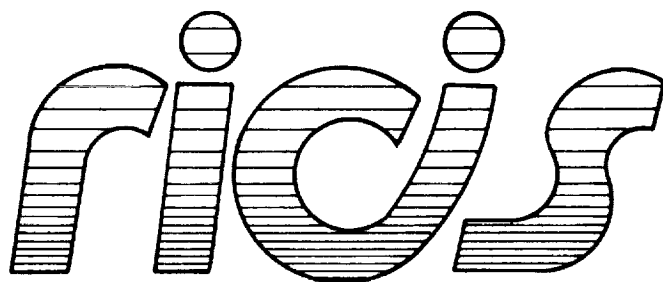# The Johnson Space Center Management Information Systems (JSCMIS) :

An Interface for Organizational Databases

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Research Institute for Computing and Information Systems
University of Houston - Clear Lake

T·E·C·H·N·I·C·A·L   R·E·P·O·R·T

The RICIS Concept

The University of Houston-Clear Lake established the Research Institute for Computing and Information systems in 1986 to encourage NASA Johnson Space Center and local industry to actively support research in the computing and information sciences. As part of this endeavor, UH-Clear Lake proposed a partnership with JSC to jointly define and manage an integrated program of research in advanced data processing technology needed for JSC's main missions, including administrative, engineering and science responsibilities. JSC agreed and entered into a three-year cooperative agreement with UH-Clear Lake beginning in May, 1986, to jointly plan and execute such research through RICIS. Additionally, under Cooperative Agreement NCC 9-16, computing and educational facilities are shared by the two institutions to conduct the research.

The mission of RICIS is to conduct, coordinate and disseminate research on computing and information systems among researchers, sponsors and users from UH-Clear Lake, NASA/JSC, and other research organizations. Within UH-Clear Lake, the mission is being implemented through interdisciplinary involvement of faculty and students from each of the four schools: Business, Education, Human Sciences and Humanities, and Natural and Applied Sciences.

Other research organizations are involved via the "gateway" concept. UH-Clear Lake establishes relationships with other universities and research organizations, having common research interests, to provide additional sources of expertise to conduct needed research.

A major role of RICIS is to find the best match of sponsors, researchers and research objectives to advance knowledge in the computing and information sciences. Working jointly with NASA/JSC, RICIS advises on research needs, recommends principals for conducting the research, provides technical and administrative support to coordinate the research, and integrates technical results into the cooperative goals of UH-Clear Lake and NASA/JSC.

The Johnson Space Center Management Information Systems (JSCMIS)

An Interface for Organizational Databases
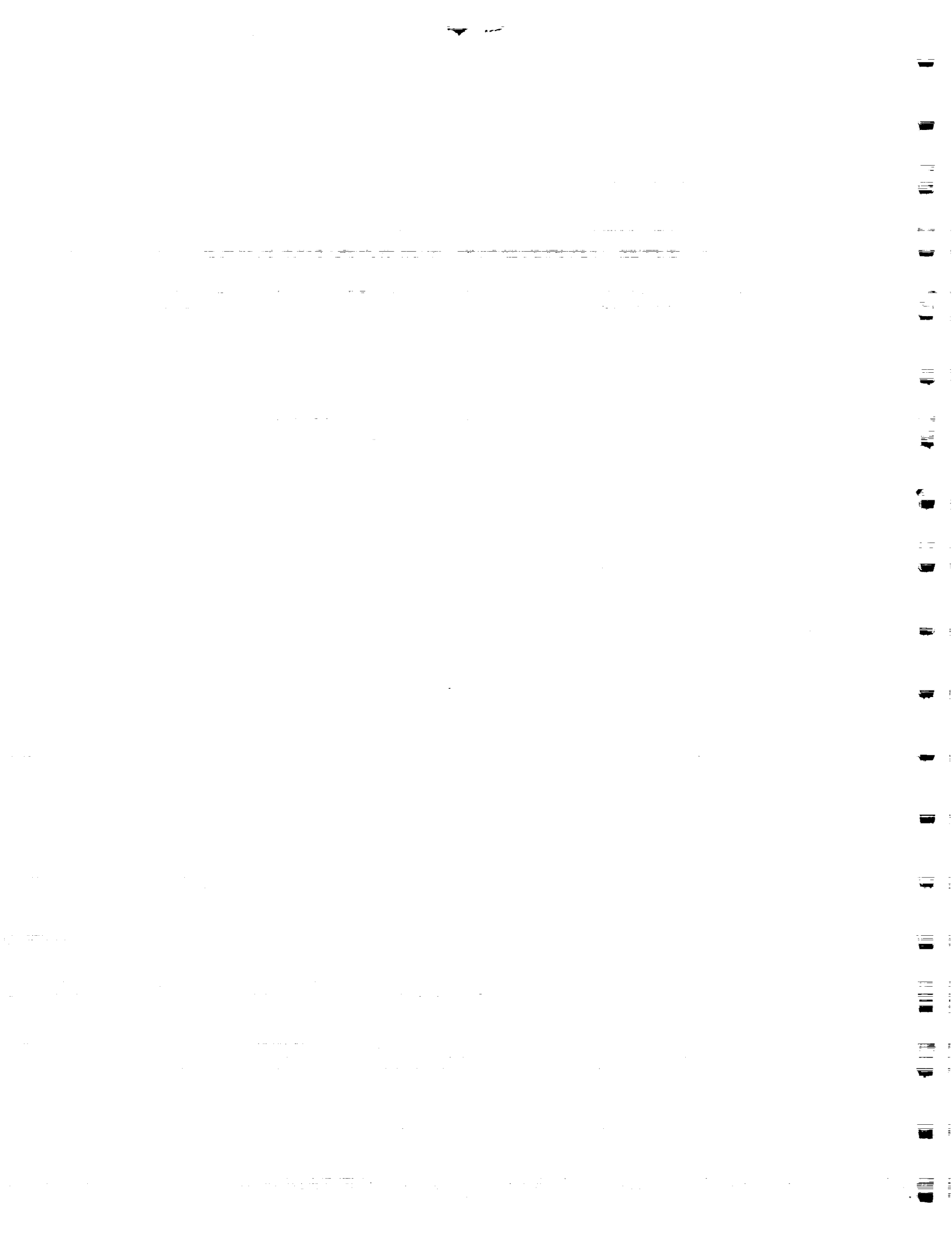
Preface

The research was made possible through funds provided by the Research Institute for Computing and Information Systems at the University of Houston-Clear Lake. RICIS is a cooperative research agreement sponsored by the Johnson Space Center. Dr. Peter C. Bishop, Associate Professor and director of the Space Business Research Center at the Univeristy of Houston-Clear Lake, is the principal investigator and project director for the study. Systems development is being carried out by Carol Dickens and Tim Tulloch of TNT Consulting. David Learned, a Graduate Research Assistant, provides beta testing of the system and user support for the study. Kim Trull, Graduate Research Assistant, was instrumental in the publication of this report.
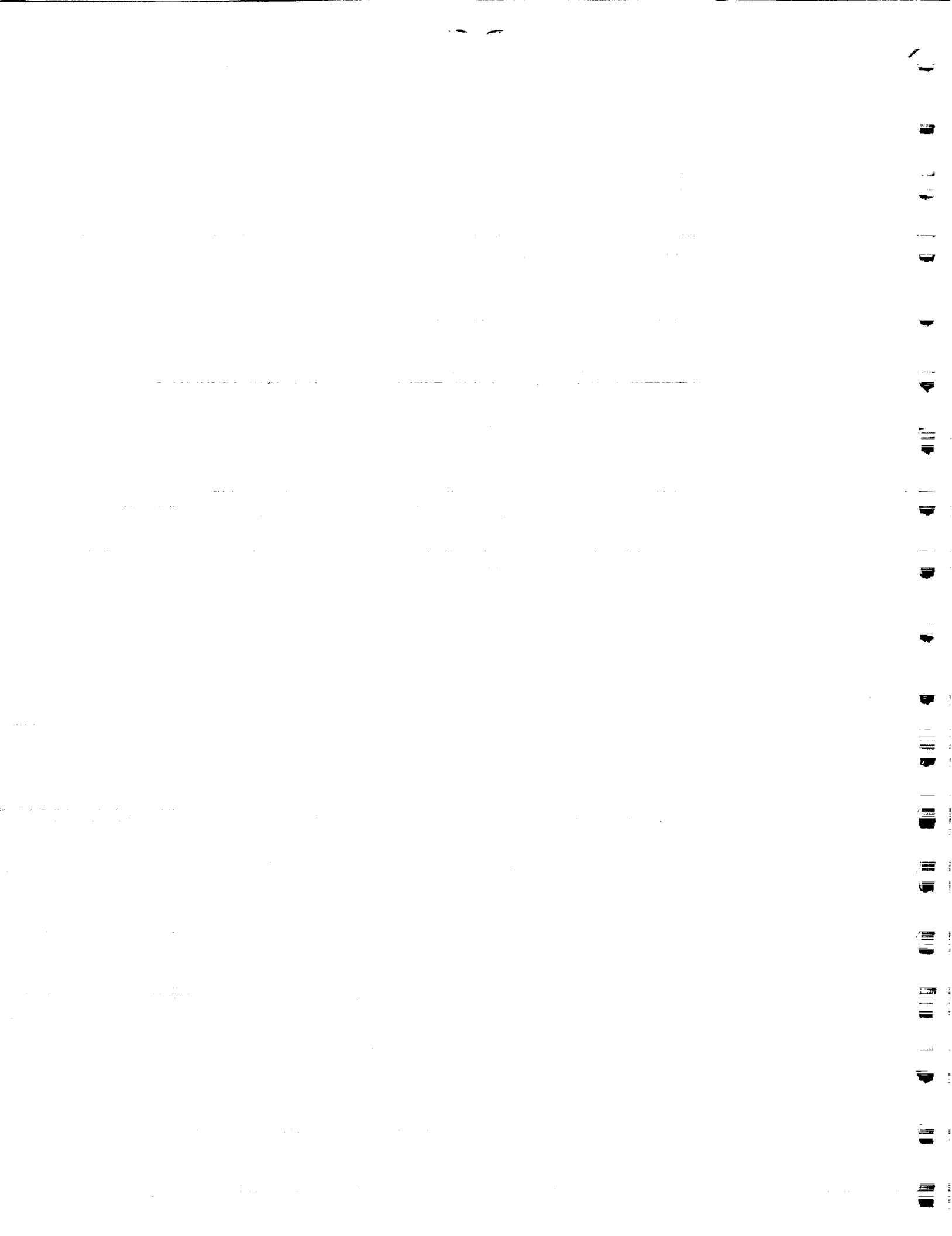
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Management Information Systems
(JSCMIS)

An Interface for Organizational Databases

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Complex organizations still find it difficult to provide access to numerous databases for large segments of their members. Local area networks work fine for small groups, but incompatible systems usually make access across the organization difficult. The NASA Johnson Space Center (JSC) confronted this problem and developed a generic interface to access all databases on the site. This paper describes the design principles and some of the features of this interface. The interface is gaining wide acceptance at JSC and could be a design standard for interfaces to other database management systems.

