form would be used to ask for information on the purpose of the search. Search requests would not be accepted when they are inappropriate for the system.
User/Audience: The audience of the system will be the professionals of the DP community. As a national institution, the system's publications and services will be available for the use of educators, DP managers and training co-ordinators, and individual students throughout the United States.

Publications: The following publications would be available from the system:

1) list of courses indexed in system publication; this list would contain four fields of information -- subject group, course title, abbreviation of sponsoring organization, and geographic location.

2) DP subject headings -- all the DP subject groups in the database would be arranged alphabetically, with cross references, and in categorized lists. This list would serve as a reference to the users of the system.

3) TIPS current catalog -- this will be a bibliographic listing of course titles cataloged in the database. It will be published monthly (course titles only), and quarterly (subject categories and course titles).

4) TIPS technical bulletin -- in addition to the foregoing publications, the system will issue a technical bulletin. It would include the following: a column on
customer services which describe the latest enhancements to the systems' services; brief essays which discuss the nation's growing DP training needs and how the TIPS system strives to meet these needs; a list of technical advances which have been achieved in the period covered; and other miscellaneous information that is of interest to the users. This monthly newsletter will be distributed to the regular users of the system.

Evaluation and feedback: The system will receive continuous informal feedback from users of its services. Demand search results forwarded to every user would be accompanied by a TIPS course evaluation form. The form will be designed to record comments on the adequacy and usefulness of the courses. Completed appraisal forms will be made available to the future users of the system upon request. They would also be forwarded to the sponsors of the courses so that, if necessary, they will have an opportunity to improve the course offerings.

Existing state of the art: Since it was believed that a system like TIPS is unprecedented in nature, an informal survey was conducted at the beginning of the study to determine whether a data processing training information database would be beneficial to the potential users of the system. It was found that there are a few organizations in
existence today which offer information about educational programs, but their resources mainly cover programs in management training and development.* They offer very little information on data processing educational programs. Moreover, almost all of them store and retrieve information manually. Their functions are similar to that of a reference desk in a public library -- providing information to users upon request after manually consulting their training registers. Thus the responses received from the participants in the survey indicate that a) there is a pressing need for the kind of on-line interactive service the TIPS system proposes to offer, and b) it will be extremely effective in giving fast, accurate, and comprehensive information to those DP professionals who would be the users of the system.

Cost/benefit analysis: The cost effectiveness of the proposed system cannot be measured in terms of dollar amount, because the benefits expected from the system are all intangible. The cost of the TIPS system is expected to be over $150,000 by the time the system becomes operational. This would include $50,000 for the minicomputer, $25,000 for the DBMS, $30,000 for the peripherals and other software.

* Two such organizations are Seminars Directory in Madison, Wisconsin, and Mantread Inc., in Saint Paul, Minnesota.
$35,000 for developmental expenses like salaries of personnel, and $15,000 for other operational expenses. The benefits are primarily anticipated cost savings experienced by the users from more effective, more efficient information processing -- such as a) ease of information acquisition, b) increased accuracy of information, c) improved performance of the users, and d) a uniformity in data processing training methods and practices. These are all intangible benefits and are difficult to quantify because there are no direct units of measure for them.
Figure 1: System Overview.
CHAPTER II
FUNCTIONAL SPECIFICATIONS

The functional specifications are a description of what the proposed system is to do and how the benefits and advantages of the new system are to be provided. It is one of the most important documents in the entire design process and it should be written in sufficient detail so that the users can easily understand them. Consequently this section will contain the following sub-divisions:

1) the system summary

2) the processing requirements

3) identification and flow of information within the system

4) inputs required and outputs created by the system

5) the system performance.

1) THE SYSTEM SUMMARY.

The Training Information Processing System (TIPS) is oriented around a single database, a central repository of DP training information. The data processing departments of all organizations within the country will share this common
fund of information in performing their separate but related tasks. Database information will be organized so that each user can refer to it and utilize it according to his own needs.

2) PROCESSING REQUIREMENTS.

It is proposed that a DEC system PDP-11 minicomputer be used. It will be an on-line interactive system with a video display terminal and a line printer serving as peripheral I/O devices. Data will be stored in DBMS-11 (Data Base Management System-11) which is a CODASYL-standard database management system. DBMS-11 database is compatible with the PDP-11 minicomputer. The TIPS database can be interrogated by many user terminals scattered throughout the country. These remote terminals would be linked to the minicomputer through a data communications network. The database, however, can be updated only by the systems' personnel.

3) IDENTIFICATION AND FLOW OF INFORMATION WITHIN THE SYSTEM.

A description and summary of the data to be processed by the system is important to the understanding of the proposed system. So this section will discuss the following -- the manner in which data gets into the system, how it is
to be edited and processed, where and how it will be stored, how and when it is to be retrieved, what reports are to be created, and what information safeguards, such as audit trails, are to be built into the system. Figure 2 illustrates the document and information flow within the proposed system.

In accordance with the procedure subsequently described, the vendors/sponsors of the programs would supply the course information and any corrections or modifications to the records stored in the database. Those users who do not wish to use the dial-up querying facilities, would submit a completed information request form as input; they would also submit a completed course appraisal form after participating in the course(s). The system itself would internally initiate user details and formulate parameters for publication of bulletins and other literature.

All these inputs would be processed by an operator. He would first perform the necessary editing on the terminal, and when satisfied with the form and content of the input information displayed on the screen, he would transmit it to the computer by depressing the transmit/return key. The data would then be received by the computer which would proceed to process it depending upon the type of input supplied.
Figure: 2. Information Flow Within The System.
Outputs from the system can be in one of the following forms: a) the response to a demand search displayed on the terminal and/or printed in report format as a list of course indexes; b) processed evaluation information on course(s); c) sorted user/vendor lists; d) a number of reports to be included in the publications for distribution to the general public; and, e) statistical reports for the internal use of the system. Figures 3, 4, and 5 illustrate the input, retrieval and output processes for the system.

4) INPUTS.

There would be two types of input into the system, externally initiated inputs and internally initiated inputs. The following inputs would be initiated because of some need for processed information outside the TIPS organization: a) information request form; b) course contents form from vendors/sponsors of educational programs; and, c) post course evaluation forms.

The inputs initiated by the system personnel for their own use include a) the forms that contain the publication parameters; and, b) the forms that contain user/vendor names and other details of transactions that they have had with the system. A definition of each of the fields
Figure: 3. Search & Retrieval Process.

17
Figure: 4. Input Process.
Figure: 5. Output Process.
referred in the various forms are given at the end of this chapter in figure 25A.

**All Information Request Form:** This form would be specially designed for the use of people who request information from the database. There would be two types of information request forms. One for the use of organizations which have a number of employees with a need to undergo the educational programs, and another for the use of individual users. Figures 6 and 6A describe the format of the two request forms. Organizations or groups can specify the training needs for a particular job level (ex: computer operator, systems programmer), for people working together in a project (courses in project management, systems analysis, database design or on-line processing) or for a particular DP subject. The individual user, while describing the training needs, would specify the skills he/she hopes to acquire and what they plan to accomplish as a result of undergoing the educational programs. These information request forms are to be filled in manually and sent to the TIPS system. Upon receipt of this form, the system's staff would prepare the input for processing using the following format:

<table>
<thead>
<tr>
<th>Description</th>
<th>Field Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject category</td>
<td>25</td>
</tr>
</tbody>
</table>

20
INFORMATION REQUEST FORM FOR INDIVIDUALS

Requester’s name:___________________________________________

Mailing address:____________________________________________

Work location (if different from above):________________________

Educational background (specify jr.college, college, others)
________________________________________________________________________

Current job title:______________________________________________

Description of educational needs:_______________________________

Expected job benefits:_________________________________________

Details of course information requested

Subject category:______________________________________________

Course title:__________________________________________________

Geographic location preferred:__________________________________

Course time preferences:_______________________________________

Number of days available for course:_____________________________

Approximate $ amount available:_______________________________

Additional comments (please comment on any possible conflict between your present work and the course schedules.)
________________________________________________________________________

Date:________________________________Signature:___________

FIGURE 6.
# INFORMATION REQUEST FORM FOR ORGANIZATIONS

<table>
<thead>
<tr>
<th>Organization requesting information:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mailing address:</td>
</tr>
<tr>
<td>No of participants expected to attend courses:</td>
</tr>
<tr>
<td>Job title(s) or brief description of employee task(s):</td>
</tr>
<tr>
<td>Description of educational needs:</td>
</tr>
</tbody>
</table>

## Details of course information requested

<table>
<thead>
<tr>
<th>Subject category:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course title:</td>
</tr>
<tr>
<td>In-house or publically held program:</td>
</tr>
<tr>
<td>Geographic location preferred:</td>
</tr>
<tr>
<td>Course time preferences:</td>
</tr>
<tr>
<td>Number of days available for course:</td>
</tr>
<tr>
<td>Approximate $ amount allocated:</td>
</tr>
<tr>
<td>Other general comments:</td>
</tr>
</tbody>
</table>

Date: ____________________ Signature: ____________________

**FIGURE: 6A.**
course title
in-house scheduling/
publicly held ('I' or 'P')
geographic location
course date preferences
(three 8 position fields)
no. of days available for course
$ amount allocated for fees
abbreviations of training needs
organization/individual requesting information
mailing address
number of participants for course
date of request
listing sorted by (subject, course, location, dates)

The subject category would be abbreviated and stored as a six character subject group code in the records. The I or P in the type of program requested denotes whether the user(s) would like to participate in a program that is to be scheduled in-house or in one that is to be held in public. The user(s) would also have the option of specifying three different dates in which they would like to commence the program. The number of days available for the course indicates the actual number of days that can be set aside.
from their other duties in order to participate in the educational program. The first eight fields of information would be used to retrieve information from the training programs database. The last four fields of information would be used by the system for its internal use; to create a new record in the user/vendor database if it is a first time request from the user, or to increment the transactions counter if the user has previously used the services of the system. User records would be identified by the word 'user' in the first field of the record; vendor records by a four character vendor abbreviation in the same field of the record.

