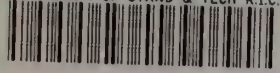


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# Prospectus for Data Dictionary System Standard

Application Systems Division

Center for Programming Science and Technology  
Institute for Computer Sciences and Technology  
U.S. Department of Commerce  
National Bureau of Standards  
Washington, DC 20234



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U.S. DEPARTMENT OF COMMERCE  
NATIONAL BUREAU OF STANDARDS

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September 1980

**U.S. DEPARTMENT OF COMMERCE, Philip M. Klutznick, *Secretary***

**Luther H. Hodges, Jr., *Deputy Secretary***

**Jordan J. Baruch, *Assistant Secretary for Productivity, Technology, and Innovation***

**NATIONAL BUREAU OF STANDARDS, Ernest Ambler, *Director***



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## PREFACE

This report provides Federal computer personnel with information about Data Dictionary Systems, their use and benefits, and initial planning for a Federal standard in order to solicit technical discussions and input from Federal personnel and system producers regarding appropriate content for a Federal standard. Comments and suggestions should be addressed to me at the address below. The conclusions or assertions in this report are subject to change. In particular, objectives and schedules are dependent on funds not yet appropriated. The contributions of Belkis Leong-Hong, John Berg, and Patricia Konig to this report are appreciated.

Dennis W. Fife, Chief  
Application Systems Division  
National Bureau of Standards  
Washington, D. C. 20234

PROSPECTUS FOR  
DATA DICTIONARY SYSTEM STANDARD

Application Systems Division

A Data Dictionary System is an automated information system to assist in organization-wide data management, without restriction to computer data. This report describes NBS efforts to develop a Federal Data Dictionary System standard. It discusses the scope and purpose of the standard, its intended uses, general issues being investigated, and the basic project approach.

Key words: Computer program; data dictionary system; data inventory; data management; data standards; database; database management system; documentation; software.

1. PURPOSE OF THIS REPORT

A Data Dictionary System (DDS) is a computer software system that provides for recording, storing, and processing information about data and its usage. Numerous commercial and user-developed DDS packages are available and increasingly are being used [1,2,3]. The National Bureau of Standards has initiated a project to develop a Federal standard Data Dictionary System. This report explains the purpose and various functions of a DDS, its envisioned benefits, and the approach for creating a proposed standard. The report is primarily intended to initiate discussions with Federal users about detailed requirements and with potential vendors about implementing the standard software.

2. DATA DICTIONARY SYSTEM

The Federal government, like all large organizations, collects a large quantity of data for its operations and decision making. Data collection and handling are expensive, and poor quality can impede government services and decision making. For example, problems exist when:

- \* data is collected redundantly by different departments, or data is collected anew instead of finding and using equivalent existing data;
- \* data is collected or recorded inconsistently; for example, different measuring units or codes are applied when similar data is collected by two different groups.

The Data Dictionary System (DDS), when consistently and conscientiously used by data management and computing personnel, will reduce problems such as the above.

## 2.1 General Functions of the DDS

The DDS is itself an information system about all of an organization's significant data and data processing entities. Pertinent entities include individual data items or elements (such as client name or parts on hand), data groups (such as client's dependents), data collection forms, records, files, databases, programs, systems, reports, user procedures, and users. The content of the DDS, often called "metadata" but usually called simply the "data dictionary", consists of formal descriptions of the pertinent entities. An individual DDS entry, hereafter called an entity description, therefore contains important information about a named entity (for example, the data element CLIENT-NAME), but does not contain actual instances of the entity (that is, all existing client names). Rather, the actual instances exist outside of the DDS; as examples, they are data values stored in a database or on a magnetic tape located in a vault.

A DDS may be used effectively to describe data elements and other entities that do not involve computer processing, as well as to describe computer applications. A fully developed data dictionary for an organization or project is a catalog of its data resources, but also is a computer database that fully documents its data collection, processing, handling, and dissemination activities. A DDS is therefore an automated documentation and information retrieval system to support organization-wide data management, without limitation to computer data. A DDS may have more substantial capabilities as an active component of computer applications, as will be described later in this section.