February 1990
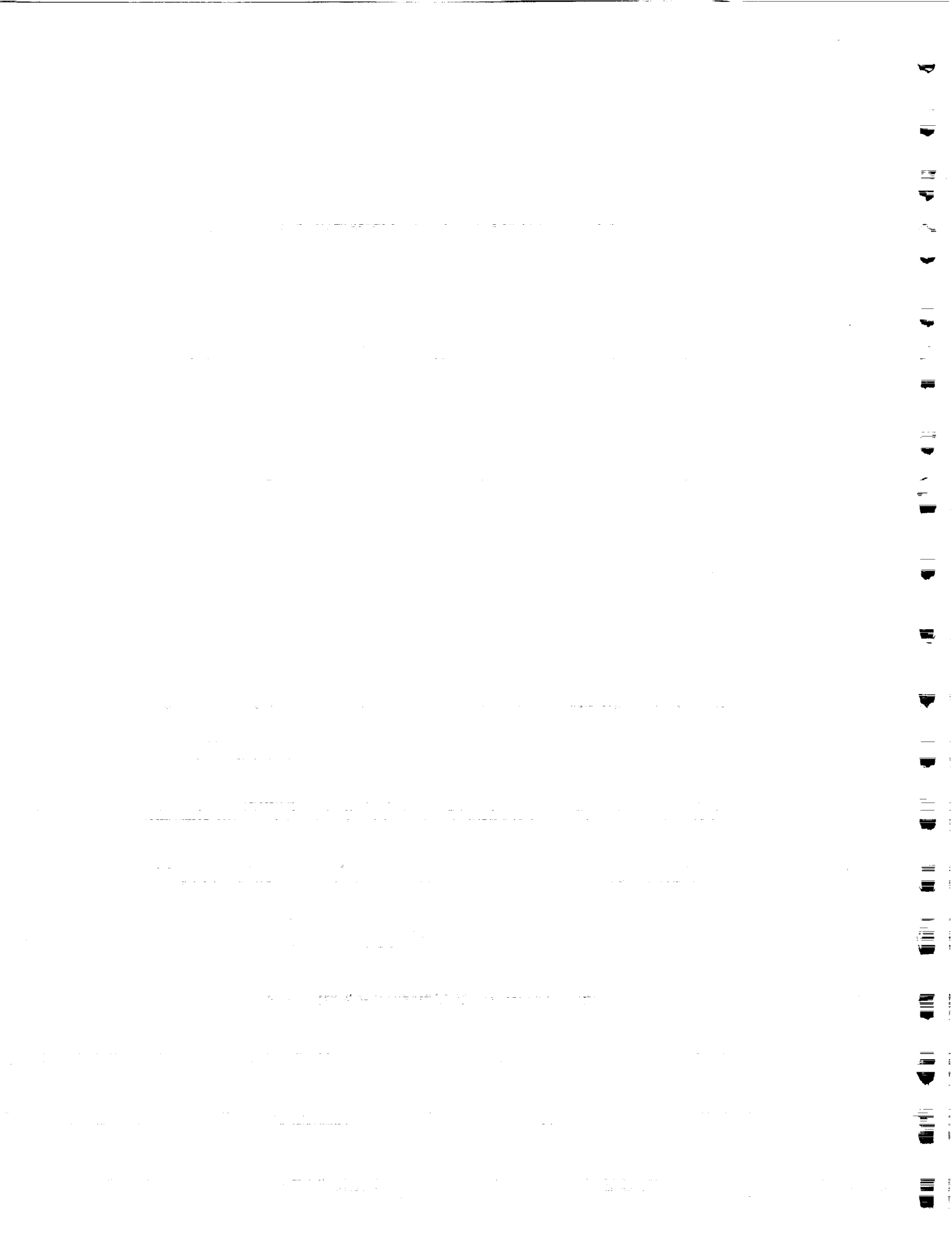
Executive Summary

The Management Information and Decision Support Environment (MIDSE) is a research activity pursued jointly between the Data Processing Systems Division (DPSD) at the NASA Johnson Space Center and the Space Business Research Center (SBRC) at the University of Houston-Clear Lake. The research is designed to build and test a prototype of a generic human interface to databases on the JSC Center Information Network (CIN). The goal is derived from the JSC Strategic Plan for Information Systems. The authors of that plan noted that operational personnel used JSC databases every day. Management and support staff, however, had difficulty getting direct access to that same data. The problem was, of course, that the interfaces had been developed specifically to support operations rather than the type of data which management could use. The diversity of the many interfaces and their relative difficulty discouraged occasional users from attempting to use them for their purposes. The MIDSE activity has approached this problem by designing and building a generic human interface to one JSC database—the personnel statistics table of the NASA Personnel and Payroll System (NPPS). The interface was designed against the following requirements:

. **generic** — use with any relational NOMAD database

. **easy to learn** — intuitive operations for new users

. **easy to use** — efficient operations for experienced users

. **self-documenting** — help facility which informs users about the database structure as well as the operation of the interface

. **low maintenance** — easy configuration to new applications

The two year activity has produced a prototype interface entitled the JSC Management Information Systems (JSCMIS). The interface was developed by Carol Dickens of TNT Consulting. It resides on CIN/PROFS and is available to JSC management who request it. The interface has passed management review and is ready for early use. Three kinds of data are now available: personnel statistics, personnel register, and plan/actual cost. Other kinds of data will be made available early in 1990.

The Problem

One of the recent goals of central computer facilities has been to provide management with easy access to the data that resides on those systems. Because of the complexities of computer networks, database management systems, incompatible formats, and a host of other problems, this goal still eludes most large organizations.

The elements of such a system are a central database that contains the information networked to all workstations. The method for accessing the data should be straightforward, requiring little to learn or remember. The data itself should be the actual data that the organization uses in its day-to-day operations in order to prevent duplication and error. The access should allow individuals to manipulate and customize the data to their purposes, preferably with tools at the workstation.

But for a host of reasons, this simple goal eludes even the most dedicated organizations. Until distributed databases are perfected, central mainframes are still the only vehicles for providing universal access to databases. They are traditionally difficult to use and require the care and feeding of large data processing departments. The networks linking computers and workstations are not fully compatible, and the access path often restricts what the individual can do with the data. Maintaining security in an open database environment is not fully understood. And finally, even perfect technical access cannot change old bureaucratic obstacles to share data that were once hidden from the rest of the organization. For all its power, the image of universal access to databases still eludes most organizations.

Organizations have tried several approaches to solve this problem. One approach emphasizes software running in the standard mainframe environ-

ment. The advantage is that users can get access to the "real" data, the kind that the operational staff is using, rather than copies. The cost of providing that information to many people is usually small compared to the rest of the investment in hardware, software, and operational support for those same systems.

The problem with the mainframe approach has been simply that too few use the access they have because the interfaces are still too difficult to use. An example of this approach is the fourth generation language (4GL). 4GLs were introduced as the user-friendly language which puts direct access to corporate databases within everyone's reach. The reality, however, is different. 4GLs did turn out to be easier for programmers to use, but not for the occasional "end-user." Although 4GLs have proven to be much faster for application development than traditional 3GLs, their syntax requires continuous use to remain proficient. Infrequent users may find themselves leafing through manuals every time they want one small item of information.

Another approach is to use departmental machines, powerful new workstations and local area networks to decentralize the data to departments or individuals who would maintain and share it. Decentralized computing was the major advance for the 1980's so why not decentralize data as well? The reason is that today it is still very difficult. If it is hard to get data from a central mainframe, it will be even harder to get it from different machines, under different formats, and different access paths. Distributed databases promise a solution to this problem, but until they become technically sound and generally available, there is no getting away from a central source for corporate information.

Still another approach places the data in a central source, not the corporate mainframe, but in a dedicated set of hardware and software whose

sole purpose is to provide corporate data to managers and executives. Dubbed "executive support systems", they sport tailored screens of many colors and even highlight the items that executives should pay attention to. They are easy enough to use so that even the most computer-phobic managers will not be afraid to use their touch screens to search the database for "the right information."

But nothing comes for free. These systems are expensive—dedicated hardware and software, dedicated programmers to create the databases and the screens (and to keep them current), and dedicated data entry personnel to keep the data current. Without a lot of support, these multi-colored report generators may contain data that is as out of date as the printed report used to be. Executive information systems are not the answer to **universal** database access, but rather, are usually limited to the executive suite.

The answer lies rather in adapting the philosophy of executive support systems to the mainframe itself. That's where the real data is located and where today's operational networks terminate. This paper describes an approach that achieves that goal.

The Setting

The NASA Johnson Space Center (JSC) is the U.S. center for manned space operations. JSC is responsible for selecting and training astronauts and planning and conducting their missions. JSC also participates in many research and development projects with other NASA organizations. JSC employs approximately 3,500 civil servants who are in turn supported by 10,000 contractor personnel in the immediate area. It is a complex, highly technical organization and is a prime candidate for an information system that

allows people to communicate and share data with each other.

JSC adopted a strategic plan for its information systems in 1985. The plan contained a number of ambitious programs, many of which have led to improvements in computer operations and use. The plan called for universal connectivity of all computers—mainframe, mini, and workstation. It called for common tools for common functions to prevent the proliferation of incompatible systems. The most crucial strategy for this study was to provide managers and planners with direct access to operational data in support of tactical and strategic decisions.

The plan portrayed the information environment in the traditional triangular fashion (Figure 1). The operational layer at the bottom represents the very detailed source data used for the daily running of the Center. The tactical layer is that used by the analyst -- less detail, but frequently from more than one source. Finally, the strategic level at the top has the least detail, but requires the broadest scope. The planners felt that the operational systems were not a strategic concern. They seemed to be in place and operating to specification. They found, however, an almost complete lack of access to the data in those systems by anyone other than the direct operational personnel. Managers were still making decisions on no data or on hardcopy printouts distributed in mind-boggling volumes, only small portions of which had any real value.

The problem of access was not a hardware problem. Most workstations at the Center were well connected to one of two backbone networks—an IBM SNA network and a DEC Ethernet network. The IBM network was primarily used for administration; the DEC network, primarily for science and engineering. Some bridges were in place between the networks, but they were not as functional as they could have been. Nevertheless, the target population for

administrative data (i.e., Center management) was already connected to the IBM network.