Al Course Contents Form: This form would be filled by the vendors/sponsors of the programs, or by the system personnel using the information supplied by the vendors about the proposed course offerings. Figure 7 describes the layout of this form. The following fields of information would be used as input to the system:

<table>
<thead>
<tr>
<th>Description</th>
<th>Field Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>vendor/sponsor of program</td>
<td>30</td>
</tr>
<tr>
<td>title of course</td>
<td>30</td>
</tr>
<tr>
<td>subject category</td>
<td>25</td>
</tr>
<tr>
<td>Instructional staff</td>
<td></td>
</tr>
<tr>
<td>(four 20 character fields)</td>
<td>80</td>
</tr>
</tbody>
</table>
COURSE CONTENT FORM FROM SPONSORS OF PROGRAMS

Title of program: ____________________________________________

Sponsor of program: _________________________________________

Instructional staff: __________________________________________

Location of program: _________________________________________

<table>
<thead>
<tr>
<th>Where held</th>
<th>Date</th>
<th>Duration</th>
<th>No. of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fee: Member ______ Non-member ______

Accommodation: ____________________________________________

In-house presentation available (yes or no): __________

In-house fee: Member ______ Non-member ______

Course description: ______________________________________

FIGURE: 7.
The vendor name supplied in the course contents form would be stored as it is and in an abbreviated form which would be used as a key to retrieve records from the database. The names of up to four instructors per course can be supplied in the form. This is because it is possible for different instructors to offer the same course. The vendor would have the facility to specify five different geographic locations where the courses are to be offered, along with their start dates and durations, and the maximum number of participants that can be accommodated in each program. Besides the fields keyed in, there would be some additional fields created to make the records more useful for retrieval of information later on. Among these would be the
abbreviated name of the course sponsor, the abbreviated code for subject category, a counter to indicate the number of times information about that particular course was retrieved, etc. This last field would be used for statistical purposes to evaluate the popularity of the courses.

2) Post Course Evaluation Form: This would be a carefully designed form that would be completed by the users after they have participated in the programs. These forms would serve a twofold purpose; 1) they would be used by organizations that wish to acquire information about the effectiveness of programs before offering them to their employees; and 2) they would be used by the vendors and sponsors of programs to make modifications to the courses if the necessity for any change arises. Figure 8 depicts the layout of the post course evaluation form. This form would supply the following fields of information to the system:

<table>
<thead>
<tr>
<th>Description</th>
<th>Field Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>title of course</td>
<td>30</td>
</tr>
<tr>
<td>vendor/sponsor of program</td>
<td>30</td>
</tr>
<tr>
<td>geographic location</td>
<td>30</td>
</tr>
<tr>
<td>date/duration of program</td>
<td>8/2</td>
</tr>
<tr>
<td>method of instruction (codes 1a,1b,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>28</td>
</tr>
</tbody>
</table>
POST COURSE EVALUATION FORM

Title of program:

Sponsor of program:

Course location:

Date and duration of course:

A. METHOD OF INSTRUCTION
How would you rate the methods of presentation (if applicable)

very effective neutral not effective

Student participation □ □ □
Use of teaching aids □ □ □
Speakers' content □ □ □
Completeness of coverage □ □ □
Reading materials □ □ □

B. PRESENTATION
In your opinion the presentation was

1. □ elementary □ advanced □ just right
2. □ fast □ slow □ well paced
3. □ too general □ theoretical □ correct

C. SESSION CONTENT
Which information was of most value to you?

D. REACTION TO SESSION AS A WHOLE
To what extent did you get the information you expected from this session?

great extent □ some extent □ not at all □

FIGURE: 8.
E. PLEASE INDICATE WHY YOU FEEL SOME PARTS WERE INEFFECTIVE.
You may check more than one box.

- read speech  □ not adequately prepared □
- boring  □ strayed from subject □
- too formal  □ repetitious □
- no objective stated  □ other (please describe) □

F. CAN YOU APPLY THE MATERIAL PRESENTED?

- directly applicable □ to some extent □
- just barely  □ not too easily □
- not at all □

G. RECORD YOUR OVERALL REACTION TO SESSION

- excellent □ good □ average □
- fair □ poor □

Feel free to make any additional comments you may have regarding this session:

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________

Date of evaluation: __________________________

Participant sponsored by: _______________________

Position held in the organization: _______________________

FIGURE: 8 (contd).
The evaluation form in figure 8 is typical of the end-of-course evaluation that most educational institutions use. Some of the aspects of the program evaluated include:

a) the method of instruction based on the use of teaching aids and reading materials, speakers' content, completeness of coverage and student participation;

b) whether the presentation was elementary, too detailed, theoretical, well paced or other;

c) the extent to which the participants received the information they expected from the course;

d) whether some parts of the course were effective, and if so, why?

e) whether the material presented is directly applicable to their work;

f) how good or bad the entire session was, etc. Depending upon the box or boxes that the participants check in each category, the answers would be recorded in abbreviated coded form in the database. The program for processing this type of input would first locate...
the master course record using the course title given in the evaluation form. It would then create a member evaluation record for that course record. If there are other evaluation records already existing for that course record, the latest evaluation record would be placed last in the group of evaluation records.

**DI User/Vendor Form:** This is a form used by the system personnel for generating information for internal use. This form could be used for retrieving information about one user/vendor or many of them. The format of the user/vendor form is displayed in Figure 9. It would provide the following fields as input to the system:

<table>
<thead>
<tr>
<th>Description</th>
<th>Field Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>record code type</td>
<td>1</td>
</tr>
<tr>
<td>user/vendor name</td>
<td>30</td>
</tr>
<tr>
<td>type of information to be retrieved</td>
<td></td>
</tr>
<tr>
<td>(address, number of times information requested, number of times services used)</td>
<td>20</td>
</tr>
<tr>
<td>complete or partial list (&quot;C&quot; or &quot;P&quot;)</td>
<td>1</td>
</tr>
</tbody>
</table>
USER/VENDOR FORM

Type of input: ____________________________

User/vendor name: ____________________________

Type of information to be retrieved(*): ____________________________

________________________________________

Complete or partial list: ____________________________

Date: ____________________________  Signature: ____________________________

*(address, number of times information requested, number of times services used, others)
This input form could be used to retrieve a variety of information from the database and could be used to generate a number of listings. It could be used to get data about a single user or vendor, or a complete list of information about users or vendors. When only the address is requested for users/vendors, it will produce a mailing list of user/vendor names.

El Input for Publication Parameters: As the name implies, this will be a form where the input parameters for retrieval of information on courses would be specified. This would be an internally initiated form used by the system personnel to generate the various publications printed by the system. Since this would be a general purpose input form, all the fields in the form need not be filled in at any given time. Figure 10 shows the layout of this form. The data input into the system using this form would be:

<table>
<thead>
<tr>
<th>Description</th>
<th>Field Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>type of listing code (LC, SH, CC, or TB for list of courses, subject headings, current catalog or technical bulletin)</td>
<td>2</td>
</tr>
<tr>
<td>monthly or quarterly listing</td>
<td>1</td>
</tr>
<tr>
<td>number of copies needed</td>
<td>4</td>
</tr>
</tbody>
</table>
SYSTEMS FORM FOR PUBLICATIONS

Type of listing (LC, SH, CC, or TB):

Reporting period (monthly/quarterly):

Number of copies needed:

Additional codes for input:

Special notes:

Job accounting ID:

Date: ____________________  Signature: ____________________

FIGURE: 10.
The program(s) to retrieve data from the database using the input from this form would access the database sequentially, and depending on the type of publication desired, print the required number of copies of data. If the listing code is 'LC', for list of courses indexed in system publication, four fields of information would automatically be retrieved -- the subject group, course title, abbreviation of vendor name, and geographic location; if the code is 'SH', for the reference list of DP subject headings, all the DP subject groups in the database would be printed; for a code of 'CC', which stands for TIPS current catalog, a bibliographic listing of course titles cataloged in the database would be retrieved. If, in addition, it is a quarterly listing of course titles, subject categories would also be included in the listing. For the listings to be used in the technical bulletins, which would be printed when the listing code is TB, any or all of these combinations of information can be retrieved.

