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AUTHOR Juckiewicz, Robert; Kroculick, Joseph
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ABSTRACT

Columbia University's major program to distribute its central administrative data processing to its various schools and departments is described. The Distributed Administrative Management Information System (DAMIS) will link every department and school within the university via micrcomputers, terminals, and/or minicomputers to the central administrative computers. Departments and schools can enter, track, control, and report administrative information. DAMIS will also provide local files at the department/school level and, when coupled with the university administrative databases, will satisfy the majority of their administrative information needs in an online environment. Past events since 1977, as well as future projections, are outlined for the following key databases: Human Resources Information Database, Student Information Database, Financial Accounting System, Alumni Records and Gift Information System, and Facilities Management Database. Details of the hardware/software are provided, and the capabilities of the system are identified. The sections of DAMIS are also described: department/school needs and capabilities that are satisfied/are not satisfied by university core systems, and integration of local (department/school) capabilities with university core system capabilities. (Author/SW)

DISTRIBUTED ADMINISTRATIVE MANAGEMENT INFORMATION SYSTEM (DAMIS)

Robert Jucklewicz
Joseph Kroculick

Columbia University
New York, New York

ABSTRACT

Columbia University has embarked on a major program to distribute its central administrative data processing to its various schools and departments. DAMIS will link every department and school via microcomputers, terminals, and/or mini computers to the central administrative computers. Departments and schools will have the capability to enter, track, control and report administrative information that is relevant to their specific needs. DAMIS will also provide local files at the department/school level and, when coupled with the University administrative data bases, will satisfy the majority of their administrative information needs in an on-line environment.

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1. OVERVIEW

1.1 The Problem

Columbia University is a complex organization for many reasons. First of all, Columbia has several campuses with 25 schools and over 200 academic and administrative departments. Columbia has a population of over 30,000 students and employees. Thus, Columbia is not unlike other major teaching/research institutions and not unlike major commercial organizations. Complexities arise not from specific teaching, research, and administrative functions, but arise from the interrelationships of these functions. For example, Columbia incorporates a number of administrative processes and procedures. One example is that the registration process is a centralized function, whereas admission procedures vary from school to school.

In 1979, Columbia commenced a program to replace several key systems with packaged, i.e., vendor-supplied, systems to offset many of its problems. Two such system installations were the Financial Accounting System (FAS), to provide the University with a basic accounting system, and the Student Records System (SRS). Despite the benefits reaped by the departments and schools, much of the information provided by these packaged systems, after four years of installation, are still not timely nor accurate.

Information is disseminated to departments monthly and they usually do not receive a copy of their reports until two weeks after month-end. This dated information, along with the usual voluminous amount of unneeded data, has proven to be too much and too late for departments to make timely decisions. To alleviate this problem, almost all of the departments maintain manual records, and some of them have gone to the extent of computerizing their financial records. In addition, the problems of timely and accurate information by University systems has prompted departments to extend their manual data processing (and automated record-keeping systems in some cases) to these areas.

Record-keeping, whether manual or computerized, represents a duplication of effort for data entry -- once to the department's system and again to the University's main core system. Although this procedure is a burden and an expense to the University, the departments maintain that it is necessary for timely and accurate information. These systems create as many problems as they try to solve. For example, the manual systems do not provide reporting capabilities such as "how much money was spent with vendor X". This information is available, but searching the records manually is too time-consuming. This is also true for departmental computerized systems. One such system, for example, requires 40 hours of uninterrupted machine time to print monthly reports, making easy access to data virtually non-existent.

During the early part of 1982, an extensive survey was conducted at Lamont-Doherty Geological Observatory (one of our research facilities located in Palisades, New York) where there is a computerized local record-keeping system. The Lamont system does not satisfy local needs for two reasons: a) it is cumbersome to use and takes a longer than desired cycle to provide the required information, and b) it does not interface or reconcile

to the University's core systems. The study discovered that although there were technical problems with their system, it did provide them with more current data than available through FAS. The study outlines the strengths and weaknesses of Lamont's system. The strengths are: accessibility, convenience, responsiveness, flexibility, self-reliance, and relevance and the weaknesses are: reliability, capacity, penetration, integrity, integration, and self-sufficiency. Similar results were obtained from discussions with departments at the College of Physicians and Surgeons which had automated record-keeping systems.

From the Lamont study, we identified key benefits that resulted from local record-keeping systems. It was concluded that if the local record-keeping system had been designed as an off-shoot (or integrated with the core systems), many of the problems with the local systems and their relationship to the core systems could have been avoided. The study was completed in June 1982, and soon thereafter the concept of Distributed Administrative Management Information Systems (DAMIS) was formulated.

