

Progress Report

3

WESTERN
DATA
PROCESSING
CENTER

GRADUATE SCHOOL OF BUSINESS ADMINISTRATION
UNIVERSITY OF CALIFORNIA, LOS ANGELES 1961



Foreword

This publication is the third in an annual series in which we report the activities of the Western Data Processing Center's staff and users. This report covers the period from June 1960 to May 1961. The year just concluded has been characterized by a marked increase in total number of active users, and by a dramatic increase in the amount of computing time consumed by users from participating institutions. In fact, for the first time since the founding of the WDPC, participating institution requirements exceeded the time available for them.

To meet this increased demand from off-campus users, the mail-order job handling and consulting procedures have been improved and new members have been added to the staff section responsible for this work.

There also have been significant changes in the WDPC facilities. The IBM 709 Data Processing System has been replaced by a 7090—a transistorized machine several times faster than the 709. This new system, coupled with other new equipment to be installed in the near future, will provide even greater expansion in capacity and versatility. Considerable effort is being devoted to the development of improved operating system programs and to the development of more efficient approaches to the education of research assistants and users. Thus we expect continuing progress in providing more and better service to WDPC users.

I would like to acknowledge the contributions of all members of the WDPC staff, whose efforts make the progress which we report.

GEORGE W. BROWN, Director

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WDPC PARTICIPATING INSTITUTIONS AND REPRESENTATIVES*

- | | |
|--|---|
| United States Air Force Academy
Major J. J. Inman | National University of Mexico
Prof. Sergio F. Beltran |
| Alameda State College
Dr. T. H. Southard | Montana State College
Dr. F. S. McFeely |
| Arizona State University
Dr. George Summers | Montana State University
Prof. Jack J. Kempner |
| University of Arizona
Dr. A. Wayne Wymore | University of Nevada, Reno
Dean Robert Weems |
| Brigham Young University
Prof. C. Edwin Dean | University of Nevada, Las Vegas
Dr. Helen Cole |
| University of California, Berkeley
Prof. Julian Feldman | New Mexico Highlands University
Dr. R. T. Tussing |
| University of California, Davis
Mr. D. A. Pope | University of New Mexico
Mr. H. L. Walker |
| University of California, Medical Center,
San Francisco
Dr. John B. deC. M. Saunders/Dr. C. Zippin | Occidental College
Prof. Charles W. Seekins |
| University of California, Riverside
Prof. Morris Garber | Orange County State College
Prof. David H. Li |
| University of California, Santa Barbara
Prof. C. G. McClintock | Oregon State University
Prof. Alexander N. Davidson |
| University of California, San Diego (La Jolla)
Dr. Clay Perry | University of Oregon
Prof. John Soha |
| California Institute of Technology
Prof. G. D. McCann | University of Oregon Dental School
Dr. Kuo Hwa Lu |
| California State Polytechnic College,
San Luis Obispo
Prof. Ralph E. Weston | College of Osteopathic Physicians and Surgeons
Dr. Oscar Janiger |
| California State Polytechnic College, Pomona
Prof. Kenneth B. Kriege | College of the Pacific
Dr. Arthur Beckwith |
| Chico State College
Mr. Robert O. Bess | Pacific Union College
Dr. I. Neilsen |
| Claremont Graduate School
Prof. D. Vandermeulen | Pasadena College
Prof. Garth E. Morse |
| Colorado School of Mines
Dr. T. H. Kuhn | Pepperdine College
Dr. Ladis D. Kovach |
| Colorado State University
Dr. E. Remmenga | Pomona College
Dr. John A. Vieg |
| University of Colorado
Prof. Paul Jedamus | Portland State College
Dr. Ralph L. Boyd |
| Fresno State College
Dr. McKee Fisk | University of Redlands
Prof. Charles Hobart |
| University of Hawaii
Prof. John B. Ferguson | Reed College
Prof. John A. Dudman |
| Idaho State College
Prof. F. D. Seelye | Sacramento State College
Prof. J. R. Cox |
| University of Idaho
Dean D. D. Kendrick | San Diego State College
Prof. Raymond Killgrove |
| Immaculate Heart College
Dr. Kahlil Gezi | San Fernando Valley State College
Prof. Donald Raun |
| Long Beach State College
Dr. Robert T. Littrell | San Francisco State College
Prof. Frank Williams |
| Los Angeles State College
Prof. William Voris | University of San Francisco
Prof. J. P. Simini |
| Loyola University
Mr. Norman Weir | San Jose State College
Prof. Edward Laurie |
| The College of Medical Evangelists
Mr. James Yoder | University of Santa Clara
Prof. C. L. Ham |
| | Seattle University
Father Louis B. Gaffney, S.J. |
| | University of Southern California
Prof. R. L. Williamson |