4a) OUTPUTS.

Five different types of reports are expected to be printed as outputs from the system. They are a) report of individual search results, b) listing of literary search
results, c) post course evaluation listings, d) user/vendor lists, and e) the various listings that would be used in the system publications. Of these, one of them, namely the user/vendor list, would be used by the system personnel. All other reports would be printed for the benefit of the users.

Individual Search Results: This is a listing generated as a result of processing a request for information from an individual or an organization. It would contain the following information --- report number, title, rundate, and name of user requesting information in the heading line of the report. The detail lines would contain the subject category, course title and all the pertinent information about that course. Depending upon the type of input code specified, the report would be sorted by subject category, course title, location, or date. There may be more than one record listed if the choice of code used was subject category, location or date. Figure 11 displays the layout of this report.

Report of Literary Search Results: Since this is a report that contains information on a course topic of wide interest, it will be on a multiple part paper, and would contain the following information --- title of the report and rundate in the heading; the course title in the
<table>
<thead>
<tr>
<th>REPORT #: XXXXX</th>
<th>REPORT OF INDIVIDUAL SEARCH RESULTS: XXXXX</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBJECT CATEGORY</td>
<td>COURSE TITLE</td>
<td>SPONSOR OF PROGRAM</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>DURATION OF COURSE</td>
<td>NUMBER OF PARTICIPANTS</td>
<td>FEE PUBLIC PROGRAMS</td>
</tr>
<tr>
<td>XX DAYS</td>
<td>XXXX</td>
<td>XXXX</td>
</tr>
</tbody>
</table>

**Figure: 11. Report of Individual Search Results.**
subheading and all other pertinent information about that course in the detail lines. This report would be run as and when a need arises for a listing of literature search results. One copy of this listing would be kept filed and stored in the system office. Other copies will be used for publication in the monthly technical bulletin and for distribution to different DP journals for publication purposes. Figure 12 is a display of this report.

cl Report of Course Evaluations: Since the input for this report is in a specially designed form which is convenient for users to follow, the report would also be printed in the same format as the input. System personnel would have the option to print more than one copy of these evaluation reports at run time, if there is a demand for more of them. Figure 8 is the format for both the input and output of this report. The report of course evaluations, like the previous reports, would be produced when a user requests this information from the system.

d1 User/Vendor Lists: This report would be generated strictly to satisfy the information needs within the organization. It would be on a single part or multiple part paper depending on the requirements of the staff. The report would have the report number, title and run date in the heading of the report. The subheading would specify
**Figure 12. Report of Literature Search Results.**
whether it is a user list or a vendor list; this would be determined by the code type entered as input. The detail lines could be in many forms; it could be a complete or partial list of details of user/vendor records; it could just display information about one user or vendor; or it could be in the form of a mailing list --- addresses only of the users and/or vendors. A format of this report is displayed in Figure 13.

**Reports For System Publication**: Four different reports would be produced under this category; they are the list of course titles, list of DP subject headings, TIPS current catalog of courses, and other reports for the system technical bulletin. The list of course titles indexed in a report would be used for references, in place of a brochure by the users of the system. It will be generated monthly and it can be used independently by the users; the contents of this report may also be reproduced in the technical bulletins or in other DP periodicals for publicity purposes. The DP subject headings, like the previous listing, would be used for reference purposes by the users; it will have all the subject categories listed in a sorted alphabetical order. This listing too will be generated monthly, and can be in multiple part paper. The TIPS current catalog of courses would be published monthly and quarterly. A copy of the catalog would be sent for further processing so that it
can be used for publication purposes.

**Transactions in the TIPS system:** All interactions between the users and the system will take place through the terminal. At this point it is possible to identify some 7 transactions for the TIPS system. Each transaction will require one or more lines of input from the user. A brief explanation of each transaction follows:

1) **The initial screen:** After starting the terminal, a user who wants to interface with the system must enter a pre-assigned operator identification (figure 14). When the system receives the operator-ID, it checks the identification for validity; if satisfied, it allows the user to continue on by displaying the user service menu (figure 15).

2) **TIPS user service menu:** This screen shows the user how the different transactions in the system can be accessed. By entering an appropriate selection number the user can access the transaction of his choice. If a selection number is invalid, an error message will be displayed on the right side of the last line on the screen.

**Course information request transaction:** The course information request transaction (figure 16), is the one
<table>
<thead>
<tr>
<th>COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-10</td>
</tr>
<tr>
<td>01</td>
</tr>
<tr>
<td>MENU</td>
</tr>
<tr>
<td>01. COURSE INFORMATION RETRIEVAL</td>
</tr>
</tbody>
</table>

45

FIGURE: 15.
<table>
<thead>
<tr>
<th>ITEM</th>
<th>DISPLAY</th>
<th>BUFFER</th>
<th>ADDRESS</th>
<th>OR- DERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>08.26</td>
<td>N/H</td>
<td>OPT</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>08.26</td>
<td>A/H</td>
<td>REQ</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>08.40</td>
<td>A/H</td>
<td>REQ</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>08.26</td>
<td>A/H</td>
<td>REQ</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>08.51</td>
<td>A/H</td>
<td>REQ</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>08.18</td>
<td>N</td>
<td>REQ</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>08.30</td>
<td>N</td>
<td>OPT</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>08.13</td>
<td>N</td>
<td>OPT</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>08.13</td>
<td>N</td>
<td>OPT</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>08.53</td>
<td>A/H</td>
<td>REQ</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>08.45</td>
<td>A/H</td>
<td>REQ</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>08.53</td>
<td>A/H</td>
<td>REQ</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>09.27</td>
<td>A/H</td>
<td>REQ</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>14.22</td>
<td>A/H</td>
<td>REQ</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>14.31</td>
<td>A/H</td>
<td>REQ</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>14.32</td>
<td>N</td>
<td>REQ</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>16.58</td>
<td>N</td>
<td>REQ</td>
<td></td>
</tr>
</tbody>
</table>

FIGURE: 16.
around which the whole system is designed. It allows a user to enter the necessary parameters to retrieve information on DP training courses. The user must specify the subject category, the type of scheduling (in-house or public), location, date(s), days available to undergo the program and the training needs of the user. He may optionally specify the course title and the fee amount. When the system receives the information request transaction, it retrieves the data from the database and displays it on the TIPS course information screen (figure 17). If a user specifies a need for a hardcopy listing, the course information is printed on the report of individual search results.

Course evaluation request transaction: When a user wants to obtain course evaluation information, he uses this screen to convey his needs to the system. The format of this screen is shown in figure 18. The user is required to type in the course title, name of the vendor, geographic location and date of the program, and whether he needs the information displayed to him on the terminal or printed as a report. The TIPS course evaluation screen (figure 19), is used by the system to display the information retrieved from the database. If there are a number of evaluations available on any one course, they will be displayed one after another; a message on the twenty-third screen line will inform the user that there is more evaluation information available to him.
<table>
<thead>
<tr>
<th>COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-10</td>
</tr>
<tr>
<td>11-20</td>
</tr>
<tr>
<td>21-30</td>
</tr>
<tr>
<td>31-40</td>
</tr>
<tr>
<td>41-50</td>
</tr>
<tr>
<td>61-70</td>
</tr>
<tr>
<td>71-80</td>
</tr>
</tbody>
</table>

**TIPS COURSE EVALUATION SCREEN**

**E. WHY SOME PARTS WERE NOT EFFECTIVE:**

- Read speech: X, X, Not adequately prepared
- Boring: X, X, Strayed from subject
- Too formal: X, X, Repetitious
- No objective: Stated: X, X, Other: X

**F. APPLICABILITY OF MATERIAL PRESENTED:**

- Directly applicable: X, X, To some extent
- Just barely: X, X, Not too easily
- Not at all: X

**G. OVERALL REACTION TO SESSION:**


**H. ADDITIONAL COMMENTS:**

**DATE:** MM/DD/YY  **SPONSOR OF PARTICIPANT:** X
**POSITION HELD:** X
**ENTRY:** XX
**PRESS ENTER TO CONTINUE**

**ENTER PG FOR NEXT PAGE, JT FOR NEXT TRANSACTION, RM FOR RETURN TO MENU**

**FIGURE: 19 (contd).**
if he keys in 'PG' (for page), to access the next page.

**Course contents input transaction:** The system personnel will use the course contents input transaction to enter data into the system about a new program. The same screen can be used by them to make modifications to an existing course record in the database. When a new program is being added, all the fields on the screen are required to be entered with valid data. Invalid data will be displayed in high intensity along with an error message that will inform the operator that the fields in high intensity need to be corrected. When making modifications to existing course records, only those fields which are to be altered need to be entered. Figure 20 shows the format of the course contents input screen.