The term "data dictionary", which stems from the early applications that simply catalogued and defined data elements, is no longer completely appropriate and descriptive, but nevertheless continues to be widely used and will be retained in the Federal standard effort until a better term is evident.



To summarize, a DDS provides capability for:

1. Specifying the type of an entity, such as a form, a data element, or a computer file.
2. Uniquely naming an entity and describing it in appropriate terms, such as the range of values of a data element or a narrative description of its meaning.
3. Specifying the flow and the storage locations of data within the organization or within the computer installation.
4. Specifying associations and relationships among the data entities; for example, appearance on the same form, or derivation of one entity from another.
5. Specifying and producing reports about the data dictionary content, such as a listing of all data elements or a cross-reference listing of all entities.

## 2.2 Types of Entity Descriptions

A DDS provides a prescribed set of different entity types; each type has a prescribed set of attributes. These attributes describe an entity of the given type. An entity description is entered into the data dictionary through the DDS as one or more text lines that name the entity and its type, and give values for the applicable attributes. The entity name, type designation, and other attributes must follow the prescribed conventions of the DDS. For example, an entity name may be from one to 30 alphanumeric characters only; the type designation must be one of the established codes, such as EL for data element or SD for source document. For some entity types, an available attribute may be a text field, say up to 150 characters, for entering a narrative description pertinent to each entity.

Figures 1A and 1B present two examples of actual entity descriptions, coded in the language of two different commercial DDS's, DATAMANAGER and DATA DICTIONARY. Figure 2 is a very brief summary to illustrate available DDS's, see [1,2,3] for more information.

FIGURE 1A

Example of a Data Element Entity Description  
(Coded Using DATAMANAGER)

ADD CUSTOMER-NUMBER  
ITEM  
ENTERED-AS CHAR 7  
CONTENTS FORMAT "ANNNNNN"  
  
HELD-AS ALPHANUMERIC  
  
REPORTED-AS PICTURE 'A9(6)'  
  
DESCRIPTION  
'CUSTOMER NUMBER UNIQUELY IDENTIFIES A CUSTOMER ACCOUNT'  
  
CATALOGUE  
'SALES', 'BILLINGS', 'ACCOUNTS-RECEIVABLE'  
  
ALIAS ASSEMBLER 'CUSNO'  
  
NOTE  
'NUMBER ORIGINATES IN SALES DEPARTMENT'  
'SOURCE DOCUMENT NUMBER IS FM2152'  
'USED BY SALES, BILLINGS, ACCOUNTS RECEIVABLE SYSTEMS'  
'USED AS KEY IN THE CUSTOMER NAME AND ADDRESS FILE'  
;

FIGURE 1B

Example of a Source Document Entity Description  
(Coded Using CINCOM's DATA DICTIONARY)

SF-171 SD ADD NAME=AP-FORM DESC='APPLIC FORM FOR FED EMPL',  
ELEMENT=APPL-SYS, FED-REG-SYS, APPLICANT-REC,  
USER=PERSONNEL

FIGURE 2

A Sample of Currently Available Systems

DDS CONTACT NAME AND ADDRESS	HARDWARE	MAIN MEMORY	COST (* )=GSA Sche
DATA CATALOGUE Synergetics Corp 1 De Angelo Dr. Bedford, MA 01730 617-275-0250	IBM 360/370	100-125K	\$12.9K-37K(*)
	UNIVAC-1100	25-35K	\$21.9K-33K(*)
DARCOM US Army Materiel Development & Readiness Cmd. Cmdr. Autom. Logistic Mgt. Activities Attn. DRXAL-DED P.O. Box 1578 St. Louis, MO 314-268-6001	IBM 360/65	150K	Negotiated
IDD CULLINANE CORP 20 William St. Wellesley, MA 02181 617-237-6600	IBM 360/370 IBM 4330/4340 IBM 303x	IDMS DB  stand-alone: 350K virtual	\$15K(*)
PRIDE/Logik M. Bryce & Assoc 1248 Springfield Pk Cincinnati, OH 45215 513-761-8400	IBM 360/370  DEC-10, DEC-20 B-3700, 4800 H6000 ICL-1903 CDC-CYBER	128K	\$27K
RAS/STADES US Navy Data Autom. Cmd. (NAVDAC) NARDAC Bldg. 196 Washington Navy Yard Washington DC 20374 202-433-3571	H 6000 IBM 360/370  UNIVAC-1100	29K	Negotiated

A DDS could also provide for the user to define additional types of entities and their attributes, and then subsequently to enter entity descriptions according to these user defined types.