Figure 1

JSC INFORMATION SYSTEMS

```
                          /\
                         /  \      STRATEGIC
        (No Activity)   /    \
                       /------\
                      /        \
                     /          \  TACTICAL
      (Little Activity)         \
                   /  /\        \
                  /  /  \  /\  /\  /\
                 / NEMS \/MRDB\/AMIS\/ICFAS\
     (Lots of   / ADABAS NOMAD  DB2  ORACLE \ OPERATIONAL
     Activity) /   NEMS  CENBUD PCASS  SEAD   \
              /   SUPPLY ICFAS  PRACA          \
             /     NPPS  PLAN/ACT               \
            /      MRDB   AMPTS                   \
           /_____\
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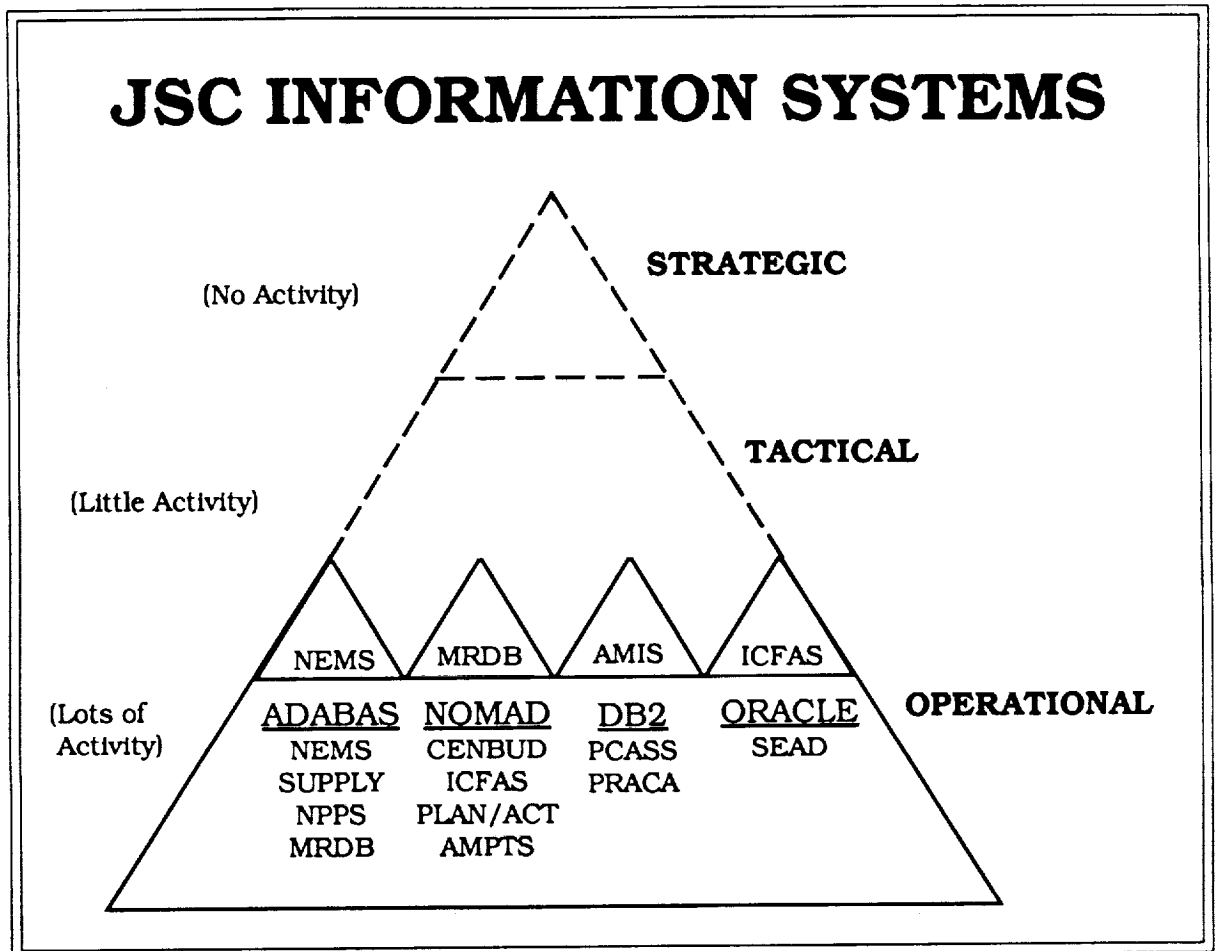
Software was not the problem either. The Center's "common tools" strategy had stopped the proliferation of database management systems at two—NOMAD and Adabas. NOMAD was considered a better reporting system and end user tool, while Adabas was considered better for high volume transaction processing. Since that study in 1985, SQL databases have become a standard across much of the industry. Two such DBMS's are now in use at JSC: DB2 and ORACLE. Since the JSCMIS resides on a different mainframe from any of the operational systems, the data in the system is a copy of the

original. Thus the DBMS used in the operational system is really not important.

The core problem remained the method for accessing the data at the tactical and strategic levels. Some attempts had been made to provide database access to managers and their staff, but none had been successful (see small triangles in Figure 1). These systems were limited to just one application (budget, procurement, personnel), so they did not provide access to all databases through a common pathway. That approach would never work because managers who need to access many databases would not learn or remember a different access method for each application. Thus, the strategic goal was to provide effective access to all Center-wide databases using a common system.

JSCMIS Requirements

The task became a research activity under a cooperative agreement between JSC and the University of Houston-Clear Lake concerning computers and information systems. The objective was to construct a prototype of a generic interface to JSC database for management use. The JSCMIS interface would be developed in NOMAD.

Types of Uses

The requirements for the interface were developed from a conception of the needs of the "occasional user"—i.e., the manager, analyst, or any other employee who needed data from multiple databases. The first step in the requirements analysis was to develop a firm concept of the "occasional user"—

a member of the JSC community whose primary task is not computer-oriented. The computer is a tool—not a primary focus of activity—for the occasional user. While these users may use computers a great deal (in fact, they may administer computer operations on site), their jobs do not specify that they work with a computer.

Another type of user on site was the operator. The operator is an individual whose primary job occupation is to maintain and interact with a specific operational system. Data entry personnel, programmers, and reporting personnel are all operators. They differ from the occasional user in a number of ways:

1. They use one and only one system. They have no need to access more than that one system.

2. Their use of that system is continuous and intensive. Whatever time it takes to learn the system is small compared to their total time on the system. Hence ease of learning is not as strong a requirement as it is for the occasional user.

3. They perform the same operations over and over. Ease of use during repetitive operations is therefore a strong requirement.

As a result, most operators interact with their system through a custom interface. The interface optimizes speed and productivity on that one system. The overhead required to develop efficient interfaces is small when it is spread across all operators over an extended period.

The requirements for JSCMIS were specifically designed not to replicate the functions of these custom interfaces. Practically, this meant that JSCMIS would provide a general set of reporting capabilities, but none that were as detailed as what an operator might find on his or her specific system. JSCMIS would emphasize breadth (the ability to get good data from many systems) rather than depth (the ability to get all the data from any one system with optimal efficiency). The third type of user was the analyst. Like operators,

analysts use computers as a necessary part of their job. Rather than using them in structured routines like operators, however, analysts have to get access to data in all its forms and manipulate it in many ways to answer new questions and solve new problems. They are the typical power users.

As with the operators, JSCMIS was not designed to meet all the needs of analysts, particularly in those systems which they knew well. NOMAD has a 4GL which allows maximum flexibility and capability in reporting the data. Since analysts were expected to have that type of power over the data, we surmised that they would have to spend the time learning the 4GL. And since NOMAD2 is a supported product at JSC, extensive on site training is available for the asking. As before, however, their training would be spread over many years of use so that it would be worth the investment. Practically, for this project, this decision meant that JSCMIS would not replicate all the functions of the 4GL. It was only necessary to capture those functions which the occasional user would need. In this case, JSCMIS concentrated on standard functions required by many people rather than all the functions required by only a few.

System Requirements

Having defined and distinguished the occasional user from the other primary database users, the requirements for the entire target population were then understood as:

1. *To provide one access path to all databases.*

   Since users can only remember special access paths to one or two databases, they will never access all the databases if each path is unique.

2. *To assume only standard PC hardware and software in connecting to the mainframe.*

   Most users will access JSCMIS from their own offices. While they may have sophisticated database tools resident there, they may also want to access the data from other workstations or while away from their office. The lack of specific hardware and software requirements also broadens the potential user group beyond those who are willing to invest in specialized features. It also uncouples the interface from changes in workstation design and functionality.

3. *To assist the user in understanding not only how to operate the interface (process help) but also on the information contained in the application itself (content help).*

   Process help is a standard feature of all programs today. Content help is new and important. The occasional user does not know or remember the details of the many applications that he or she uses. The interface should be able to dynamically provide the details of the database itself and assist the user in selecting the desired data.

4. *To allow the user to perform operations in an arbitrary order.*

   People want to do what they think of, when they think of it. The interface should accommodate an arbitrary order of operations whenever it is logically possible, rather than require the user to step through a pre-ordered set of operations.

5. *To move rapidly between selecting an option and seeing the results of that selection.*

   The problem with old-time batch processing was the relatively large investment made in constructing the batch stream before the programmer received any feedback on decisions made. Interactive computing allows immediate feedback on decisions and actions.

   Quick feedback also implies the capability of undoing any previous step or changing information already entered. Users are encouraged to "learn by doing" since no step in the process is fatal or irreversible.

6. *To save previous operations for later retrieval.*

   Users should only have to enter a set of parameters or operations once. They should then be able to recall that set and use it many

times. Since no step is permanent, they should also be able to modify what they have retrieved, use it and/or save it at their discretion.

7. *To minimize keystrokes.*

Occasional users are often not accomplished typists, since their work does not require computer use. While the keyboard is the default input device for computers today and cannot be avoided, the number of keystrokes to perform simple operations can be kept to a bare minimum.

8. *To operate in an obvious, intuitive manner.*

This requirement is particularly hard to define and make operational although it may be the most important one of all. Nevertheless, the design team assumed that some operations "made sense" and others didn't. (We have certainly been subjected to plenty which didn't!) Therefore, the interface presents a "look and feel" where users are able to do what they naturally want to do at the time they want to do it.

Interface Design Principles

To meet the specific user and system requirements three design principles for the interface emerged:

1. Define a uniform semantic structure

2. Employ a windowed interface design

3. Maintain consistent behavior of functions

These principles were followed by the design team in every case before programming to insure a consistent look and feel to the interface.

1. A semantic structure would guide operations.

The first step in designing the interface was to create a set of common terms. The semantics of the interface (the concepts employed and their

relationship to one another) have turned out to be one of the most powerful aids to the user. Having to learn new terms in order to use a new system is not ideal. On the other hand, part of the problem with customary approaches, specifically overly hierarchical and rigid menus, can be avoided by introducing a few new terms which make the approach more straightforward and intuitive. While the user must learn the new terms, four in this case, the pay-off in understanding how the interface operates is immense.

The first term is Application, another term for a database or a view of a database. Users first choose an application (or database) before proceeding to specify their report. A Report is the term for the output of the interface. A report consists of two parts. The Format defines the structure of the data on a report—columns, rows, headings, calculations (Figure 2).

Figure 2

Composition of JSC Workforce
By Occupation and Sex

	Female		Male		Total	
	No.	%	No.	%	No.	%
WG/Technician	–	–	–	–	–	–
Scientist & Engr.	–	–	–	–	–	–
Prof. Admin.	–	–	–	–	–	–
Clerical	–	–	–	–	–	–
Total	–	–	–	–	–	–

FORMAT: GENCNTOCC

FORMAT Only, No Data

The Conditions define which records from the database are used in building the report. Figure 3 shows the complete report after specified records from the database have been used to calculate the data in the report.

Figure 3

Composition of JSC Workforce By Occupation and Sex

	Female		Male		Total	
	No.	%	No.	%	No.	%
WG/Technician	20	9.7	186	90.3	206	5.8
Scientist & Engr.	340	14.7	1967	85.3	2307	65.3
Prof. Admin.	298	52.3	272	47.7	570	16.1
Clerical	445	98.9	5	1.1	450	12.7
Total	1103	31.2	2430	68.8	3533	100.0

FORMAT: GENCNTOCCData as of: 09/22/89

FORMAT: Same as Before (GENCNTOCC)
CONDITIONS: All 3,533 JSC Employees

The elements work together as shown in Figure 4. Having picked the application "PERSTAT," the user sees the main window. This window contains blanks for specifying the other three parameters, "REPORT," "FORMAT," and "CONDITIONS." The quickest route is to select a pre-defined report and display it. The name of the report can be typed or picked from a dynamically generated list. Any displayed report can be filed or printed at either the mainframe or the PC.

Figure 4