**Course evaluation input transaction:** This transaction is similar to the previous transaction because it is for the use of the system personnel to enter data into the system about evaluations to courses that exist in the database. It has the same screen format as the TIPS course evaluation screen (figure 19). The system will check the input for correct entries, and display the incorrect ones in high intensity along with an error message on the twenty-third line of the screen.
<table>
<thead>
<tr>
<th>ITEM</th>
<th>DISPLAY ADDRESS</th>
<th>BUFFER ADDRESS</th>
<th>ORDER</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>11</td>
<td>63</td>
<td>N</td>
</tr>
<tr>
<td>33</td>
<td>11</td>
<td>74</td>
<td>N</td>
</tr>
<tr>
<td>34</td>
<td>12</td>
<td>15</td>
<td>N</td>
</tr>
<tr>
<td>35</td>
<td>22</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>03</td>
<td>25</td>
<td>A/N</td>
</tr>
<tr>
<td>37</td>
<td>03</td>
<td>42</td>
<td>A/N</td>
</tr>
<tr>
<td>38</td>
<td>04</td>
<td>21</td>
<td>A/N</td>
</tr>
<tr>
<td>39</td>
<td>07</td>
<td>26</td>
<td>A/N</td>
</tr>
<tr>
<td>40</td>
<td>07</td>
<td>26</td>
<td>A/N</td>
</tr>
<tr>
<td>41</td>
<td>10</td>
<td>26</td>
<td>A/N</td>
</tr>
<tr>
<td>42</td>
<td>13</td>
<td>29</td>
<td>A/N</td>
</tr>
<tr>
<td>43</td>
<td>22</td>
<td>10</td>
<td>A/N</td>
</tr>
</tbody>
</table>

The same screen is used for making modifications to course contents at that time all the item entries are optional except item numbers 1, 2, 3, 35, and 43.
**System information retrieval transaction:** This transaction will be used by the system personnel to request retrieval of information from the course records (figure 21). The response to this transaction will be on one of the following screens: course retrieval display screen (figure 22), or subject headings display screen (figure 23).

**User/vendor information retrieval transaction:** Like the previous transaction, this screen will also be used by the system personnel. They will have the facility to use this screen to get reference information on one or more user/vendors. Depending upon the type of request, the name, address and other details of user/vendors will be displayed on the user/vendor information screen (figure 25).

5) **SYSTEM PERFORMANCE.**

The TIPS database would be available for use during the hours 8 a.m. to 8 p.m. everyday excluding weekends. The extended hours in the evenings are for the benefit of those users (like those in the west coast), who because of time zone differences would not otherwise have availability of the TIPS database for a full eight hours a day.

**Response Time:** Since the hardware would be a stand alone, dedicated minicomputer, response time is expected to be
<table>
<thead>
<tr>
<th>COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-10</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

**SYSTEM INFORMATION REQUEST**

**TYPE OF RETRIEVAL**
- COMPLETE/PARTIAL: XX
- DISPLAY/LIST: X

**TYPE OF LISTING**
- XXXX

**NUMBER OF CABLES**

**PRESS ENTER TO CONTINUE**

**ENTER LC, LIST, COURSES, SJ, SUBJECT HEADINGS, CG, CURRENT CATALOG, TR-TECH BULLETIN**

**FIGURE: 21.**
### Figure 24

**USER/VENDOR INFORMATION REQUEST**

**Record Code Type:** X

**User/Vendor Name:** X

**Type of Information:** X

**Complete/Partial:** X

Press enter to continue.

Enter U or V for Code Type, C or P for Complete/Partial, Enter Name If Partial.

---

**Item** | **Display** | **Buffer Address** | **Orders**
---|---|---|---
1 | 03 28 | AN | REQ.
2 | 04 28 | AN | OPT.
3 | 05 28 | AN | OPT.
4 | 06 28 | AN | CYT.
5 | 07 28 | AN | OPT.
6 | 08 28 | AN | REG.
fairly quick. The system would always give the operator a response for every input the operator enters.

**Security:** The terminal, which is the only mode of input to the system will be capable of being shut off when not in use and locked after business hours. After the system's start operation, the system would require the operator to prove his identity by entering a password. This password, unlike other input, will not be displayed on the screen when entered and would be changed periodically. Each of the remote users would be given unique passwords to access the system.

**Reliability:** The system would only tolerate one simple failure per day (like minor power failure), since it has no alternative systems to use. It is assumed that this simple loss of service would be a failure which can be corrected within a minute or two with no significant loss of data or files. A serious failure in which the recovery takes a substantially longer time is expected to occur only once or twice a year. If an isolated part of the system breaks down (like one of the disk packs in the system, or the printer), it is expected that the vendors of hardware would provide prompt service or replace the malfunctioning part.
**Error recovery:** The system will have integrated journaling and recovery features for the database. It will automatically maintain a journal of all changes made to the database. This journal would include both 'before' and 'after' images of modified portions of the database. When a program ends abnormally, a utility will immediately recover the database. Programs doing retrieval only will not be recovered. Those in the protected update or exclusive update usage modes will be recovered. This utility will perform as a rollback operation replacing 'before' images for the program that terminated abnormally.
**Subject category:** the curriculum area to which a program belongs; each program in the database will appear under one subject category. An alphabetical list of all subject categories in the database will be maintained.

**Course title/Title of program:** the title of the educational program available for the user of the database.

**Course description:** a description of the program contents; it includes the primary purpose, aims and objectives, and special characteristics of the program.

**Sponsor of program/Vendor name:** the complete contact information of the organization offering the educational program. It can be a hardware vendor, a consulting firm, an educational institution, or an association which offers DP educational programs.

**Scheduling/Inhouse/Publicly held:** the vendor indicates whether a program has inhouse presentation available for individual organizations or whether the presentations are to be given at pre-determined geographic locations for the general public.

**Geographic location:** the location preferences of the user; when a vendor supplies this item of information, it shows the different geographic locations where the program is scheduled to be held; up to 5 locations can be indicated in each course information input form.

**Number of participants for course:** when supplied by the vendor, it indicates the usual group size expected or the maximum seating capacity for a program; when supplied by the user, it denotes the number of people expected to attend a program from one organization.

**Instructional staff:** the name(s) of people who conduct the educational program. There may be one or many instructors to teach the same program.

**Fee member/Non-member:** the tuition fees differ for members and non-members of the organization which offers the program.

**Who should attend:** it is a description of the job categories for which the course is specifically designed.

**Registration information:** as the category suggests, it contains information about how to register for a program. It would also include names, addresses, and phone numbers of people to contact for additional information.

**Accommodation:** indicates the accommodation arrangements.
available to the participants of a program; it would also include information on how reservations to the available accommodation are to be made.

Other special information: the category would include any other general information helpful to the user; some of them might be residence characteristics, number of times the program is offered each year, pre-course preparation if any, admission requirements, the cancellation policy of the sponsoring organization, and the kinds of tuition and membership options available (ex: prepaid tuition, billed tuition, associate membership, open enrollment option).

course date preferences: the user indicates the date(s) when he will be available to attend the program(s).

number of days available for course: the estimated number of days that a user can free himself from his normal work to attend a program.

$ amount allocated for fees: estimated amount of money that a user is willing to spend for tuition.

abbreviation of training needs: the estimated knowledge/skills that a user hopes to acquire as a result of participating in the programs — the knowledge that he would apply in the pursuit of his chosen profession.

organization/ individual requesting information: the complete contact information of the user.
CHAPTER III
DESIGN OF THE DATABASE

This chapter will describe in detail the logical design of the TIPS database. This design of the database is an opportunity to plan the organization, use, and management of the data in the TIPS system. The emphasis will be on analyzing the data requirements of the system, and on the accurate reflection of these requirements in the design of the schema. Hence this chapter would contain the following sections:

1) Identification of data organization requirements of the database.

2) Identification of processing requirements of the database.

3) The system description expressed as a data model schema.

4) Description of the schema using the data description language of the DBMS chosen.

Identification of data organization requirements:
Determining the data organization requirements of the TIPS system is the first and most important step in the database
design process. Data organization requirements are best identified by listing all the entities which are of interest to the TIPS system, and the relationships between the entities. An entity in this context is a data item of interest to the system. While doing this it is best to bear in mind that most databases often change, and the TIPS database is not likely to be an exception; it is likely that new data items and new associations between data items would occur. So care has been taken in the grouping of data items so that changes to the database can easily be made. Some of the important aspects that were considered while identifying the entities of interest to the TIPS system were: a) what are the data items (entities) of importance to the system? b) what is the most appropriate name for each data item? c) what facts or attributes are of interest to each data item? d) what are the values for each data item? (for instance course duration can be specified in weeks or days); e) what are the known dependencies between data items? and, f) what are the unique identifiers for each entity? (for instance, is course title a unique identifier for the programs offered, or is it a combination of subject group and the name of the vendor of the program?).