1.2 Developing a Global Strategy

Before DAMIS could be implemented, we had to devise a **global solution** for creating an administrative systems capability into the 1990's. Essentially, we have a three-fold strategy:

1. Continue upgrading Columbia's administrative core systems. However, the enhancement process would be an on-line, data base management system, report generator environment. Essentially, a program is in place to rebuild our systems, utilizing data base technology. The key University data bases will be the:

   - Human Resources Information Data Base
   - Student Information Data Base
   - Financial Information Data Base
   - Alumni Information Data Base
   - Facilities Management Data Base
   - Health Sciences Management Information Data Base
   - Library Data Base (academic and administrative)

   Other data bases will include Student Services, Public Information, Housing, Materials Control, and Investment.

2. Continue upgrading our administrative computer hardware, communications, and operating system software capability. To that end, we are proceeding with a number of activities to upgrade our hardware, utilities, operating systems software, and data base management system software.

3. The **distribution** of information to schools and departments by **down-loading** or **up-loading** data. This concept is called DAMIS (Distributed Administrative Management Information System).

2. IMPLEMENTING THE STRATEGY

ADMINISTRATIVE SYSTEMS

Basically, the Center for Computing Activities (CUCCA) Administrative Data Processing (ADP) is attempting to satisfy the administrative requirements of specific users, and to build a set of integrated systems that are responsive, online, and considers the needs of departments and schools.

2.1 Human Resources Information Systems

2.1.1 The Past

- In 1977-78, the Personnel Information System (PIS) was implemented to provide the University with fundamental data of personnel information on all Columbia employees (except casuals).
- In 1980-81, the Effort Reporting System was developed and implemented and subsequently incorporated in the new Labor Distribution System.
- In 1981-82, a major modification to the Affirmative Action System was designed, programmed, and implemented.
- In 1982-83, the new Labor Distribution System was developed to overcome numerous problems that were never resolved by the installation of the MSA Payroll System and the Financial Accounting System (FAS).
- In 1982-83, a new Benefits Information System (BIS) was planned and designed. Installation will begin in early 1984.
- A new Applicant Flow System has been programmed and will be implemented in January 1984 to track job applicants.

2.1.2 The Present and Future

The key element regarding HRIS is **redesign** and **integration**. To that end, the following activities will take place:

- The Payroll System and LDS will be on-line in 1984.
- A new BIS will be implemented and integrated with PIS.
- The key Human Resource Systems (including PIS, BIS, LDS, and Payroll) will be integrated via a Data Base Management System (DBMS). Data entry for the systems may be integrated, and the data base will be linked to the IBM Mass Storage System (MSS) so that data accumulated during a ten-year period may be easily accessible.

2.2 Financial Systems

2.2.1 The Past

In early 1980, the Financial Accounting System (FAS) was designed and programmed for the Controller's Office by Information Associates Incorporated (IAI), and was installed under the auspices of Peat, Marwick, and Mitchell. The system, which went live in July 1980, was intended to solve the financial accounting problems of the University schools and departments. Although FAS is reasonably sound, it still does not fully address local needs of the schools and departments. Also during that time, a new IAI Accounts Payable System was installed, which further compounded the problems of central administration, schools, and departments. Additionally, FAS was deficient in the area of Fiduciary Accounting and Governmental Historical Reporting.

- Major modifications were made to FAS in the area of data base and reporting, including development of new detail and summary reports.
- A new Fiduciary System was installed to cost out payments from the investment office.
- The Accounts Payable System was modified extensively to improve the operating and research characteristics of the system; the system was put to improve invoice research.
- In late 1980, the OPG System was developed by CUCCA ADP to track (on-line) progress on all applications for projects and grants, including development of the budgets and tracking of personnel on the projects. It was recently interfaced to FAS to input budgets directly. The system also has several major subsystems, including a Subcontract System, an Institutional Review Board System, and a Patents Subsystem.
- In 1981, a Space Management Inventory System (INSITE II) was installed to track space and inventory for compliance with new government (A-21) regulations. This system tracks and designates all of Columbia's usable space for functional usage by departments and schools. Additionally, the system tracks all inventory of equipment that falls under A-21 classification.
- In late 1982, a new Purchasing System (called CAPS) was designed by CUCCA's ADP. It will be on-line and expected to be operational by early 1984. This system will eventually be extended to schools and departments -- a major enhancement in their efforts to gain control of their environment and to create a timely purchasing operation.