```
  __JSCMIS_____
 |        Johnson   Space   Center   Management  Information  System       |
 |--------------------------------------------------------Version-1.1---|
 |    _Application: PERSTAT_____                                |
 |   |Enter the application in the f |                                     |
 |   | cu  | Main============================                              |
 |   | -   | Please fill in the blanks, or press |                        |
 |   | PE  | the LIST functionkey for entries.   |                        |
 |   | PE  |_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ |                             |
 |   | PE  |      REPORT name:              |                             |
 |   | PL  |                               |                             |
 |   | ST  |   FORMAT name:                |                             |
 |   |_____|                               |                             |
 |         |  CONDITIONS name:             |                             |
 |         |_____============================                           |
 |                                                                         |
 |                                                                         |
 | Function Keys                                                           |
 | --1-- --2-- --3-- --4-- --5-- --6-- --7-- --8-- --9-- -10-- -11-- -12-- |
 |       Save  Clear Erase Alter Note  List  Exit  Help               Retn |
 | |_____|
```

If the data is not contained in a previously defined report, then the user selects the other two parameters individually. Pre-defined formats and conditions are available for constructing new reports, which can be displayed and directed to output devices. The user also has great flexibility to build and modify sets of conditions and see the results of those selections immediately displayed on the screen. The ability to also modify formats is a planned feature

of a later release. New reports can be stored at any time with new user-specified names, and sets of conditions can also be saved at any time for later retrieval and usage.

2. All operations would take place within windows.

The ability of NOMAD to construct windows on an IBM mainframe was a distinct advantage in programming the intuitive operation of the interface. The advantages of windows for this type of application are that they:

- focus attention on a particular area of the screen

- define a spatial and temporal boundary to each operation

- provide a standard location for

  - instructions (top)

  - menus or parameters (middle)

  - function keys (bottom)

- allow data to be displayed in more than one area at a time

- provide a visual record of previous windows or selections, which gives the users an idea of where they are and how to return to a previous point. (See Figure 4). The JSCMIS is designed so that the user is never far from the main menu (Figure 5). Indeed, most of the time the main menu is visible in the background so the user knows where he is in relation to it. The exception is while the report itself is being displayed.

Figure 5

JSCMIS Logic Flow

PROFS
Section 1

JSCMIS
Section 1

**Pick
APPLICATION**
Section 2

MAIN MENU
Section 3

Report Name

Format Name

Conditions Name

SAVE
Section 9

DELETE
Section 10

SPECIFY REPORT

**Pick
REPORT**
(FORMAT + CONDITIONS)
Section 4

**Pick
FORMAT**
Section 5

**Pick
Create
Modify
CONDITIONS**
Section 6

Global Commands

EXIT   Section 11
HELP   Section 12
NOTE   Section 13

DISPLAY REPORT

**Run and View
Report**
Section 7

OUTPUT
Section 8

Mainframe
PROFS
Print
File

PC
Print
File

JSCMIS93

3. Similar operations would be performed in a similar fashion.

While consistency seems to be an obvious principle, the design team was tempted more than once to violate this principle because of functional or programming problems. Nevertheless, the principle was upheld in all logical cases. The benefit is that even the moderately experienced user begins to expect certain functions to operate a certain way. When they do, that user is reinforced to try that way again which in turn gives the operation a more intuitive feel.

Consistency was enforced in the use of function keys. Since the JSCMIS is accessed from PROFS, the function keys have been selected to be similar to those in PROFS. Two types of functions keys were defined—general and specific. General functions are the same for all windows. They are:

ENTER — Execute, Done

PF8 — Logoff

PF9 — Help

PF12 — Previous, Done

ENTER was selected as the normal exit from a window. In that way, users could press ENTER when in doubt and usually be correct. PF3 (the IBM Quit Key) was selected as the standard abnormal exit from a window. It simply closes the window and backs up to the previous window without executing anything. Almost all navigation between windows is handled by one of these two keys.

The rest of the function keys are active only for certain windows. Even in that case, however, function keys have the same definition whenever they are active:

PF2 — Save

PF3 — Clear (parameters)

PF4 — Erase, Page Left

PF5 — Alter, Page Right

PF6 — Note

PF7 — List

PF8 — Print

PF10 — Page Down

PF11 — Page Up

The other area of consistency is data entry. Two primary data entry strategies were employed depending on the number of choices available. Menus are used when the number of choices is small, usually asking the user to choose an action. Picking an action is an example. In that case, the user moves the cursor to the desired action and presses ENTER. Menu selection is preferred in this case because it presents the options available, reduces the number of keystrokes, and prevents errors due to typing.

When the number of choices is large, the user is presented with a space in which to type a parameter value. The names of reports, formats, and conditions are an example. Users who know the name they want can simply type it in the space. Those who do not know the name or prefer to pick from a list press function key PF7-List.

PF7 is always active whenever a parameter is required. It opens a menu window showing the choices available. The user can then move the cursor to the desired choice and press ENTER. That choice is then automatically entered into the fill-in space.

The PF7-List function key is one of the most powerful features of the interface. Not only does it provide menus on demand to fixed items, like the operators available in a conditional statement, it can also build lists directly from the database schema. A list of field names for a particular database, for instance, is not stored by the interface, but is constructed dynamically whenever the user presses PF7 when required to provide a field name. This dynamic list construction not only allows the interface to read any NOMAD database schema for such information, it also eliminates the need to update the interface whenever the database schema is updated. Thus the interface is independent of the types of data it displays.

Therefore, PF7-List is the most important method for meeting the requirement that the interface provide help about the content of the database, as well as process help about itself. It allows the interface to "know" about the database it is accessing and provide that knowledge to the user.

Implementation

The prototype version of JSCMIS was introduced to a test group in February 1989. JSC management had been interested in having electronic access to the Center's personnel system, and JSCMIS was perfect for the task. A small group of personnel employees used the system before it was shown to upper management in May 1989. Their reaction to the system was very positive.

The implementation includes tracking user behavior via background processes in the interface itself. The computer keeps records of users log-in and log-off time and their resource usage, such as CPU seconds and disk I/O's. The interface also records when a user encounters an error condition and sends the message along with the error messages to the system developer. Users can also initiate comments to the developer from the within the interface on other matters. These data have become a record of user behavior in the first months of use and have led to numerous small but important changes.