The conventions and attributes of data entity descriptions are especially important in assessing a DDS. Data descriptions are essential to almost all computer programs. For example, a COBOL application program requires a DATA DIVISION. A database management system (DBMS) requires a description of its database using its Data Definition Language (DDL). Central storage of data descriptions under a DDS can improve data standardization, integrity, and control considerably, if the DDS can compile and output selected descriptions with the form and content required by other software. Many DDS packages are specifically designed for this purpose, so their data descriptions do incorporate the necessary information at least for one software system such as a given DBMS or for a category of software such as COBOL programs. However, the syntax of the DDS language usually differs substantially from that of the DBMS DDL or the COBOL DATA DIVISION.

### 2.3 Types of DDS

There are two principal ways to classify the wide range of capabilities and implementations found in present DDS. One way is according to the DDS capability to provide data entity descriptions to other software. In this respect, the DDS could be called passive or active. Another classification is according to the dependence of the DDS on other software for implementing its functions. Here it could be a stand-alone DDS or a dependent one.

2.3.1 Passive and Active DDS. A passive DDS is an information tool that is only accessed by personnel, to enter or retrieve entity descriptions. With a passive DDS, descriptions of the same data will exist concurrently in other software such as COBOL programs. Changes in the DDS content do not automatically produce corresponding changes in the other data descriptions, and vice versa. Thus a passive DDS does not control the organization's data descriptions directly, although it would assist manual procedures to do so.

An active DDS, through software interfaces and computer operating procedures, provides the ONLY source for data descriptions to other processing components such as compilers, assemblers, and DBMS's. The active DDS assists in the enforcement of data standards and usage throughout the organization and its computer applications. For example, an

active DDS could produce the DATA DIVISION for any COBOL program from dictionary data and parameters supplied in the job stream. The text would be collated with the program source text and passed to the COBOL compiler. Here the DDS is said to be active with respect to the COBOL compiler.

2.3.2 Stand-alone and Dependent DDS. A stand-alone DDS is self-contained; that is, its functions are performed without relying on any other general purpose software such as a DBMS. A stand-alone DDS may be passive or active. Most of the current stand-alone implementations have available the features that make them active when invoked by a user.

A dependent DDS is specifically tailored to operate in conjunction with another general purpose software system, usually a DBMS. It requires the DBMS facilities to perform DDS functions. In some cases, the dependent DDS is implemented as an application under a DBMS, wholly using DBMS facilities. Such an intimate connection does not necessarily mean that a dependent DDS is automatically active with respect to the DBMS. However, it may be easier to invoke facilities that would make the DDS active.

## 2.4 Roles of the DDS

As the central repository of current and accurate information about an organization's data and its handling, a DDS can assist a wide range of management and technical tasks. The following identifies several application areas where use of a DDS is appropriate.

2.4.1 Data Resource Management. Because of the impact of government-directed data collection on the private sector and also the increasing costs of labor-intensive data handling, government agencies are striving to reduce redundant data collection and to improve the utility of existing data resources. A well-developed DDS provides high visibility to similar data elements, forms, and collection procedures, and reliably identifies current holdings [4,5]. Officials who control data collection projects or data usage can use DDS reports to eliminate unnecessary data gathering and to redirect data management to reduce costs and improve overall effectiveness [6,7,8].

2.4.2 Data Standardization. Data collected for one purpose often cannot serve another because inappropriate standards were used in the original collection. NBS is producing selected government-wide data standards under its Data Element and Representation Standards program, but each agency must also undertake data standardization for its unique concerns [9]. A DDS can be used to record the data standards

applied to every data element, and to assist auditing to assure that the required standards are in effect. Moreover, an active DDS can be used as the source of established data standards when needed by various activities, and also can participate in computer processes that edit and validate data against the established standards.