The result of this series of questions was a list of entities and their attributes for the system; this was similar to establishing a data dictionary of all database
names and their meaning. This aggregate list is shown in figure 26. There are three areas of interest to the user in this list: a) the course area, b) vendor area, and c) the user area. As their names suggest, the course area will handle all data related to the course offerings, the vendor area will keep details of each of the vendors, and the user area will support the service aspects of the TIPS system.

The next task in the design process was to identify the relationships or connections between these entities or data items. For example, course titles and subject categories are related since it is known that every course title belongs to a subject category. Similarly course titles and vendor names are related because courses are offered by vendors. Relationships between entities were identified by asking the following questions: 1) what are the known relationships between entities? 2) what is the appropriate name for each relationship? 3) what is the mapping property of each relationship — whether it is 1:1, 1:M or M:M? 4) which are the most important relationships? (those that can be used meaningfully) 5) what are the relationships which are not used, but are still meaningful?

The relationships obtained from this process for the TIPS system are shown in figure 27. The mapping property of each relationship as well as the direction of the mapping is indicated beside each of them. There are many ways in which
<table>
<thead>
<tr>
<th>Entity</th>
<th>Relationship</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>course subject</td>
<td>1:M</td>
<td>from subject category to course title</td>
</tr>
<tr>
<td>course vendor</td>
<td>1:M</td>
<td>from vendor name to course title</td>
</tr>
<tr>
<td>course location</td>
<td>1:M</td>
<td>from course to public locations</td>
</tr>
<tr>
<td>course in-house</td>
<td>1:M</td>
<td>between course and in-house details</td>
</tr>
<tr>
<td>course evaluation</td>
<td>1:M</td>
<td>from course to evaluation</td>
</tr>
<tr>
<td>vendor particulars</td>
<td>1:1</td>
<td>between vendor information and vendor details</td>
</tr>
<tr>
<td>user details</td>
<td>1:M</td>
<td>from user name to user details</td>
</tr>
<tr>
<td>vendor details</td>
<td>1:M</td>
<td>from vendor name to vendor details</td>
</tr>
</tbody>
</table>

**Figure:** 26.
DATA ENTITIES AND ATTRIBUTES OF THE TIPS SYSTEM

COURSE AREA

course: course title, subject category, vendor name, type of program, instructors' name, location, date, duration, type of participants, registration information, accommodation, other details.

type of program: in-house, public, fee, other details.

subject category: course titles, pre-requisites for courses.

evaluation: course title, vendor name, location, date, duration, evaluation details.

VENDOR AREA

vendor: vendor name, address, title of course, date of offer, date of last transaction.

program: course title, subject category, location, date, duration, instructor, fee, type of program.

registration: course title, location, date and number of participants, fee, type of accommodation needed.

USER AREA

user: name, address, subject category, course title, training needs, date of request, number of participants, fee available, number of days available for program, date of last transaction.

FIGURE: 27.
these entities can be associated to form a logical database. An attempt is made here to design a model that will give a near optimal grouping of data items, one in which most of the redundancies have been eliminated. The resulting minimal structure or canonical schema is shown in figure 28. This canonical schema represents the user's view of the database; at the same time it is independent of individual applications as well as the hardware and software mechanisms which would be employed in using the data. The first bubble in each group are the keys. These keys and their associations are shown in red. The complete mapping does not include any M:M associations. Each course record is dependent not only on the subject group but also on the name of the vendor of the program. Therefore a concatenated key has been introduced -- subject code + vendor name abbreviation (7).

Identification of the data processing requirements: The second step in the design of the TIPS database was to identify the data processing requirements of the system. All the anticipated transactions that require access to the data stored in the database have been included here. For each, it is necessary to identify its nature (retrieval or update), its frequency, and its purpose together with the part of the database it will affect. A list of all transactions and their characteristics have already been
Figure 28. Bubble chart/canonical schema of the 'TIPS' database.
covered in great detail in the functional specifications. Therefore we will just identify the database entities and relationships that will be involved in each transaction, together with a brief outline of the data access.

It must be mentioned here that even though information for update would be typed-in by the users from remote terminals as part of their input for information retrieval, no real-time updating of the TIPS database would be possible from remote locations. All of the update information to the database would be collected in a transaction file on disk, and merged into the database at the end of the day.

The course information request transaction: accesses the course region of the database in a retrieval mode, and accumulates update information for the user region. The transaction retrieves information from the following records -- the subject-code-root, the vendor-info-root, the course-seg and the user-vendor-root; depending upon the user's needs, it also accesses the c-inhouse-seg or the c-location-seg records. The update procedure as a result of this transaction, involves checking the user-region to see whether a user-vendor-root record already exists for the user. If one does not exist, a new user-vendor-root record and a u-user-seg record for that root record are created; otherwise only another u-user-seg record is created for an existing user-vendor-root record.
The course evaluation request transaction: this transaction, like the previous one, accesses the course region in a retrieval mode and provides input for the update of the user-region. It retrieves information from the course-seg, c-location-seg, c-evaluation-seg, and user-vendor-root records. When a new u-user-seg record is created, the u-training-needs field of the record would contain the entry "evaluation-request" for this type of transaction. Creation of a new user-vendor-root record would also take place if there is none existing for that particular user.

The course contents input transaction: is either used to create records in the database or to modify existing ones; so both the course and the user regions are accessed in an exclusive update mode. If new information on courses are being added, the following records would be created -- the subject-code-root, the vendor-info-root, course-seg, c-location-seg(s) and/or c-inhouse-seg, the user-vendor-root, and u-vendor-seg records. If the transaction is used to make modifications, any of the above-mentioned records are accessed and the necessary changes made.

The course evaluation input transaction: is used to create or modify c-evaluation-seg records. The database is
accessed in an exclusive update mode. The c-evaluation-seg records are reached via the course-seg records and either a new evaluation record is created or an existing one modified.

The system information retrieval transaction: is used just to retrieve information from the course-seg records and/or the subject-code-root records.

The user/vendor information retrieval transaction: as the name implies, accesses the database in a retrieval mode to get information from the user-region. This transaction accesses the user-vendor-root, the u-user-seg and/or the u-vendor-seg records.

Design of the data model schema: The system is next expressed as a data model schema, a graphical description of the proposed system according to the data model of the DBMS under consideration. It has been proposed that an existing commercial DBMS, namely DBMS-11, be used.

DBMS-11 is a version of IDMS, and is a CODASYL standard database management system. It uses the set definition as the basic building block with which complex data relationships can be defined. DBMS-11 supports multi-level sequential, hierarchical and network data structures. DBMS-11 will allow each application program in the TIPS
system to access a subdivision of the database through a single set of commands that act as extensions to COBOL, the programming language that is to be used to state user problems (6,8).

Figure 29 depicts the schema diagram for the TIPS database. It gives the names of all the record types and data items and specifies the relationships between them. Each block is a record type. The solid lines connecting the blocks show associations between the record types. In our schema, there are nine record types with eight associations between them. The subject code-root and the vendor-info-root are both connected to the course-seg indicating that the key to the course-seg is a combination of subject-category and the name of the vendor who supplies the program. Each course-seg can have one in-house-seg record and a number of location-seg and evaluation-seg records. Similarly, a user-vendor-root can have a number of vendor-seg records if it is a vendor-root, or a number of user-seg records if it is a user-root. It is possible to access a vendor-info-root or a subject-code-root from a course-seg, since there are bi-directional links between subject-code-root and course-seg on the one hand, and vendor-info-root and course-seg on the other.

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Figure 29. Schema of the 'Tips' database.
The dashed-lines indicate cross references. They do not provide any additional information besides indicating linkages in files which enable data to be located more quickly. The dashed-line between the vendor-info-root and user-vendor-root signifies that the two record types have the same keys, and one of the record types can be retrieved easily if the key to the other record is available. The primary keys in each of the record types are underlined. The secondary keys are shown with a double-arrow link indicating what it points to.

For a network system such as DBMS-11, the system description must be transformed into data structure diagrams. Each data structure diagram is a logical means of showing the set relationships which exist among record types within a subschema. Each record is represented by a rectangular box containing the general characteristics of the records. Sets are represented by arrows which connect the rectangular boxes. The arrow points from the owner record type of the set to the member record type.