Initial close monitoring and fine tuning were an important part of insuring the success of the system. Users were contacted shortly after initial use of the system to inquire about difficulties they may have experienced. Another follow-up occurred after one month to gather their impressions and suggestions for modification. As a research prototype, these data were extremely important in the final stages of implementation.

JSCMIS is now being released to upper management. The system has been made available on the same mainframe that contains the centerwide electronic mail system, PROFS. More people know how to access PROFS than any other system, so this makes the JSCMIS available to the widest possible audience. Research is continuing on how to enhance the interface to make it even more valuable to the users. Some things already requested are flexible formats, boolean logic for sets of conditions, and the ability for a user who has built a special set of conditions to be able to ship it to another user who may need it.

The initial release of the JSCMIS has three kinds of reports: personnel statistics, personnel register, and financial -- plan versus actual costs. Additional data should be added early in 1990. Procurement data and help desk data are leading candidates at this time.
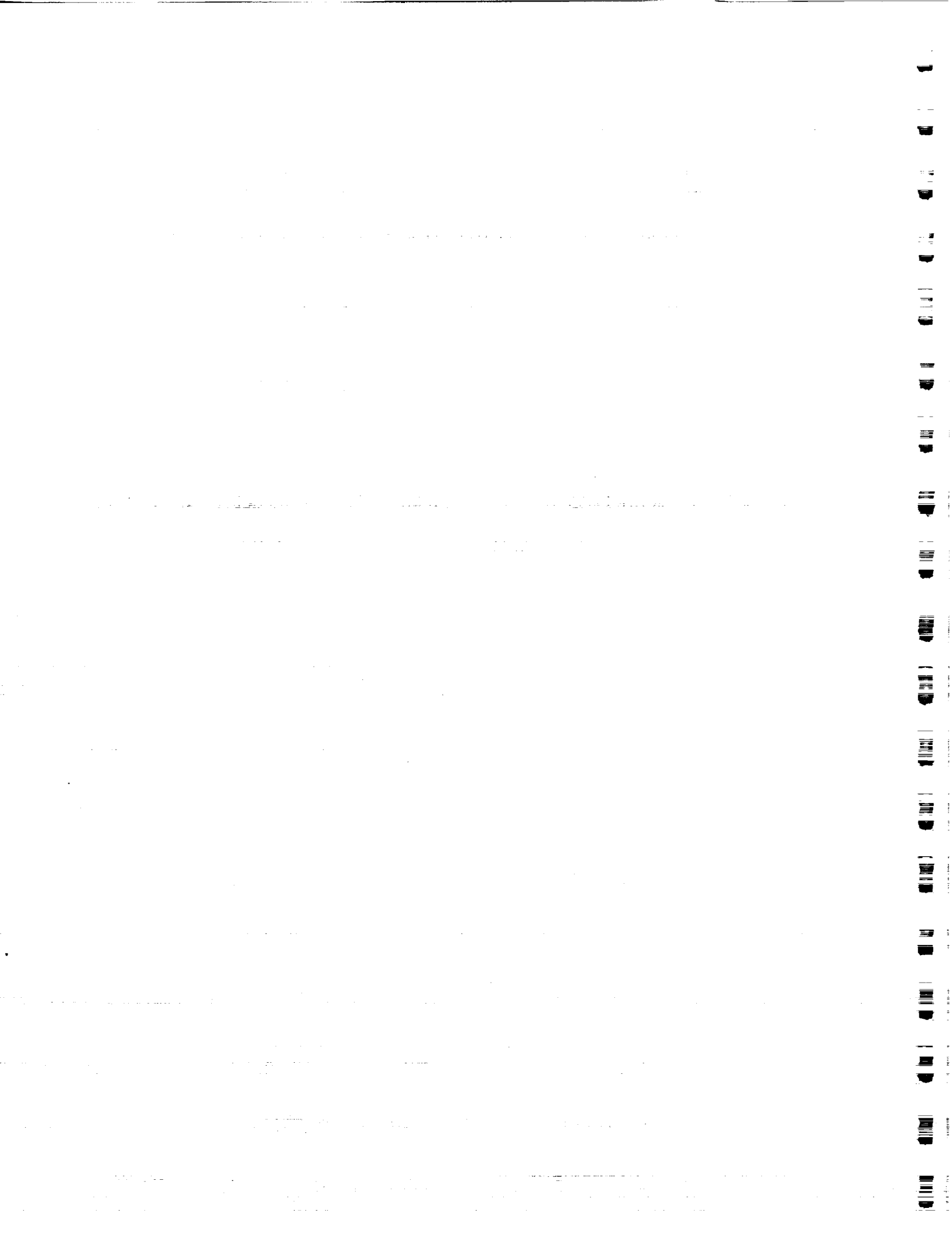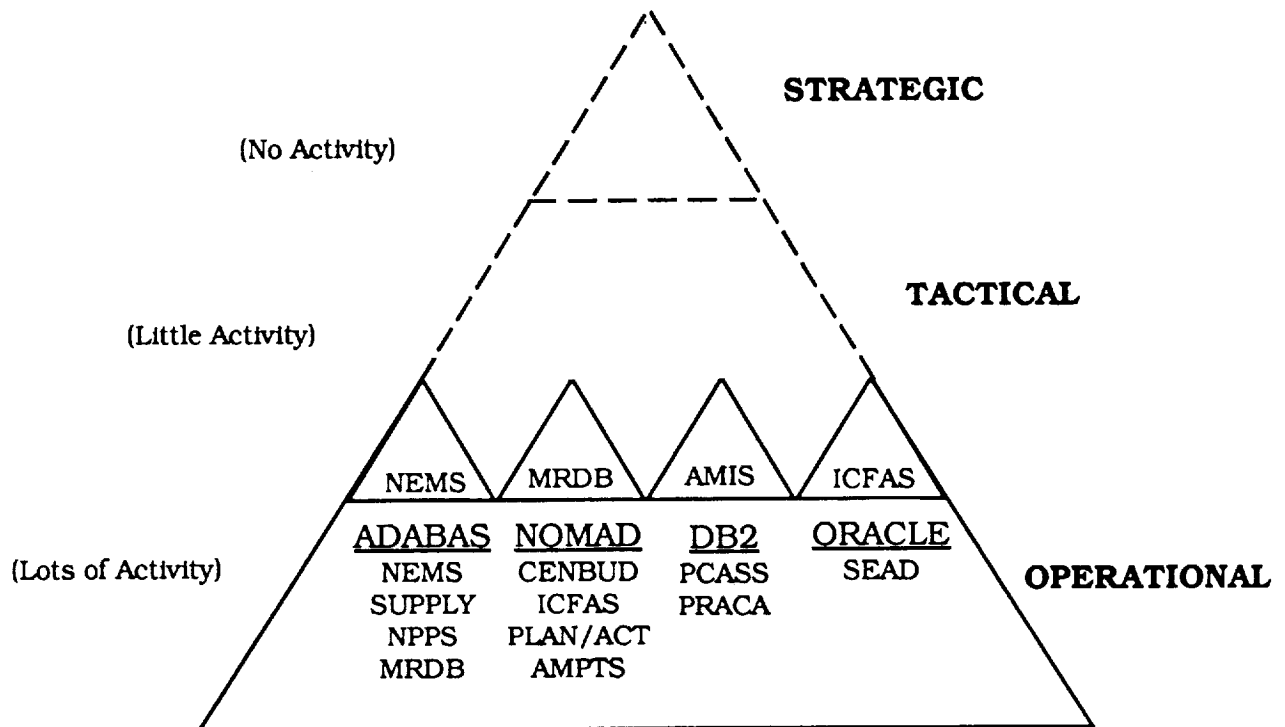
APPENDIX I: OVERVIEW

**Johnson Space Center
Management Information System
February 20, 1990**

**Lloyd Erickson
Data Processing Systems Division
Mission Support Directorate**

JSC INFORMATION SYSTEMS STATUS
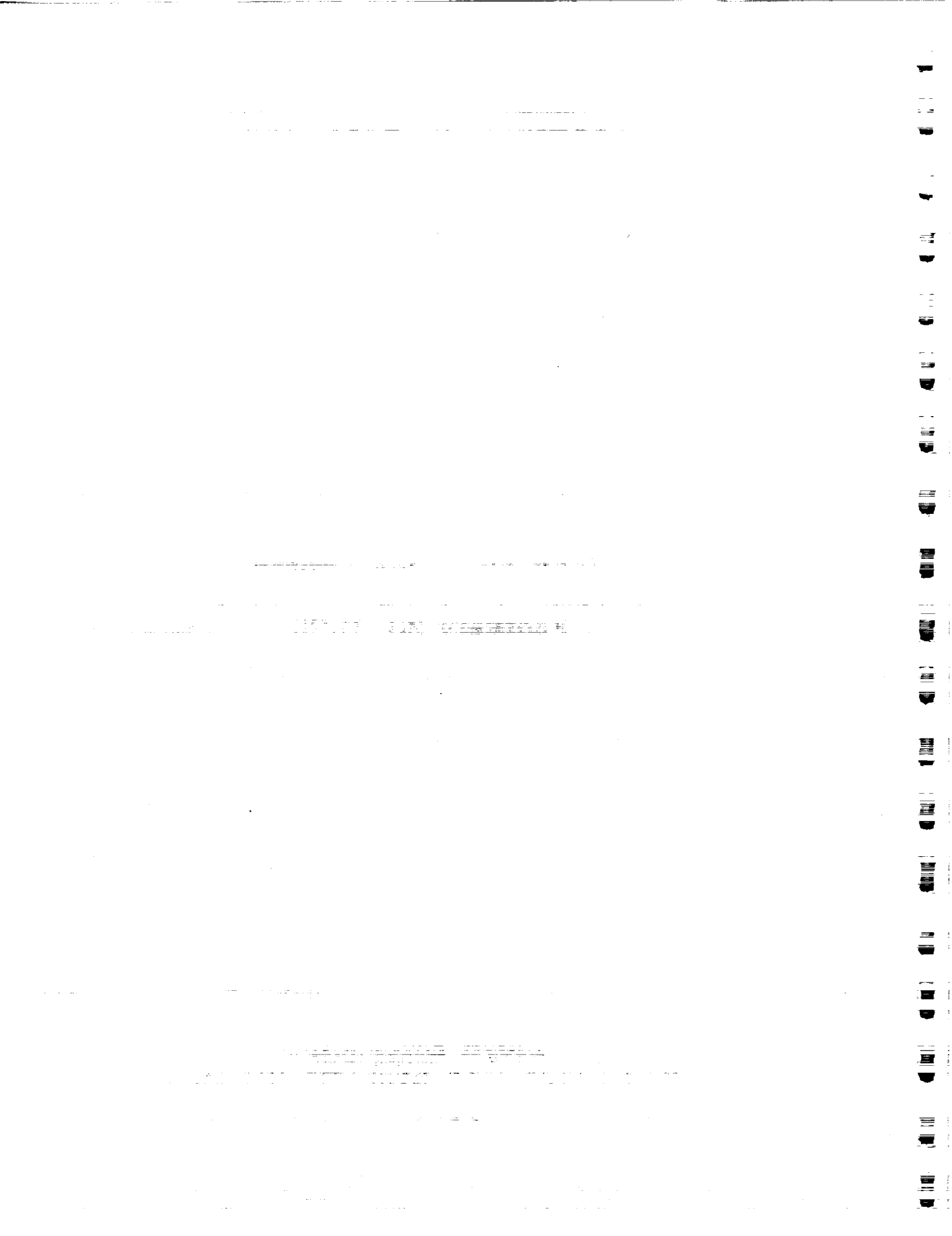
```
                              /\
                             /  \      STRATEGIC
                            /    \
         (No Activity)     /      \
                          /   -  -  \
                         /          \   TACTICAL
                        /            \
         (Little Activity)  /          \
                      /  /\            \
                     /  /  \  /\  /\  /\  \
                    / NEMS \/MRDB\/AMIS\/ICFAS\
                   / ADABAS  NOMAD   DB2   ORACLE \
         (Lots of  /  NEMS   CENBUD  PCASS  SEAD    \  OPERATIONAL
          Activity) SUPPLY   ICFAS   PRACA
                  /  NPPS    PLAN/ACT           \
                 /   MRDB    AMPTS                \
                /_____\
```

The triangle illustrates the levels of information at JSC. The base of the triangle, or the "operational" level, represents those data base applications which are used on a daily basis to run the Center--as for example, the Central Budgeting System (CENBUD) or the NASA Personnel Payroll System (NPPS). Note that there are at least four different Data Base Management Systems (DBMS) in use on mainframes at JSC today - ADABAS, NOMAD, DB2, and ORACLE.

The "tactical" level represents the analysts - those people who understand the data very well, but only need occasional access to get reports. The small triangles represent separate interfaces that programmers have developed for each application. The difficulty is that each of these interfaces looks, feels, and behaves differently from the others. Since each of these interfaces cost time and money, a generic interface that will work with any system should prove to be a cost savings in the long run.

The "strategic" level represents the decision makers. As the drawing indicates, there has been almost no effort to provide electronic access to our operational systems for the decision makers.

1

JSCMIS
PROBLEM & STRATEGY

- Problem
  - Many People, Especially Managers, Need Access to a Broad Spectrum of JSC Data

- Approach
  - Prototype Easy-to-Learn, Easy-to-Use, Intuitive Interface
  - Use Existing, Standard JSC Hardware & Software
  - Provide Growth Capability for Skilled Users
  - Take One Step at a Time
  - Use RICIS* for Research and Prototyping Support

- Outcome
  - JSC Management Information System Interface (JSCMISI), a Generic Interface to JSC Data Bases

  * Research Institute for Computer & Information Systems: a Cooperative Agreement Between NASA and UHCL

JSC has lots of data being loaded into data bases by many different organizations, but very little of it is accessible for decision making. Few people know what is available, much less how to get to it. Therefore MSD directed us to create a generic, easy to learn, easy to use interface to alleviate this problem. Such a generic interface would make data from all sources available since it is not peculiar to any one specific application or data type.

Another requirement was to use standard JSC hardware and software. Standard hardware includes IBM compatible mainframes, MS-DOS PC's (or even "dumb" terminals), and the existing Center Information Network (CIN). The interface is programed in NOMAD, one of JSC's standard Data Base Management Systems. Using these standard products provides growth capability as it leverages existing training and experience. The interface itself provides the ability to download reports into MS-DOS files for import into PC word processors, spreadsheet like LOTUS 1-2-3, and graphics packages like HARVARD GRAPHICS.

Version 1.0 of the JSCMIS provides tabular reports to the user. These reports have fixed formats but with variable conditions (more about this later). We have not attempted to solve all problems, but rather to concentrate on just one: making standard reports of different kinds of data available through one common, intuitive interface. Once the foundation is established, it is then much easier to add additional capabilities as our users request them.

The prototype was designed and built through the cooperative agreement between NASA and the University of Houston at Clear Lake (UHCL) called RICIS (Research Institute for Computing and Information Systems).

JSCMIS
PARTICIPANTS

- Technical Monitor:

  Lloyd Erickson
  Data Processing Systems Div.
  NASA Johnson Space Center

- Principal Investigator:

  Dr. Peter Bishop
  Space Business Research Center
  UH-Clear Lake

- System Developer:

  Carol Dickens
  TNT Consulting

- User Support:

  David Learned
  Space Business Research Center
  UH-Clear Lake

RICIS ACTIVITY IM.9

This activity was deliberately started with a limited number of participants. Lloyd Erickson from JSC provided the technical oversight and conducted the relations with the sponsors of the task. The RICIS team from UH-Clear Lake contributed to the requirements analysis, conceptual design, alpha test, and user support services. TNT Consulting did the actual programming and integration.

JSCMIS
RESEARCH ACTIVITIES

- Interviewed Managers & Potential Users About Needs
  - What Information They Would Like to See
  - How They Would Like the Information Arranged
  - Published a Summary in February 1988

- Reviewed User Interface Software Standards
  - MITRE Document
  - IBM's SAA/CUA
  - MUST Software's (NOMAD2 Vendor) Internal Documents

- Produced Initial Design & Implementation
  - Written in NOMAD2 Using Latest Windowing Technology
  - PC-like Friendliness on Mainframe

- Observed & Interviewed Interface Users
  - Noted "Awkward" Spots in Interface
  - Determined Additional Needs

The first step in developing the JSCMIS was a series of interviews to try to determine what managers and other potential users needed. We also had them describe a "report". These interviews were taped and a summary of the results were published in February 1988.

We also looked at various software standards for interfaces. The first step was to review the MITRE document, "Guidelines for Designing User Interface Software" (ESD-TR-86-278), which is considered the "Bible" of this field. Next we reviewed IBM's SAA (Systems Application Architecture) and CUA (Common User Access) standards. Finally, MUST Software (the vendor of NOMAD) had also published their own guidelines. Inputs from all of these were and still are a major part of the design of the JSCMIS.

We implemented our initial design using NOMAD2. There were two primary reasons for this selection: NOMAD2 is one of JSC's standard software products, and at this time it is the only software package that would permit the implementation of a PC-like windowed environment.

After the first version was ready, a dozen people who use personnel data were given access to the system. We are still getting feedback from them through periodic interviews, and also through our "comment" facility in the interface itself. These users are telling us what they like and don't like about the interface, and also what they perceive as their needs for future implementation.