2.2.2 The Present and Future

The key elements of the Financial Systems will be to **upgrade, redesign** and **integrate**. Essentially, the following activities will take place:

- FAS will be extended to the schools and department via on-line.
- A new integrated Purchasing/Accounts Payable System (APS) will be developed which is totally on-line linked to a DBMS and a report writer.
- A proposal is under way to review the possibility of linking the major financial systems to a DBMS. These systems will include FAS, CAPS, APS, DFAFS, OPG.

2.3 Student Information Systems

There are two segments to the Student Information System structure – the central University system, and the school systems.

2.3.1 The Past

- The oldest of the student core systems is the Student Loan System (SLS), which was designed by Information Associates (IAI) and installed in 1977. It gives the University the ability to record both Government and University student loans. This system holds these loans in the appropriate grace period and then issues bills on a monthly, quarterly, or annual basis, reflecting any interest due on unpaid balances.
- In 1979, the University implemented the IAI Billing and Receivable System (BRS). This system coordinates charges, payments, and credits from all departments interacting with a student's financial record. Monthly bills are produced which reflect interest charges if there are any overdue balances.
- In 1981, a Holds Sub-system was installed to provide information to the Registrar regarding students whose accounts were not current in their payment to various areas such as the Bookstore, the Libraries, and the Bursar's Office (Student Loans, Billing and Receivables, etc.). Also, holds implemented by deans or the Registrar are recorded in this system. The process of withholding grades, transcripts of records, and diplomas has been improved by this system.
- A new Student Records System (SRS), also designed and modified by IAI, was installed in January 1982. The features of this system include the recording of registration, course, instructor, classroom site, and grade data. The system not only receives data from BRS, the School Admission System (including data from Barnard and Teachers College), and the Holds Sub-system, but passes student information to the individual school's student record system. In addition, data is provided to satisfy government reporting, including Federal Certification.
- As a result, the reports gave a more meaningful representation of data.

- In January of 1983, On-line Inquiry to the Student Records System (SRSIS) was developed for the Office of the Registrar.
- During 1983, the Admissions and Financial Aid Systems were completed for two particular schools, i.e., Columbia College and the School of Engineering (undergraduate). Using the systems of these schools as models, the School of Nursing will implement an Admissions System and the Faculty of Medicine (at the College of Physicians and Surgeons) will implement a Financial Aid System, both by the end of 1983. A School Student Records System also makes available to both Columbia College and the Engineering School student data for their particular needs, and includes inquiry, updating of information, report generation, and word processing.

2.3.2 The Present and Future

During 1984-86, it is planned to revamp and redesign the Student Information systems. We envision a completely integrated Student Record System (student records, billing, financial aid, housing, and dining services) with direct links to the various school Admission and Financial Aid Systems. The envisioned system will be accessible by staff and students via on-line terminals and will, in "bank-like" fashion, provide a variety of functions. It is expected that the proposed system will replace much of our existing software. We still, however, continue to service the various schools with local admissions, financial aid, and inquiry to the core Student Record System and Billing data bases.

2.4 Alumni Records and Gift Information System

2.4.1 The Past

Alumni information is available primarily from the core system known as Alumni Records and Gift Information System (ARGIS) and is used by the Office of University Development and Alumni Relations. The system contains a data base with records of over 250,000 prospects, of which 165,000 are Columbia alumni. Each prospect record contains biographical, demographic, educational and employment history, and multiple gift records denoting past donations as well as pledges. The system was implemented in 1966 and has undergone many modifications. The most extensive of modifications occurred in 1979 to accommodate fund-raising for the construction of our East Campus dormitory, and in 1982-83 for the current fund-raising Campaign to raise $405 million. Data is used for reports, statistics, labels, pledges, and telefunds. In 1982, the system was put on-line to the University Development Office and several major schools.

2.4.2 The Present and Future

There is currently a major renovation under way to enhance ARGIS for better efficiency in reporting and access of information to improve service. Other enhancements will enable ARGIS:

- to be distributed **on-line** to schools that are capable of inputting their own demographic data and inquiring into their own data bases.
- to be linked with the Student Record System for recent graduate information.

- will automate pledge processing on-line

We also plan to link ARGIS to a Data Base Management System.

2.5 Facilities Management

2.5.1 The Past

During the last two years, a number of systems were implemented for the Office of Facilities Management. In 1981, the MIT INSITE System was installed to keep track of floor space and equipment for Physical Plant. In 1983, a new Work Order Tracking System was installed to track all maintenance work orders. This system currently runs under FOCUS.