There are two subschemas in the TIPS database -- course-file and user-file. Figure 30A is a data structure diagram for the course-file and figure 30B for the user-file. Subschema course-file consists of six record types and five sets. The subject-code-root record has a location mode of calc; that is, it can be retrieved
Figure: 30A. Data Structure Diagram of the Course-file in the 'TIPS' Database.
Figure: 30B. Data Structure Diagram of the User-file in the 'TIPS' Database.
directly using the subject-code. The record is stored within the course-region. The subject-code-root is the owner of the course-subject-set which contains course member records. It is a fixed length record and there is only one occurrence of a particular subject-code in the course-region.

Each vendor-info-root is the owner of the course-vendor-set containing course-records as members. This record is also retrieved directly using its key which is the abbreviation of the vendor name. This too is a fixed length record and does not permit duplicate records to exist in the database.

The course-seg record has a location mode of calc based on the value of subject-code + vendor-abbreviation which is the first data item within the record. It is the owner record for three sets -- inhouse-course-set, course-location-set and course-evaluation-set.

The location-seg record has a location mode of via the course-location-set. This means that the location-seg record occurrences will be stored physically as close as possible to the course-seg record to which they belong and from which they can be accessed. It permits duplicate records to exist, and the new records are to be positioned last in the series of records.
The inhouse-seg is a member of the inhouse-course-set and is also located as close as possible to the course-seg record. There can only be one inhouse-seg record to every course-seg record.

The evaluation-seg record has the same characteristics of the location-seg record. It too is accessed via the course-seg. The duplicate evaluation-seg records are to be placed last in a series of records.

The user file subschema consists of three record types and two sets. The user-vendor-root is the owner of the sets -- the user-set and vendor-set -- and the user-seg and vendor-seg are the member records. The owner record can be retrieved directly using the key field which is the user/vendor abbreviation. The two member records are accessed via the user-vendor-root. Duplicates for the owner records are not allowed to exist, while duplicates to the member records are stored last.

The set characteristics of the database are illustrated in figure 31. The name of each set in the database, the owner record types of each set as well as the member record types, the set linkage, the set order, and the nature of the sets -- whether they are manual, automatic, optional or mandatory -- are all depicted in figure 31. For example, the vendor-set has the user-vendor-root as the owner record and the u-vendor-seg records as members. The set has next,
Figure: 31. Set Characteristics of the 'TIPS' Database.
prior, and owner pointers; it has an order of last, which means that a new record occurrence is connected into the set such that it will be the last record encountered in the next direction of the set. This is equivalent to the FIFO method. The set has a membership type of MA -- mandatory automatic -- which means that set membership is automatically established by the DBMS when the member record (u-vendor-seg) is stored in the database. Once established, set membership is permanent as long as u-vendor-seg remains in the database. The DISCONNECT and CONNECT statements cannot be performed on u-vendor-seg.

**Description of the Schema DDL:** The logical design of the TIPS database schema outlined above is described in DBMS-11 with the SCHEMA DDL (schema data description language). This SCHEMA DDL gives a complete description of the database, which includes the names and descriptions of all the data items, records, sets, and areas in the database. The SCHEMA DDL is very similar to CODASYL's data description language.

Figure 32 gives an example of the SCHEMA DDL for the TIPS system. The DDL contains four types of entries which are written in the following sequence: 1) one schema entry which identifies the schema name as course; 2) one or more area entries. The TIPS database has two areas namely the course-region and the user-region; 3) record entries which
Images by command.
Note all.
Journal CRSBASE
   size 1 transaction.

Assign course-region to program
RPP 50
Backup before images
Buffer 4
Calc 2 RPP
First page is 100
Last page is 10000
Page size is 512 words.

Assign user-region to sysuser
RPP 50
Backup before images
Buffer 4
Calc 2 RPP
First page is 10100
Last page is 20000
Page size is 512 words.

Schema name is course.
Area name is course-region
privacy lock exclusive update is USONLY
privacy lock for retrieval is TIPS.

Area name is user-region
privacy lock exclusive update is SYSUSER
privacy lock for retrieval is TIPSUSER.

Record name is subject-code-root
location mode is calc using subject-code
duplicates not allowed within course-region.
  02 subject-code   pic x(6).
  02 prerequisites   pic x(200).

Record name is vendor-info-root
location mode is calc using vendor-abbrev
duplicates not allowed within course-region.
  02 vendor-abbrev   pic x(4).
  02 registration-info   pic x(200).
  02 other-info   pic x(200).

Record name is course-seg
location mode is calc using c-course-key
duplicates not allowed within course-region.
  02 c-course-key   pic x(10).

Figure: 32.
<table>
<thead>
<tr>
<th>Field Name</th>
<th>PIC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>c-course-title</td>
<td>x(30)</td>
</tr>
<tr>
<td>c-program-code</td>
<td>x</td>
</tr>
<tr>
<td>c-instructional-staff</td>
<td>x(100)</td>
</tr>
<tr>
<td>c-course-description</td>
<td>x(1000)</td>
</tr>
</tbody>
</table>

Record name is c-inhouse-seg
location mode is via inhouse-course-set
within course-region.
02 ci-type-code             | x          |
02 ci-terms                 | x(150)     |
02 ci-fee-member            | 9(5).99    |
02 ci-fee-nonmember         | 9(5).99    |

Record name is c-location-seg
location mode is via course-location-set
within course-region.
02 cl-type-code             | x          |
02 cl-geographic-area      | x(20)      |
02 cl-location              | x(30)      |
02 cl-date                  | x(8)       |
02 cl-duration              | x(2)       |
02 cl-no-participants       | x(3)       |
02 cl-accomodation          | x(200)     |
02 cl-fee-member            | 9(5).99    |
02 cl-fee-nonmember         | 9(5).99    |

Record name is c-evaluation-seg
location mode is via course-evaluation-set
within course-region.
02 ce-location              | x(30)      |
02 ce-date                  | x(8)       |
02 ce-duration              | x(2)       |
02 ce-instruction-method    | x(2)       |
02 ce-presentation-evaluation | x(2)    |
02 ce-session-content       | x(400)     |
02 ce-session-reaction      | x          |
02 ce-course-effectiveness  | x(16)      |
02 ce-course-applicable     | x          |
02 ce-overall-reaction      | x          |
02 ce-additional-comments   | x(400)     |

Record name is user-vendor-root
location mode is calc using uv-key
duplicates not allowed within user-region.
02 uv-key                   | x(4)       |
02 uv-name                  | x(30)      |
02 uv-address               | x(40)      |
02 uv-last-transaction      | x(8)       |

Figure: 32 (cont'd).
Record name is u-user-seg
  location mode is via user-set
  within user-region.
  02 u-training-needs pic x(200).
  02 u-request-date pic x(8).
  02 u-no-participants pix x(2).

Record name is u-vendor-seg
  location mode is via vendor-set
  within user-region.
  02 v-program-type pic x(60).
  02 v-offer-date pic x(8).

Set name is course-subject-set
  mode is chain linked to prior
  order is sorted within c-course-key
  owner is subject-code-root
  member is course-seg
    mandatory automatic linked to owner
    duplicates not allowed
    set selection is current.

Set name is course-vendor-set
  mode is chain linked to prior
  order is sorted within c-course-key
  owner is vendor-info-root
  member is course-seg
    mandatory automatic linked to owner
    duplicates not allowed
    set selection is current.

Set name is inhouse-course-set
  mode is chain linked to prior
  order is first
  owner is course-seg
  member is c-inhouse-seg
    mandatory automatic
    set selection is current.

Set name is course-location-set
  mode is chain linked to prior
  order is sorted within cl-geographic-area
  owner is course-seg
  member is c-location-seg
    mandatory automatic linked to owner
    duplicates last
    set selection is current.

Figure: 32 (contd).  87
Set name is course-evaluation-set
  mode is chain linked to prior
  order is last
  owner is course-seg
  member is c-evaluation-seg
  optional automatic linked to owner
  set selection is current.

Set name is user-set
  mode is chain linked to prior
  order is last
  owner is user-vendor-root
  member is u-user-seg
  mandatory automatic linked to owner
  set selection is current.

Set name is vendor-set
  mode is chain linked to prior
  order is last
  owner is user-vendor-root
  member is u-vendor-seg
  mandatory automatic linked to owner
  set selection is current.

Sub-schema name is course-file
  privacy lock is program.

  Area section.
    copy course-region.

  Record section.
    01 subject-code-root.
    01 vendor-info-root.
    01 course-seg.
    01 c-inhouse-seg.
    01 c-location-seg.
    01 c-evaluation-seg.

  set section.
    copy course-subject-set
    course-vendor-set
    inhouse-course-set
    course-location-set
    course-evaluation-set.

Sub-schema name is user-file
  privacy lock is patrons.

  Area section.

Figure: 32 (contd). 88
copy user-region.

Record section.
  01 user-vendor-root.
  01 u-user-seg.
  01 u-vendor-seg.

Set section.
  copy user-set
  vendor-set.