2.4.3 System Development and Documentation. The DDS is a valuable documentation tool over the entire life cycle of systems, procedures, and software [10,11,12].

During the requirements definition of new systems, data is collected about data, processes, and usage requirements. Descriptions of these requirements can be stored in the DDS, and used in conjunction with analysis and design software to analyze various aspects of the system under development. Subsequent changes to the requirements definitions can be easily made and reported to all affected offices and personnel, thereby minimizing errors due to inadvertent omissions or changes.

Using the current descriptions of the entities and their relationships, an active DDS can produce data descriptions for individual software modules. When used in conjunction with design aids, the DDS can produce descriptions of alternative file or database designs for evaluation.

During development, the DDS can produce data division and documentation for application programs. It can also produce the actual DATA DIVISION for COBOL programs, or the data definition language (DDL) for the DBMS

During software testing, the DDS can help generate the test data by using the entity descriptions which already exist in the dictionary. During maintenance and modification, the DDS is useful in determining the effect of proposed changes on other entities in the operational environment.

The DDS can assist in producing documentation concurrently with development, rather than after the fact. As applications are designed and programs are written, the pertinent entity descriptions, entered in the DDS, will eliminate the need to divert manpower later for documentation after the application is completed.

2.4.4 Conversion. Lack of documentation is undoubtedly the primary barrier to economical and complete conversion of applications from one computer system to another. Poor documentation can force an agency to do a system redesign, and inappropriate or fragmented documentation can impede the use of automated conversion aids. Consistent and thorough use of a DDS can substantially eliminate documentation problems

and facilitate conversion. Most importantly, an active DDS can provide the data descriptions necessary to drive automated file conversion software [13].

## 2.5 Potential Benefits

Using a DDS provides economic and technical benefits. A DDS may provide immediate savings, or it may facilitate a continuing technical process by making it easier or more reliable to perform. To summarize the benefits:

- \* Better control of the organization's data resources through improved (i.e., centralized, rigorous, and standardized) data definitions, data handling and data collection.
- \* Improved transportability of data and software between computing environments through standardized data elements and data definitions.
- \* Improved documentation for databases, programs, and systems.
- \* Automatic compilation of data definitions to be included in application programs or in DBMS database definition.
- \* Increased security and access control for the database environment.
- \* Effective aid to software development, modification, and maintenance through configuration management of system components of data and programs.
- \* Increased cost effective use of data resources throughout the system development life cycle.

## 3. OBJECTIVES AND SCOPE OF THE DDS STANDARD

The Federal Data Dictionary System standard will be a software specification which a Federal ADP manager may use to acquire a DDS. NBS will publish the specification as a Federal Information Processing Standard, so that it may be used in conjunction with Federal Property Management Regulations (FPMR) for Federal procurement purposes.

The objectives of the Federal DDS standard are:

1. To define a standard tool that will provide better management and control of a using organization's information resources.
2. To aid in the portability of DDS software, application software, and related data.
3. To facilitate selection, evaluation, and procurement of DDS software.

Portability assists Federal agencies to preserve their investments in programs and data, by providing the ability to transfer computer programs and associated data, including the DDS contents, from one computer system to another, without being required to:

1. Re-create or re-enter data descriptions, except by an unload/reload process;
2. Modify significantly the DDS application that is being transported; and
3. Learn additional user languages in order to communicate with another DDS implementation.

The Federal DDS standard must be flexible to use in a wide spectrum of applications. This will be sought with progressive levels of sophistication or capability provided in the standard DDS. That is, users will find increasing levels of capability available as necessary to meet increasingly difficult application needs within their organization.

Guidance will be provided to Federal agencies to help them determine the appropriate circumstances for using a DDS. The Federal DDS standard will NOT require agencies to use a DDS in all applications. However, whenever an agency decides to implement DDS software or services, the Federal DDS standard specification shall be used as the basis for procurement action.

A number of working assumptions characterize the capabilities envisioned for the Federal DDS standard. The Federal DDS standard will:

1. Specify a computer software system.
2. Describe or specify (as appropriate) the functional interfaces and data interchanges between the DDS and other software components (e.g., operating system) that users may need to operate the standard DDS.