2.5.2 The Present and Future

Currently, a plan is being developed to create a completely integrated Facilities Management Information System for energy management, maintenance planning, space planning, maintenance planning, scheduling, and other related functions.

3. HARDWARE/SOFTWARE UPGRADES

A key aspect to supporting a distributed environment is the placement of an adequate hardware/software environment. To that end, an in-depth analysis of the needs of administrative computing was made. The following decisions and plans were devised:

- Central administrative hardware will be upgraded from the IBM 3031 and 4341 to the IBM 3083 and 4341 II, in order to increase capacity by over 50%, and is scheduled for December 1, 1983. Afterwards, the 4341 II will be upgraded to either a Model 12 or 3083.
- Operating systems software will be upgraded in 1983:
  - * VM will be upgraded to VM/SP2-HPOR3
  - * MVS will be installed on the 3083, replacing VS1
  - * The COMTEN 3670, which is now used for administrative communications, will be upgraded to a COMTEN 3690 in order to increase our front-end capacity by 500% and to run the Systems Network Architecture (SNA) [SNA slated for installation in 1984]
  - * Several mini-computers will be integrated into the hardware environment, including a VAX 750 and an IBM S/38.
- A microwave tower has been installed in November 1983 to transmit data between our Medical Center (168th St.) and the Main Campus (116th St.)
- As of November 1st, approximately twelve PCXT workstations have been linked to the administrative network, and data is being downloaded to these PCs as a result. It is expected that this number will quadruple in 1984.

4. DAMIS STRATEGY

The concept behind DAMIS is to distribute central administrative data processing to the various departments and schools. DAMIS will, when fully implemented, link every department and school via personal computers, terminals, and/or mini computers to central administrative computers. Academic departments and schools, as well as administrative departments, will have the capability to enter, track, control and report administrative information relative to their special requirements. In addition, DAMIS will provide local files at the department and school level and, when combined with administrative data bases, will satisfy the majority of their administrative information needs in an on-line environment. The system will

- provide local data editing as it is entered at the user's location to ensure that it is clean before being passed to the core system. A method of correction will be provided to ensure that information is error free, whether the information is released to the core system or remains at the front end.
- provide a filter where data needing approvals will be linked to the appropriate University personnel for examination. Data will then be released to the core system if approved.
- have inquiry access to core system and/or file subsets, depending on what is appropriate. Access capability, via terminals, will allow users to locate information about their files immediately.
- allow users to inquire about their own data. A security program forbidding unauthorized use will be implemented.
- have tracking capability which would allow users to compare cumulative and/or monthly transactions with monthly statements. Reconciliation will be much easier as a result.
- provide local record-keeping that is specific to the user but not necessarily to the central administration. Depending on user needs, it may be appropriate to store record-keeping information on a mainframe or micro-computer.
- provide methods of generating reports, in user-specified formats, by the host or local systems (depending on volume of data).
- allow data to be transferred into local systems for manipulation by the user. Commercially-available software, such as VISICALC, can then be used to obtain information (that previously took too long to get) for making more effective and timely decisions.

DAMIS, when implemented as outlined, will alleviate many of the frustrations departments now have with obtaining correct data from the core systems. The apparent benefits of DAMIS, therefore, will be:

- reduction in time to research problems,
- more easily reconcilable systems,
- consistent and integrated department capabilities as opposed to stand-alone (non-standard) systems;
- potentially control expenditures, resulting in reduction or elimination of overdraft situations;
- reduction of overall processing errors;
- enhancement of local decision-making capabilities by means of down-loaded data to local systems for manipulation by users.

5. THE DETAILS OF DAMIS

The first phase of DAMIS deals with distributing financial information to departments for supporting local decision-making. Initially, we're using IBM's XT personal computer (PC) as a local device, but we will be testing similar applications using IBM's System 38 and Digital Equipment Corp's (DEC) VAX computers. The PC was chosen because of its flexibility and low cost for testing the DAMIS concept of inputting and down-loading University data. Because each of the pilot departments were paying for their own equipment, they also felt that the PC would be helpful in their department, even if the pilot was discontinued.

DAMIS is divided into three main sections:

- department/school needs and capabilities not satisfied by University core systems;
- department/school needs and capabilities satisfied by the University core systems;
- integration of local (department/school) capabilities with University core system capabilities.

5.1 Local Department and School Systems

The local needs are extremely important to users and are the main reason for their enthusiasm. In Phase One, the local system will include a basic bookkeeping system for maintaining immediate information on the status of their accounts. Commercially available software has been evaluated, but we have been unable to find one that encompasses encumbrance accounting and is sufficiently large in scope to handle the complexity of a large University. Therefore, we are developing our own.