End-schema.

Figure: 32 (contd).  89
specify details of the data items in the records. The nine record types in the TIPS database are listed here together with all their data items described in a fashion similar to COBOL; 4) set entries which define the grouping of records into set types. A complete description of the seven sets in the TIPS database are given here; their owner and member segments are identified, and their membership types, order, and mode of access are all specified.

Besides the above entries the DDL also includes a brief description of the subschemas; they document the names of all areas, sets and records included in each of the subschemas. The TIPS database has two subschemas, the course-file and the user-file. The course-file includes the area user-region, six record types and five sets. The user file encompasses the area user-region, three record types and two sets.

The privacy locks for the TIPS system have been specified at the area level and the subschema level. The privacy locks at the subschema level are PROGRAM for the course-file, and PATRONS for the user-file. There are two privacy locks for each area, one for retrieval and another for update of the data. In the course region area, the privacy lock for update is USONLY and for retrieval it is TIPS. In the user-region, the privacy lock for retrieval is TIPSUSER, that for update is SYSUSER.
The database design employed above would result in requiring between 2473 bits and 14178 bits (619 words - 3545 words) of storage per course record. The actual size of a course record would depend on the number of occurrences in each of its member record types. The use of fixed length records seems to make this figure somewhat larger than necessary. User data is expected to be compressed about 50% when the database is loaded, but there would also be a 25% increase in the total number of characters stored due to pointers, directories, control blocks and work areas --- features which are necessary in order to manipulate the user data. Since the database is not expected to have more than 2000 records at any one time, the allocation of two disk packs --- each with 44 million words of storage --- would be more than sufficient to hold the contents of the TIPS database.
Determine requirements of the system: The choice of hardware is one of the most important decisions in the design of any information system. Therefore, prior to equipment selection, it would be helpful to present the hardware and software requirements deemed necessary for the TIPS system. The approach used here is to study the functional objectives and making sure that the hardware selected helps to attain these objectives. Such an approach will keep the system design on the track and inhibit the inclusion of needless complexity. A review of all the data processing transactions the system is to perform indicates the need for the following:

a) a stand-alone minicomputer

b) a data base management system

c) disk drives which offer unlimited storage of data

d) communications equipment to help the users to interface with the minicomputer

e) a console terminal for data entry into the system
and a line printer to print the reports.

A minicomputer has been decided upon for the following reasons: a) the volume of transactions to be processed are not large enough to warrant the acquisition of a large computer; b) the cost of hardware chosen would be kept to the minimum if a minicomputer is chosen; and c) a mini is easier to repair because it has considerably less hardware than a larger machine. Since the TIPS system is to be an on-line, interactive system, a console CRT is necessary for data entry and information display functions. The line printer would provide the printed reports for distribution to the users. It is felt that the vast amounts of data that the system will collect and distribute would be handled most efficiently by a database management system. It has been decided that the database management system chosen should conform to industry standards, particularly CODASYL's Data Base Task Group standards.

The TIPS system would be a terminal oriented communications network. The pattern of data flow in this network would be inbound from a remote user-terminal to the minicomputer which would perform the data processing and data retrieval function that is called for, and then outbound back from the minicomputer to the same remote terminal. The remote terminals would be connected with the main computer by means of communication facilities offered
by common carriers like the telephone companies. Switched telephone lines are to be used because the volume of data flow between a remote terminal and the minicomputer are expected to be relatively low, and a full-time leased line cannot be justified for this type of use.

**Availability of System Requirements:** A brief survey of the minicomputer market indicated that a number of vendors now offer minicomputer-based database management systems. But DIGITAL is the only vendor who offers a CODASYL standard DBMS. They offer the PDP-11 series, a major minicomputer system against which all other minicomputers are compared in the market place. DIGITAL designs and manufactures a number of peripherals, processors, software and communications equipment, so that a user can start with any system and be sure of easy compatible upgrades as needs increase.

Since DIGITAL's products match the requirements of the TIPS system, it has been decided that a PDP-11 minicomputer be used, specifically the PDP-11/45, which is a mid-range, very high-speed computer. Figure 33 illustrates the hardware configuration envisioned for the TIPS system.

**PDP-11/45 Features:** The model is organized around a single fast databus called the UNIBUS that connects all system components. The processor, memory and peripheral devices operate as UNIBUS subsystems. The UNIBUS enables devices to
Figure: 33.
send, receive or exchange data without processor intervention and without intermediate buffering in memory.

Memory is the primary storage medium for instructions and data. Minimum requirements for a general purpose time-sharing system is 96 K bytes; the system can be expanded to 248 K bytes in increments of 32 K bytes. A maximum of 63 jobs may be supported depending on processor and partition size.

The PDP-11/45 has a memory management unit that provides the hardware facilities necessary for complete memory management, protection and relocation. The memory management unit prevents a user from making any unauthorized access to those pages outside his assigned area, thus effectively preventing accidental or willful destruction of any other user program or the system executive program.

Disk drives: It is proposed that the RJP04 mass storage system consisting of one disk drive (RP04) and a buffered controller expandable to 8 disk pack drives, be used. Three disk packs (RJP04s) would be used initially. The TIPS database will reside on two of the disk packs and all other application programs will reside on the third disk pack. Each disk pack has a capacity of 44 million 16-bit words. The RP04 drive is a high performance drive with a single head per track. Average access time is 36 milliseconds,
which includes the time for head positioning and rotational latency.

**Multiplexor:** The communications interface between the minicomputer and the switched lines are to be handled by a multiplexor. The DM-11B is a multiplexed interface between 16 asynchronous serial data communications channels and the PDP-11 UNIBUS. It is especially used to interface with Bell type data sets in public switched networks. The DM-11B multiplexor is programmable and it can connect up to 16 remote terminals to the PDP-11/45.

Each line of the DM-11B in the TIPS system will run at speeds of 4800 Bauds. The operating mode will be half-duplex.

In addition to the multiplexor, a single asynchronous interface (model type DL-11) will be used to handle half-duplex communication with a local console terminal and the PDP-11/45 computer. The data rate for this line will also be 4800 Bauds.

**Console CML:** It has already been mentioned before that a video display terminal will be used for communicating with the system. The device used for this purpose will be a Decscope Video Display Terminal, VT52.
The remote users would have the option of using either the VT52 terminal or any of the other terminals manufactured by DIGITAL. They would also be required to use a Data-phone offered by the Bell system companies, which would allow them to use the switched telephone system. This Data-phone is a modem provided by the telephone company, which combines the functions of a telephone and a modulator/demodulator into a single unit. Special features can be ordered by the users on the Data-phone to allow for automatic dialing and answering.

Line printer: One of the peripherals to the PDP-11/45 minicomputer will be a line printer. Model LP-11 printer would be used for this purpose. It is a 132 column line printer. Included with the printer is a control unit for interfacing with the PDP-11/45.

Software: All PDP-11 operating systems offer a variety of programming language processors, but COBOL will be used as the processing language in the TIPS system. The reason for this choice is that COBOL is a good interface between DBMS-11, PDP-11/45, and the application programs.

Maintenance and support: As the largest of the minicomputer manufacturers, DIGITAL has one of the largest sales and service networks besides the large computer companies. It
has over 50 service locations in the U.S.; hence service is expected to be very prompt. The TIPS system, as a PDP-11 user, can buy service on an individual call basis or make use of standard maintenance contracts provided by DIGITAL for on-site preventive and emergency maintenance.

Besides support services, some of the other factors that are to be considered before the system is acquired are:

a) availability -- the system should be available within 3 months after the order is received. DIGITAL will also be expected to demonstrate the basic system to satisfaction before the purchase.

b) gaurantee -- DIGITAL must be made to include a penalty clause to cover loss due to the system not meeting the specifications. Also, modifications to the vendor contract should be made if it does not already include the following: 1) delivery date commitment; 2) documentation requirements; 3) performance test requirements; 4) service commitments, and 5) trade-in
options for use at a future date.
CHAPTER V
DEVELOPMENT SCHEDULE

Once the problem of equipment selection has been resolved, the development of the system under consideration can be taken up in earnest. In this chapter, the steps involved in the development of the TIPS system are discussed, providing a logical framework for getting the system under way. Discussion of the need for periodic review of the new system for possible improvements and problems that might be encountered in the working of the system concludes the chapter.

A lot of preparatory work must be accomplished before the TIPS system can operate on a day-to-day basis. This includes preparing a detailed time and activity schedule, selecting the premises where the hardware equipment would be installed, testing and accepting the new equipment, selecting and training the necessary personnel, writing the documentation standards, the necessary controls and user instructions, creating the database and testing it, coding the programs, testing the programs and the system as a whole, and finally, preparing the start-up procedures and programs.

Development schedule: the TIPS system is expected to take 103
about six months to develop and become operational. A GANTT chart for the system is illustrated in figure 34. Many of the activities in the chart have been grouped together for the sake of simplicity. A number of them overlap each other in execution.