3. Specify a data description language sufficient to document (for human users) the data elements, entities, and aggregates processed in selected application programs and database management software packages.
4. Specify input, output, and manipulation functions and associated language for human users to apply and exploit the DDS.
5. Provide for definition of data element sources and users including forms, computer programs, and organizational units.
6. Provide a flexible facility for selecting and reporting desired information.
7. Specify a stand-alone DDS, independent of specific vendor hardware or supporting software, in order to enhance the portability of DDS applications.
8. Specify, as a minimum, a passive DDS capability that shall be provided in its entirety within a standard-conforming DDS, for documenting and cataloging an organization's data resources.
9. Provide for additional functional modules as options for Federal requirements. This provides desired flexibility in the standard DDS.

#### 4. REQUIREMENTS ISSUES AND PROJECT APPROACH

To define further the Federal DDS standard, NBS is now conducting a requirements study to resolve major issues pertinent to the Federal user community. The study will assess the feasibility of including specific DDS functions and capabilities. To accomplish this, the project approach contains the following elements:

1. Close and continuing interaction with the Federal community to determine:
  - \* whether a particular capability is useful to the Federal community;
  - \* whether a sufficiently important segment of Federal users has indicated the need for a given capability;

- \* whether it is desirable to have the capability in view of known constraints; and
  - \* whether users plan to incorporate the capability in their data processing operations.
2. In-depth technological assessments and intensive consultation with vendors, software suppliers, the research community, and Federal developers of in-house data dictionary systems, to determine:
    - \* whether it is technologically practical to develop a particular capability in the near future, e. g. 3 to 5 year range; and
    - \* if technically feasible, whether it is economical for the software industry to produce such a capability in a competitive market.
  3. Formal solicitation of comments and suggestions from all affected communities throughout the entire developmental and standardization process.
  4. Continuing interchange with related activities in the American National Standards Institute, and
  5. Periodic reports of current NBS plans.

All of these elements indicate the fundamental intent to develop a standard DDS that will be adopted by Federal agencies and implemented by a wide spectrum of suppliers.

At present, NBS staff are identifying, analyzing and defining DDS requirements as found in existing data dictionary systems developed by private suppliers and Federal agencies, as expressed in literature, and as expressed during interviews with selected agencies. From this data, NBS plans to develop a Functional Requirements report in Fiscal Year 1981. NBS plans various dissemination efforts for this report, including media announcements and workshops. This review process, besides confirming that Federal needs are properly represented, will help NBS to refine and elaborate the needed capabilities. Further development will proceed so that official review of a candidate standard would take place early in FY83. Then a recommended standard would be forwarded for approval by the Secretary of Commerce before the close of FY83.

The Functional Requirements report, as the next major step of development, will be organized along the lines intended for the standard. It will establish initial priorities among the wide spectrum of possible DDS capabilities,

extending from and refining the list in section 3 of this document. Commonly provided and needed facilities will be organized into logically and operationally related groupings or modules. More sophisticated and innovative functions will be described also as additional modules to provide the progressive capability levels. This report also will show initial NBS conclusions, drawn from interviews, from the current literature, and from product analysis, on several important requirements issues:

- \* Feasibility of a single user language for all DDS functions;
- \* Needed entity types and attributes;
- \* Active operational modes and interfaces, especially to support automated file conversion and DBMS interfaces;
- \* Features to support distributed database systems and distributed processing systems;
- \* Feasibility of an effective DDS on small computers (minis or micros).

To summarize the estimated schedule for the planned project events:

- \* Fiscal Year 1981 -- Disseminate Functional Requirements
- \* Early Fiscal 1983-- Publish candidate standard in Federal Register
- \* Before Close of Fiscal 1983 -- Transmit recommended standard for approval by the Secretary of Commerce.

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16. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)  <i>A Data Dictionary System is an automated information system to assist in organization-wide data management, without restriction to computer data. This report describes NBS effort to develop a Federal Data Dictionary System standard. It discusses the scope and purpose of the standard, the intended audience, general issues being investigated, and the basic project approach.</i>			
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