```
┌─────────────────────────────────────────────────────────────┐
│                                                               │
│                        JSCMIS                                 │
│              INTERFACE REQUIREMENTS                           │
│                                                               │
│     •   Generic - Use With Many Different Data Bases          │
│                                                               │
│     •   Virtually No Training Required to Use                 │
│         -    Browser Can View Data                            │
│         -    Analyst Can Download to Familiar PC Tools        │
│         -    On-Line Help                                     │
│                                                               │
│     •   Can Be Used From Anywhere                             │
│         -    Almost Any JSC Office                            │
│         -    Remote Dial-Up                                   │
│              *    Home                                        │
│              *    Other NASA Centers or Contractor Sites      │
│              *    Hotel Rooms                                 │
│     (Mainframe Based = No Special Hardware/Software Needed)   │
│                                                               │
└─────────────────────────────────────────────────────────────┘
```

Once again, the interface needs to be designed in such a way that it can be used with different kinds of data - personnel, financial, programmatic, etc. For example, the interface itself cannot have any reference to a specific type of data (name, address,....), but must be completely database driven.

It must be easy enough to use so that a person with access to it will feel comfortable trying to use it after having seen it in use by someone else. He should be able to browse through different reports and just view the data, or even download it to his PC for later analysis with his own familiar software tools. It needs to include on-line HELP. In short, it must be easy enough to use so that no one will require any formal training before using it, and both browsers and analysts can be immediately productive without having to attend training classes, to learn a new product, or to learn a new way of doing their job.

Finally, it must be usable from anywhere. One of the problems with commercially available Executive Information Systems is that they require special software on the PC's that access them. Since the JSCMIS interface is entirely mainframe based, it can be accessed from any location - a hotel room, another NASA center, one's own home. All that is needed is a modem and a terminal.

5

JSCMIS
INFORMATION STRUCTURE
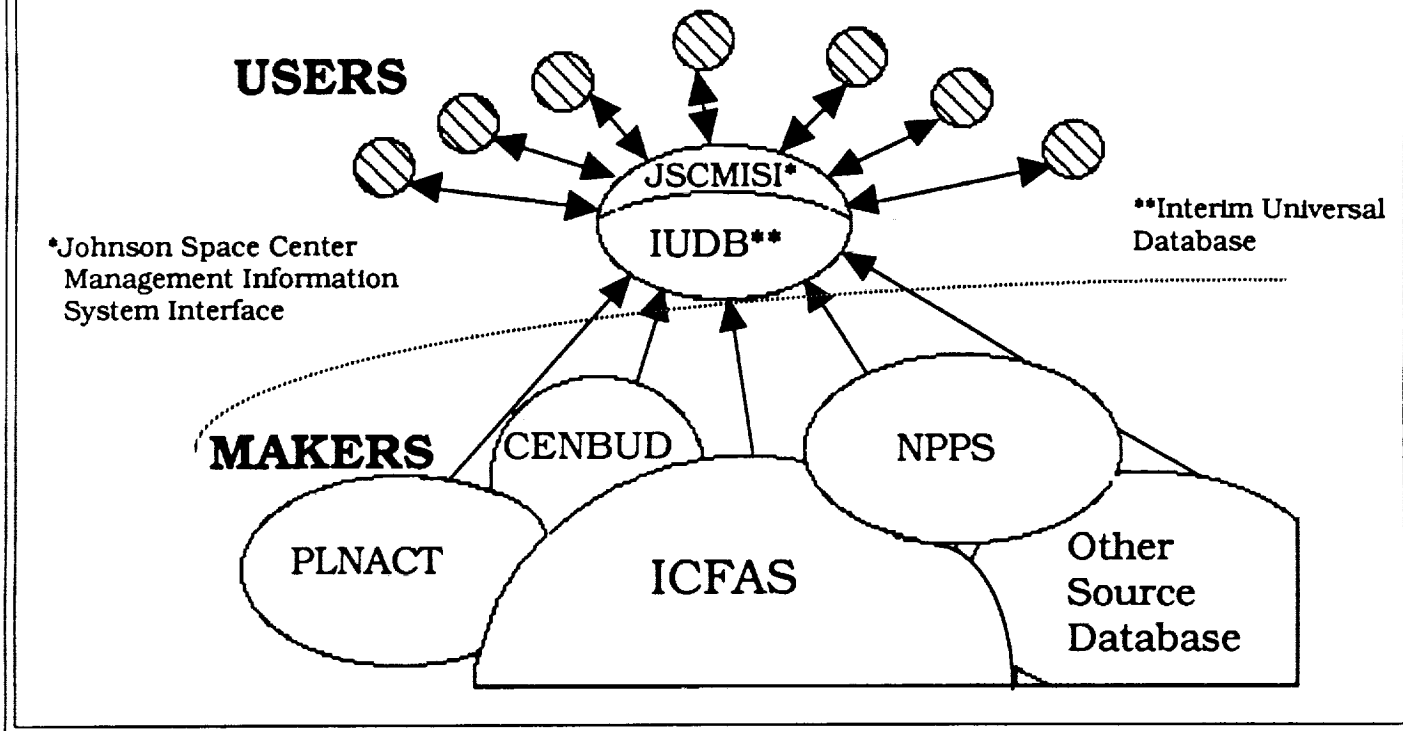
This slide depicts the relationship between operational databases and a database concept called the Interim Universal Database (IUDB). The operational systems are depicted at the bottom of the chart (PLNACT, CENBUD, ICFAS, NPPS, etc.) The MAKERS maintain the operational systems on a daily basis. The USERS are those who view the operational data through the JSCMISI (Johnson Space Center Management Information System Interface) and convert the data into information for decision making.

The IUDB is then a summary level repository for data from the operational systems. The JSCMISI is the interface, or shell, through which the user accesses the IUDB.

6

JSCMIS
PURPOSE & SCOPE

- INTERFACE: Provide a Uniform, Easy, Intuitive Access to Data
  - Generalized (Same Interface for Different Data Bases)
  - Utilize Current Environment (H/W, S/W, Training, Etc.)
  - Extensible Environment (Growth Capabilities)

- IUDB: Could Contain Summary Data From Many Sources
  - Current
    * Personnel (ADABAS, RIMS)
      - Statistical
      - Resume (Security)
  - Proposed
    * Financial (NOMAD2, TERADATA, RIMS, ADABAS)
    * Programmatic
      - Space Shuttle (NOMAD2, DB2)

The advent of the PC has redefined what is meant by "user-friendly". The JSCMIS interface itself is meant to provide a PC-like reporting environment which will give uniform, easy to learn, intuitive access to different data bases. It utilizes current JSC hardware (IBM compatible mainframes, Center Information Network, terminals/PC's/MACINTOSHes) and software (NOMAD2). This environment also provides growth capability for the skilled user.

There are only two data bases currently available, both of which contain personnel data. Several others are being proposed for later addition.

JSCMIS
CURRENT APPLICATIONS in IUDB

- "PERSTAT"
  - Personnel Statistics
  - "JSC Workforce in Profile" Report Formats
  - Sensitive Data Removed (Names, SSN, etc.)

- "PERSON"
  - Personnel Resume Data & Reports
  - Sensitive Data & Security Included

- "PLANACT"
  - Plan vs. Actual Costs

At the time of this writing, there are only three applications (databases) available through the JSCMIS interface. Two of these applications contain extracts of data from the new NPPS. PERSTAT is an on-line version of the annual report "JSC Workforce in Profile." As opposed to the printed publication, however, these data are current as of the end of the month and new reports may be added quite easily. PERSON is the on-line version of individual resumes and lists of employees. PERSON contains a security module to prevent individuals from accessing records without the proper authority.

PLANACT compares the planned vs. actual costs of various JSC organizations and programs.

Other databases will be added as time goes on.

CONCEPT OF A REPORT
IN THE JSCMIS

REPORT: a "FORMAT"
       AND
         a set of "CONDITIONS"

FORMAT: What type of information is on report (Average Age, Number of Males & Females)

       AND

    How it appears on the page (Titles, Column headings, etc.)

CONDITIONS: What records from the data base are represented on the report (Only include employees who are GS-13's and above and who were born before 1950.)

The function of the JSCMIS is based on the concept of a REPORT. A REPORT consists of two elements: A FORMAT and a set of CONDITIONS. These concepts are illustrated on the next charts.

Composition of JSC Workforce
By Occupation and Sex

	Female		Male		Total	
	No.	%	No.	%	No.	%
WG/Technician	-	-	-	-	-	-
Scientist & Engr.	-	-	-	-	-	-
Prof. Admin.	-	-	-	-	-	-
Clerical	-	-	-	-	-	-
Total	-	-	-	-	-	-

FORMAT: GENCNTOCC

FORMAT Only, No Data

This chart contains illustrates a FORMAT in the JSCMIS. It shows what type of information appears on the page (number & percent of employees by Occupation and across gender), and how it looks (column headings, titles, etc.).

Composition of JSC Workforce
By Occupation and Sex

	Female		Male		Total	
	No.	%	No.	%	No.	%
WG/Technician	20	9.7	186	90.3	206	5.8
Scientist & Engr.	340	14.7	1967	85.3	2307	65.3
Prof. Admin.	298	52.3	272	47.7	570	16.1
Clerical	445	98.9	5	1.1	450	12.7
Total	1103	31.2	2430	68.8	3533	100.0

FORMAT: GENCNTOCCData as of: 02/28/89

FORMAT: Same as Before (GENCNTOCC)
CONDITIONS: All 3,533 JSC Employees

Same FORMAT as before, but now the CONDITIONS have been set to show all 3533 employees at JSC as of 09/22/89.

Composition of JSC Workforce
By Occupation and Sex

	Female		Male		Total	
	No.	%	No.	%	No.	%
WG/Technician	13	8.7	137	91.3	150	7.2
Scientist & Engr.	51	3.9	1251	96.1	1302	62.7
Prof. Admin.	168	46.7	192	53.3	360	17.3
Clerical	262	99.2	2	0.8	264	12.7
Total	494	23.8	1582	76.2	(2076)	100.0

Conditions on data: BIRTH LE 12/31/49
Report Format: GENCNTOCC   **Data as of: 02/28/89**

> FORMAT: Same as Before (GENCNTOCC)
> CONDITIONS: Include All JSC Employees
>   Who Were Born Before 1950

Again the same FORMAT, but the CONDITIONS have been changed such that only the 2076 employees who were born before 1950 are represented on the report.