The bookkeeping system will use standard accounting procedures, but this is not intended to replace the University's FAS. Rather, it augments FAS with information important to departments, but not necessarily to the University in general. Transactions will be keyed into the PC to update their local bookkeeping system and also go into a separate file for subsequent up-loading to the host systems. A user will be able to inquire, report, and calculate against the local system.

Users are also using commercially-available software for maintaining information locally, i.e., LOTUS 1-2-3 and Aston-Tate's DBASE II. 1-2-3 is being used when spread-sheet applications are needed and DBASE II for data base applications. These were chosen to allow users the option to modify the system for their own requirements. Most are also using a word processing package for combining information from 1-2-3 into text documents.

5.2 Host Systems

The host systems contains information that is invaluable to departments. In the past, this information has not been available to end-users. Through DAMIS, we will be allowing users to gain access to information concerning their own departments.

Phase One of the pilot will allow users to gain access to the on-line FAS and Accounts Payable (AP) systems. Although these on-line systems were previously in use by the Controller's Office, major modifications and screen changes were implemented. A security system allowing users to view only their own data was incorporated.

All of the Administrative Data Processing Systems are on IBM mainframe computers and are accessed by 3270 terminals. Access by PCs via asynchronous links, however, is capable only through a protocol translator made by DATASTREAM, Inc. We will be upgrading to an IBM Series/1 computer.

5.3 Integrated Systems

Integrating local with host systems is the most challenging area, and an area where major savings can be achieved. Information float, i.e., the time it takes for information to pass from one area to the next through the approval chain, can be greatly decreased and the accuracy of data improved with on-line systems. Data available on the host system could be manipulated by PCs using available software already on the market. This should allow users to design specialized reports not available through host systems and not to impact the hosts.

As mentioned previously, the local bookkeeping system will contain a file for up-loading into the host system. In fact, data will go into a queue file on the host which will allow the Controller's Office to review information and approve transactions for updating FAS. Transactions that are not approved will be so noted and left in the queue for appropriate action by the user. Users will only be able to view their own transactions in the queue, i.e., transactions of other users will be invisible.

Transferring data from the host computer to the PC will be possible, as well as formatting for appropriate software packages (1-2-3 and DBASE II). For the pilot, the selection will be made at the host by account number with a pre-defined set of data elements. However, we are evaluating a common user interface that will reside on the PC and allow one standard interface. This interface will make the necessary translation for obtaining information from different systems.

Asynchronous communications protocol will be used for the transfer of data, and was

chosen because it is the least expensive way for communications at Columbia. A program developed at CUCCA called KERMIT will assure data integrity. Because of the distance involved, a communications speed of only 4800 baud will be achieved. A microwave link is being used between the Medical Center and the Main Campus.

The following advantages to integrating the systems will thus be achieved:

- distributed equipment will off-load host cycles;
- users help will fund cost of distributed computers;
- users will have ability to tailor systems for their own reporting requirements;
- users will be responsible for their own data entry for obtaining more accurate and timely information;
- there will be a less need for data entry clerks and data production coordinators;

In order to make the system easy for the occasional user of computer systems, we designed a menu (for use on the IBM PC) which will automatically be displayed once the user starts the system. The menu is mnemonically driven and the use of special keys is not needed. This allows the system to be transported to different PC's without major modifications. A menu bypass system allows an experienced user to navigate through the system with few menus. A security system allows only valid DAMIS users access to the DAMIS programs and files and non-DAMIS users can access to other (non-DAMIS) program and files.

DAMIS is the first project at Columbia where PCs are being placed on managers' desks. The success of DAMIS requires that pilot users gain a knowledge of personal computers and how they interact with host systems. To do this, a training curriculum was implemented. Though PCs are not easy at first, many managers have found that they were not impossible to learn. The Office Automation Group of CUCCA has found that the best way for teaching the uses of the PC was to have students use a computer-based instruction (CBI) course (using selected software packages) after they have attended an overview class. The overview classes last approximately two hours and teach the basic concepts of the operating system or the software package(s). The CBI should encourage students to practice what they are taught as the course proceeds.

After Phase I of DAMIS is complete, the project will be analyzed and, if necessary, redirected. It is expected that the pilot project will provide us with needed information to provide an objective assessment of the project direction. At this point, there are still many questions and a variety of potential solutions. However, until we follow through with a pilot, we will not be in a position to accurately determine which solution is best. It should be noted that this project will not only change automation aspects, but may change basic operating procedures at the department level, the interaction between central administration and departments, and the central administration level.