One of the first tasks in the development of the TIPS system would be the placing of the order for the purchase of the hardware equipment. This is done to ensure that the equipment are delivered in time for the system development to progress smoothly without delays.

**Physical requirements:** the layout of the new system is expected to be fairly simple — the minicomputer and peripherals would be located in the systems' office; they would not need any extensive preparations besides the installation of electrical outlets and necessary office furniture for the console terminal and the operator.

**Testing and acceptance of the equipment:** DIGITAL's field service engineers are expected to test the equipment thoroughly after they are installed and before their acceptance by the TIPS system personnel.

**Hiring and training of personnel:** the placement of the equipment order and the scheduling of its installation would be followed by the selection of qualified personnel to
1. PHYSICAL PREPARATION.
2. EQUIPMENT INSTALLATION.
3. PERSONNEL SELECTION.
4. TESTING OF OPERATING SYSTEM.
5. DB CREATION AND TESTING.
6. PROGRAM SPECIFICATIONS.
7. CODE AND TEST PROGRAMS.
8. HARDWARE & PERIPHERALS TESTING.
9. BACK UP, RECOVERY, UPDATES, AND AUDIT TRAIL PREPARATION.
10. PREPARE DOCUMENTATION.
   (STANDARDS, CONTROLS, USER MANUALS, PROGRAM DOCUMENTATION.)
11. OPERATING PERSONNEL TRAINING.
12. PREPARATION OF STARTUP PROCEDURES AND PROGRAMS.
13. START SYSTEM OPERATION.

Figure: 34.
develop the system and carry out the normal operations of the system. It is estimated that two people would be required to do the systems design, database creation, programming and testing of the software, system documentation and other managerial activities. Two other people would be needed to operate the equipment. The latter two would also be in charge of all clerical work, data entry, and other routine office work. Training of the operating personnel as well as those in charge of system development would be a necessity. Courses offered by DIGITAL on the operations of the hardware and the use of the database management system will be utilized for this purpose. This training will be supplemented with on-the-job work exposure.

Remote users would be provided with written procedures describing their activities, as the primary method of learning. They would also be provided with a formal write-up of the system, particularly the usage of the display screens, in order to familiarize them with the workings of the system.

**Documentation:** Two types of documentation would be prepared in the TIPS system; the first type would describe the system, while the second type would be concerned with managing the resources needed to design, develop, and implement the system. Project initiation documents like the system summary and functional specifications fall into the
first category; since these have already been discussed in great detail before, they will not be mentioned here again. Reference will be made of operational documents and other system management documents like system specifications, program documents, run summaries, user manuals, and system control documents.

al System specifications: this document would include all information needed to define the system from programming, testing and on to implementation.

al Program documents: two types of program documents would be developed for the TIPS system. 1) program specifications which would describe the activities performed by each program in the system, and 2) program documentation which would describe the program logic for each application, and the activities to be performed by the system personnel in order to use the program.

cl Operations manual: written for the benefit of the operating personnel, these run summaries will be a description of each and every segment of the total set of processing operations. Each one of them will outline the main purpose of the run and its role in the overall processing of the system.
User manuals: these would specify procedures that are required to be followed by terminal operators and other remote users. It will be written in a non-technical language and will cover many of the topics described in the functional specifications, together with all the operating procedures of the terminal. All items directly affecting inputs and outputs would be covered. Each screen layout would be explained in as simple a language as possible without leaving anything to chance. This would be in addition to the self-documenting screen formats, where the basic entries and their meanings would be defined right in view of the user.

System control document: this document will focus on the actions to be taken in the event the system fails to perform as expected. It would also indicate what users should do to avoid a failure. The following controls would be specified as necessary to ensure reliable processing of data in the TIPS system:

1. Processing controls: controls that guarantee that data are accurately and reliably transformed into information. These controls include: a) I/O controls—these describe what constitutes a valid transaction, which data are mandatory or optional, error-checking procedures, default values for erroneous or omitted data, actions to be taken when errors occur, and appropriate user responses; b)
programming controls -- consists of techniques used to assure good processing of data. Some of these techniques include 1) authorization test -- checking a transaction against a table to determine whether a user is authorized to initiate that kind of transaction; 2) character mode test -- a form of validation check which sees that all characters within a field are of the prescribed mode -- numeric, alphabetic, or alphanumeric; 3) completeness test -- a check to see that all the necessary fields are present in a transaction; c) hardware controls -- provided by the manufacturers, they would specify the type of equipment controls that are available and how they perform; parity checks and read-after-write checks are examples of these controls; d) database controls -- procedures would be established and specified that safeguard the data in the TIPS database from loss or destruction. If loss or destruction does occur, then audit trails, roll back recovery and other backup procedures would be implemented to recreate the lost data.

21 Security controls: refers to all the physical and logical preparations taken to be sure that the system is not intentionally disrupted during operations.

31 Administrative controls: these controls involve the administration of the system. These activities cover aspects of overall guidance and responsibilities like a)
assuming leadership responsibilities for the system and coordinating the services provided to the users; b) monitoring staff selection, assignment, and training activities; c) establishing performance standards - determining what is expected of the system, when it is expected, how they are to be done, and by whom.

Creation of the database: the physical generation of the TIPS database would consist of the following four steps:

1) writing the data definition language (DDL) programs which will implement the DBMS-11 schema;

2) loading the data according to the schema using programs specially written for the purpose;

3) interfacing each application program using the data manipulation language (DML) of DBMS-11;

4) testing and running each application program.

Of these four steps, the last two would be carried out as part of the programming and testing phase.

Programming and testing: the writing of computer programs that would be used to access the database is the largest and most time-consuming activity in the development phase of the
TIPS system. This activity starts with the preparation of program specifications; it would be followed by the flowcharting of programs. The logic in the flowcharts would then be translated to a coded program which would be desk checked -- examined closely for flaws and omissions. After that the coded program would be compiled and tested. Simulated input would be used, and attempts would be made to perform all of the related processing steps to produce the required output. The final task would be to prepare the program documentation which would describe what the program does and how it is to be used.

Test the system: once the application programs to access the database have been compiled and tested, the system would be tested to check how the entire logic performs. The focus would be on the flow of data through the entire system. Because the TIPS system would be an on-line, interactive system, a number of application programs, software and hardware features, and an infinite combination of input/output states would all be interacting at the same time. Thus it would be difficult to systematically test all these interactions and combinations. Once an error-condition occurs, it would be very difficult to go back and recreate the situation which caused the error. Hence great care and effort should be taken to do this activity thoroughly if the system is to perform
satisfactorily.

**Operation of the new system:** after the database has been created and the reliability of the new system has been proven, the TIPS system would become operational. Before the start of this step, care must be taken to ensure that the operating personnel have familiarized themselves with the operations and maintenance procedures. Scheduling the operations of the TIPS system initially would be a difficult task. The job would become more routine once the system personnel become familiar with the new system.

Alternative processing plans would be specified in case of equipment failure. These plans would be documented and made a part of the systems' operations manual. They would state explicitly what the critical jobs are, how they are to be handled in case of equipment failure, who will be responsible for the system during down-time, and what deadlines must be met during and after the emergency.

Just after the system becomes operational, the tangible and intangible benefits set forth in the initial cost analysis would be reviewed to verify that these benefits are, in fact, being achieved. Discussions with users and operating personnel would also help in determining how well the TIPS system is performing. Perhaps the most important follow-up activity the system personnel would have to
perform would be to verify that the system controls are functioning properly.
This study has considered the general issues in designing a centralized information dissemination system for data processing training and education. A prototype design has also been presented to illustrate the ways in which the general ideas and concepts can be applied.

A purpose of this study has been to suggest that the success, in terms of developing a centralized system which would accumulate and disperse timely information on DP educational programs, requires an efficient and economic method of collecting and generating the data. A database management system seems to offer an ideal vehicle for the collection and distribution of the vast amounts of data involved.

Our efforts to investigate the design and development of a database oriented information system has led us to believe that it is possible to implement a system like TIPS. However, predicting the post implementation performance of this system is much more difficult because it has no precedents; hence one can only guess its operational performance. Questions like "are the advantages realizable?", and "do the end users really benefit?", are difficult to answer. But our study has convinced us that
the answers are mostly encouraging. The system and the
database have both been designed in a simple and disciplined
manner. There is adequate planning in the design and
documentation of the system. Care has also been taken to
make sure that the cost of developing the system would
remain minimal. With such careful planning and design
considerations the system cannot fail to perform as
expected.

Moreover, it has been amply demonstrated that there is
a severe need for a data processing training information
retrieval system. Given this fact, the above system has all
the essential characteristics - namely, a carefully designed
and centralized database which is easily accessible to all
through a nationwide communications network - to meet the
current and future needs of DP professionals.
REFERENCES


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