Note that a report which is printed from this system will have the CONDITIONS, FORMAT, and date of the data showing on each page. Since the user may not remember what conditions were in effect unless that information appears on every page, this information is important for reports which are used several days or weeks after they are generated.
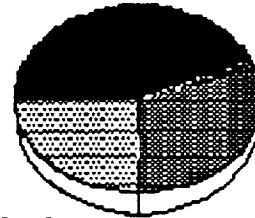
OCCUPATIONAL DISTRIBUTION

Scientist & Engr.

Clerical
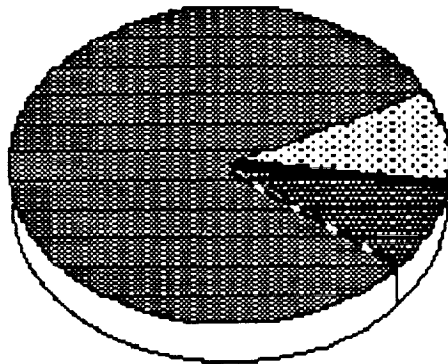
Prof. Admin.

WG/Technican

Clerical

WG/Technican

**Scientist & Engr.**

Prof. Admin.

FEMALES

MALES

This is a graph generated on HARVARD GRAPHICS using the report showing all 3533 employees by occupation and across gender. Once the report had been brought up on the screen, PF6: OUTPUT brought up a window which displayed printing and downloading options, and the file was sent to the PC by selecting the appropriate option. It was then imported to LOTUS and from there to HARVARD GRAPHICS which created the charts as they are displayed above.

This process illustrates how the skilled analyst can now get data from a mainframe data base application, download it to the PC, and generate presentation graphics without having to re-key the data as is so prevalent today.

JSCMIS
FROM DATA TO INFORMATION
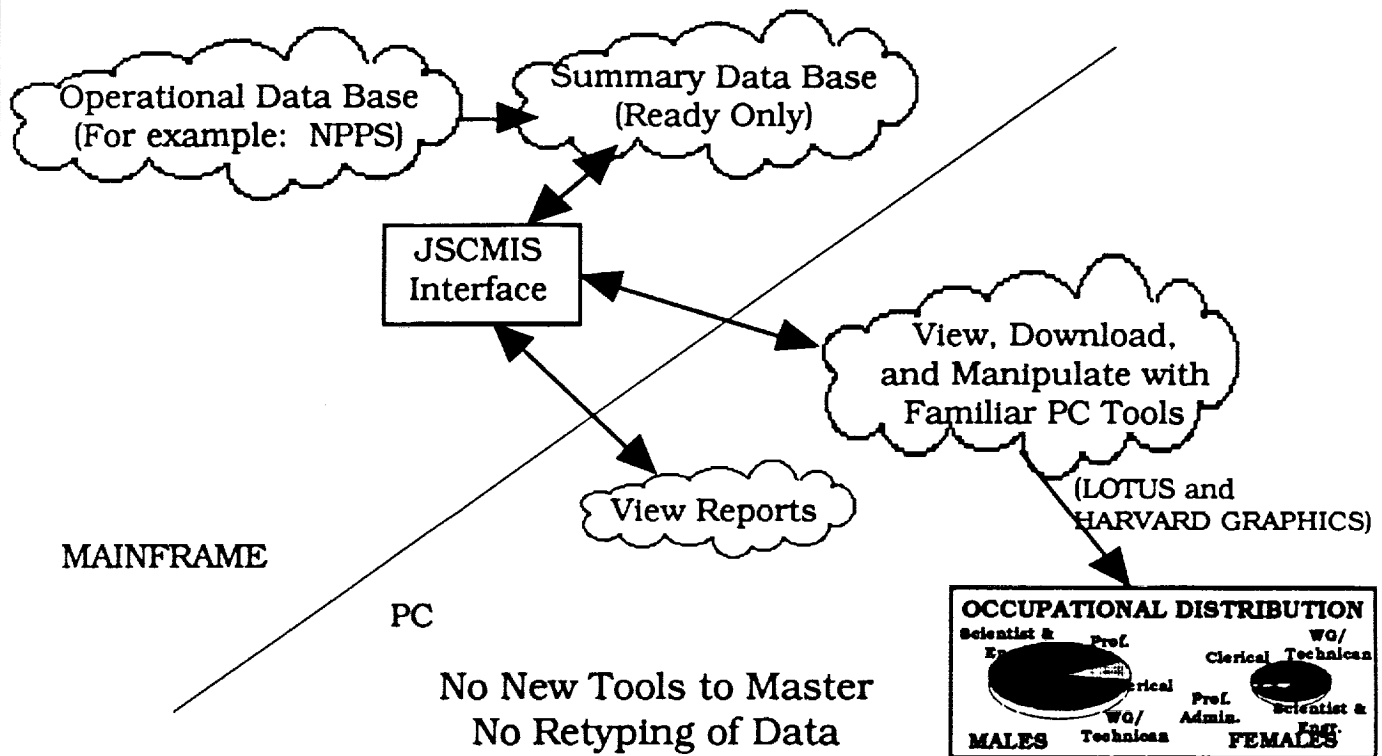
A graphic illustration of the utility of the JSCMIS. It shows how a user can simply view reports if he desires, or can download the data to his own PC and import it to his own tools, again, without re-keying the data!

JSCMIS
IMPLEMENTATION STRATEGY

- Fluid structure
  - PC Like, Windowed Environment
  - User Decides Sequence of Operations

- System Keeps Track of Detail
  - "Knows" the Database
  - "Remembers" Previous Operations

- Two Types of On-Line Help
  - Procedural (How to Use the System)
  - Substantive (Database Specific Information)

- Two Types of Input
  - Type in Value
  - Pick From List (NEVER Forced to Remember!)

The overall principle in this prototype was to use the power of the computer where it could assist people in getting to the data they need. One important feature, therefore, is to allow people to do operations in the order that they think of them, rather than in some arbitrary sequence determined by a fixed menu structure.

A second feature is that the computer keeps track of the detail so that the user can keep the overall purpose and the outcome of the data search in mind. Most importantly, the user can look up parameters or features of the data on-line while using the interface and even pick parameters from lists which are dynamically linked to the database schema and information. At the same time, the frequent user can just type in the appropriate values if he knows them.
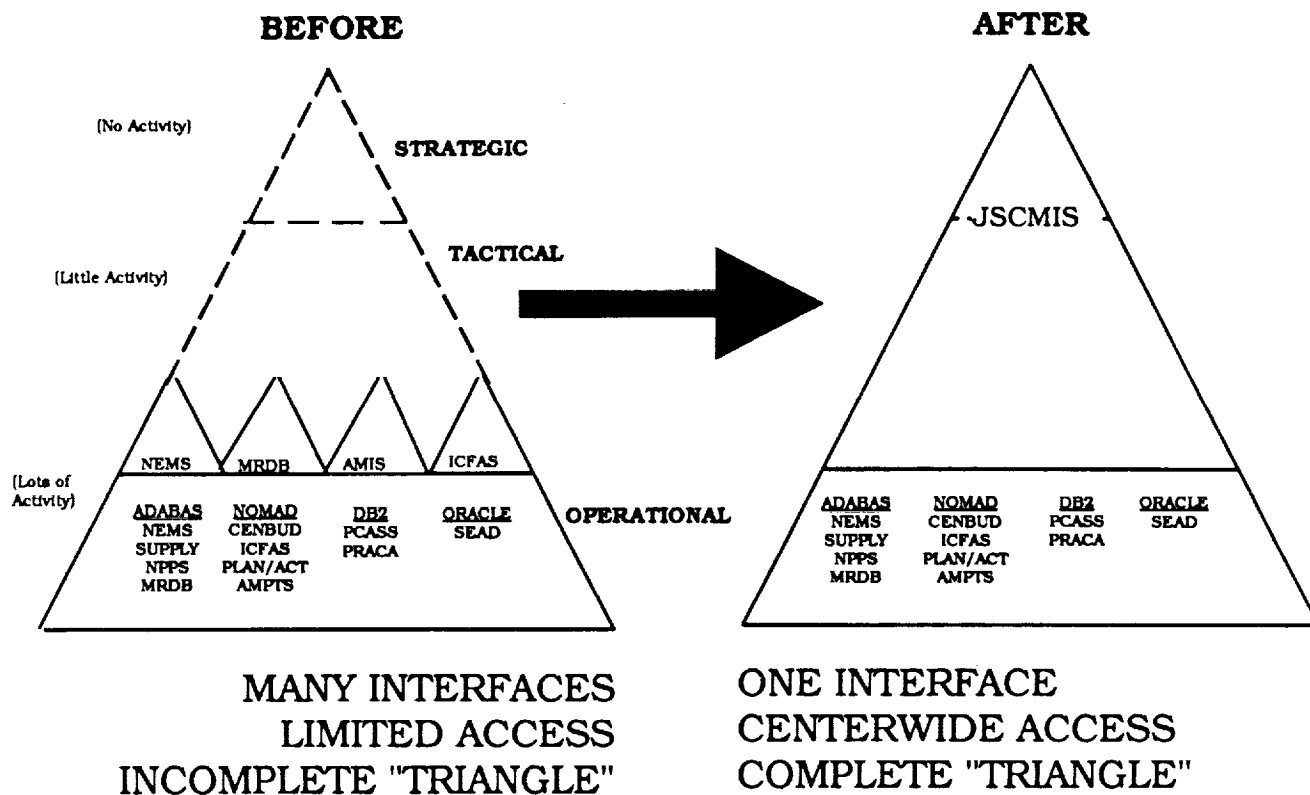
The interface contains two types of on-line HELP: standard procedural help which explains how to use the interface and substantive help on the database itself. The substantive help almost guarantees that the user will get the report he desires, and will not end up frustrated because he got stuck.

These are also features of advanced Executive Information Systems (EIS). The difference is that JSCMIS uses standard JSC hardware and software and requires only minimal programmer support. What is more, users can customize reports to their needs and send those reports to others in the decision making group. Finally, since the JSCMIS is mainframe based (although it looks and feels more like a PC product), it can be accessed from anywhere.

The ability to use whatever PC based decision support tools you are familiar with on mainframe data without re-keying it means you do not have to learn a new product before you can get real utility out of the JSCMIS.

JSCMIS
JSC INFORMATION SYSTEMS
DIRECTION

BEFORE

AFTER

(No Activity)

STRATEGIC

JSCMIS

(Little Activity)

TACTICAL

(Lots of Activity)

| NEMS | MRDB | AMIS | ICFAS |

ADABAS	NOMAD	DB2	ORACLE
NEMS	CENBUD	PCASS	SEAD
SUPPLY	ICFAS	PRACA	
NPPS	PLAN/ACT		
MRDB	AMPTS		

OPERATIONAL

ADABAS	NOMAD	DB2	ORACLE
NEMS	CENBUD	PCASS	SEAD
SUPPLY	ICFAS	PRACA	
NPPS	PLAN/ACT		
MRDB	AMPTS		

MANY INTERFACES
LIMITED ACCESS
INCOMPLETE "TRIANGLE"

ONE INTERFACE
CENTERWIDE ACCESS
COMPLETE "TRIANGLE"

As more and more data bases become available under JSCMIS, the information Triangle will become complete. Users of all types - strategic, tactical, and operational - will be able to access a wide variety of data through the same interface, and do so from almost any location.

APPENDIX II: TEST GROUP REPORT

Johnson Space Center
Management Information System
February 20, 1990

David Learned
Space Business Research Center
University of Houston-Clear Lake

JSCMIS Test Group Report

The following report is a summary of the initial methods and procedures which were used to introduce the prototype JSCMIS Interface to a small test group of employees from the Personnel Office at Johnson Space Center.

The Initial Organization of the User Group

In the Fall of 1988 the MIDSE Development Team and the Personnel Office at the Johnson Space Center agreed to a test of the prototype database interface. The Personnel Office was to initially provide the information in the database which they deemed to be useful to the employees in that office. Thus, PERSTAT, the first informational database application, consisted of statistics about the personnel of the Johnson Space Center. Soon after that, a second application called PERSON was added which provided resume information about JSC employees.

The Initial Demonstration of the Interface

By early January 1989 the PERSTAT application was installed and ready for beta testing and initial use by the employees of the Personnel Office. Additionally, an initial demonstration of the MIDSE interface was held in January of 1989 at which twelve of the Personnel Office people attended. At this time those employees were instructed as to the appropriate procedure for receiving their execs and logging on to the interface. Those employees also were introduced to members of the MIDSE development team who were available to them for help and/or feedback comments about the various features of the interface.

Phone Contact to Gather Comments

Within two weeks after the initial meeting demonstration the members of the user group were contacted by phone to confirm that they had received their execs and to record their reaction to the demonstration of the interface. Only one person of the twelve had any difficulty receiving their exec--and that problem was eventually overcome by some local engineering ingenuity. One other person was leaving the Personnel Office and would eventually be replaced--temporarily reducing the user group to eleven. Comments about the demonstration were unanimously and enthusiastically positive. One of the members was hopeful that this new interface would allow other employees to find information on their own-- information which, up to now, they had been relying on her to find for them.

At this point, members of the MIDSE team developed a questionnaire which was designed to gather responses from the new users about their initial experiences with the interface. (See the sample Questionnaire at the end of this Appendix.)

The new users were then called a second time about four weeks after the initial demonstration and asked to respond to the questionnaire. Besides providing the MIDSE team with feedback from these new users, these phone calls were also intended to provide two additional benefits: (1) to help and encourage those users who may have had procedural difficulties, and (2) to gently remind those new users who may have had trouble finding time to log on the system that we were interested in their reactions.

Attributes of the Test Group

The new users had generally similar previous computer experience. All users indicted that they used computers on a fairly routine basis. However, one member's expertise did stand out from the rest of the group. This person was a Senior Program Analyst who eventually provided many helpful suggestions and initiated some improvements to the interface.

Because of their wide range of job tasks, the new users also anticipated varying amounts of usage of the type of information that the interface would provide. Initially, five of the twelve new users indicated that they would be heavy users, three thought that they would be moderate users, and four anticipated only light or occasional use. Therefore, anticipated usage seemed to depend more upon the nature and requirements of the person's job than it did upon their computer experience. However, the person who anticipated the heaviest usage was also the most expert user. That person was the Senior Program Analyst whose job consisted of compiling and managing "manpower" statistics. Those members of the group who could be referred to as upper management did not anticipate heavy usage themselves, but were very enthusiastic about the interface's anticipated capability to enhance the efficiency and effectiveness of their people.

An effort was made to periodically contact each member of the group for several months after the demonstration (about once every four or five weeks.) However, most of the important feedback was gained in the earlier contacts. Most of the useful feedback was attained from four members who anticipated that they would be "heavy users." These individuals, because of their job requirements, clearly had a stake in helping the interface to become a success. Many of their suggestions were incorporated to enhance the effectiveness and ease of use the interface.

Some Issues which Emerged

One issue which became apparent was that occasional or light users could be very easily discouraged by a "glitch" in the operation of the interface system. Since improvements to the interface were continually being made, it was also necessary to continually beta test it for "bugs." But one of the members found a bug before the MIDSE team did and got "caught" in an "error loop"--which was rectified almost immediately by the computer software engineer. When that member, an anticipated occasional user, was contacted later to check on her progress, she indicated that the previous bad experience had dissuaded her from logging on again. The lesson learned: we should perhaps be even more careful to see that first time users don't have a bad experience in the early stages. Of course, this is not an easy thing to do when one is continually making changes to the system in response to user feedback.

Another issue arose over the need for the resume information which was contained in the application PERSON. That application was visible to the users on the interface menu but was not yet accessible to them. Several new users were apparently frustrated that they could only have access to statistical information which was contained in the application PERSTAT while not yet having access to individual personnel information in PERSON which is what they really needed at the time. Naturally, access to the application PERSON was also complicated by security issues. In any case, it became obvious that initial success for the interface was also dependent upon the immediate requirements of the users. And perhaps more importantly, it is necessary to clearly identify what data is or is not accessible.

In the months since the user group was formed there has been some employee turnover in the Personnel Office which means that some experience on the interface has left the group. However, that office is now more aware of the benefits of the interface, and the information process is in place so that the future successful implementation of the interface looks promising.

Additional Users

During the several months since the initial demonstration to the Personnel Office, many other demonstrations of the MIDSE have been given to other JSC offices. As a consequence, many other managers have requested, and received, access to the MIDSE interface. Therefore the list of new users has grown to over twenty persons. Many of these additional users are managers from various JSC offices who wish to investigate the attributes of the MIDSE interface.

JSCMIS Interface Usage Statistics

As a result of the growing number of interface users, it was decided that it might be useful to make available to those users the various data which was being recorded about their log ons. Therefore, an additional application was added to the interface. It was entitled STATISTICS and contained four types of reports: (1) Number of log-ins Across Application, (2) Total session times Across Application, (3) Elapsed Time and Disk IOs By Application, and (4) Elapsed Time and Disk IOs by User. This application is yet another illustration of the diversity of uses to which the interface can be put.

Access to the Interface Through PROFS

Because the PROFS E-mail system is so widely used at the Johnson Space Center, it is very familiar to most of the employees. Therefore, in a continuing effort to cause the interface to be easy to use, it has been arranged that it will eventually be accessible through PROFS. It is anticipated that this will increase its widespread acceptance and use. And much of the planning to increase and expand the user "Help" facilities for the interface is to be coordinated with this PROFS connection. Thus, once the interface is fairly well structured in PROFS, organized procedures can be developed to provide training and help facilities for the growing number of users.

Conclusion

The results obtained from having submitted the JSCMIS Interface to a "trial run" have been invaluable. Many "bugs" have been worked out, and many significant changes have been made in the last several months. And most importantly, some needless barriers and bottle necks to certain types of personnel information have been eliminated. Thus, in the future, this information will become more readily accessible to those who may need it.

JSCMIS QUESTIONNAIRE   NAME_____

1. Could you give us some idea as to what your job is?
   Job description?

2. What were your first impressions of the JSC Management
   Information System you saw last week?

        a.

        b.

        c.

3.. What do you think are the best things about JCSMIS?

        a.

        b.

        c.

4. In what ways would you like to see JSCMIS improved?

        a.

        b.

        c.

IF NOT MENTIONED ALREADY,........

5. Do you have your ID on CISC?   YES   NO

        If yes, have you logged onto the machine? YES   NO

        If yes, did you have any trouble logging on? YES   NO

        If yes, what was the trouble?

6. Did you load the JSCMIS Exec from your disk reader?   YES   NO

   If yes, did you have any trouble loading the Exec? YES NO

   If yes, what was the trouble?

7. Did you start the JSCMIS system?   YES   NO

   If yes, did you have any trouble starting the system?

                                              YES   NO

   If yes, what trouble did you have?

8. Did you display any data?   YES   NO

   If yes, did you have any trouble displaying the data?

                                    YES   NO

   If yes, what trouble did you have?

9. Did the system have the data you wanted?   YES   NO

   If no, what data would you have preferred?

10. Was the data in the format you wanted?   YES   NO

    If no, what format would you have preferred?

11. Did you build any CONDITIONS?   YES   NO

    If yes, did you have any trouble building CONDITIONS?

                                          YES   NO

    If yes, what trouble did you have?

12. Did the CONDITIONS work the way you wanted them to?

                                          YES   NO

    If no, how would you prefer it to work?

13. Did you have any trouble logging off the system?

                                          YES   NO

    If yes, what trouble did you have?

14. In general, do you think that you will find JSCMIS a useful
    tool?
                        YES   NO

15. What do you think would make it (even) more useful?