* As of July, 1961.

Stanford University
Prof. Oswald Nielsen
Utah State University
Dr. Bruce O. Watkins
University of Utah
Prof. C. J. Christensen
Washington State University
Prof. Harry McAllister

University of Washington
Prof. James Rosenzweig
Westminster College
Prof. J. J. Farley
Whittier College
Dr. Robert O'Brien
University of Wyoming
Prof. J. C. Routson

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FRANK DELZER, Computer Operator
ROLAND HALL, Computer Operator
DANIEL GALLIN, Computer Operator
SIGURE KNISLEY, Programming Assistant
DAVID J. OATEY, Programming Assistant
MRS. ALICE MARK, EAM Consultant
ARNOLD SOMKIN, SHARE Librarian and Tab Operator
MISS JOSIE DOTSON, Technical Staff Secretary
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EINAR A. STEFFERUD, B.A., Programmer
GORDON P. ASHBY, B.A., Programmer
LEROY WALKER, S.M., E.E., Programmer
THOMAS R. HAMILTON, B.S., Programmer

Part One: The Center

HISTORY

The Western Data Processing Center was established in November, 1956. It is the first university computing center organized specifically to encourage and support research and education in business management.

The Center was created as a result of recognition by the International Business Machines (IBM) Corporation that a solid foundation of research and education in electronic data processing is a prerequisite for significant progress in the field of business administration and management science. Concurring, the Regents of the University of California agreed in a formal contract with IBM to establish the WDPC on the Los Angeles campus. This agreement provides, among other things, that IBM supply and service the machines, that operating costs be shared, that the machines be available for use by the University of California, Los Angeles and participating institutions at least one shift each working day, and that available machine time be divided equally between UCLA and participating institutions. The Center is so organized that research and educational activities can be carried on without charging for the use of the machines. The agreement also stipulates that the Center, being devoted to education and research, may not undertake service activities for business and industry.

In April, 1957, the WDPC began operation of an interim machine installation consisting of an IBM 650 data processing machine and auxiliary punched card equipment housed in the Business Administration and Economics Building at UCLA. In August, 1958, the installation was moved to the newly completed WDPC building, and two months later the IBM Type 709 Data Processing System was installed to replace the IBM 650. A year and a half later, the 709 was replaced by the IBM 7090 Data Processing System.

The new installation and building were formally dedicated on January 29, 1959. The program for the ceremonies was presided over by Dean Neil H. Jacoby, Graduate School of Business Administration, University of California, Los Angeles. Participating in the presentation and the acceptance ceremonies were Mr. Thomas J. Watson, Jr., President of IBM, Mr. Donald H. McLaughlin, Chairman of the Board of Regents, Dean Lawrence C. Lockley, School of Commerce, University of Southern California, and Chancellor Vern O. Knudsen, University of California, Los Angeles.

The new building provides 25,000 square feet of space for the IBM 7090 and auxiliary equipment, for classrooms, conference rooms, a library, and offices for WDPC staff, visiting research workers, and for IBM personnel.

The library contains books, journals and other publications related to the field of data processing and machine computation.

In 1959, a grant from the Ford Foundation established the Western Management Sciences Institute. Its director is Professor James R. Jackson, who is also head of the Management Science Research Project in the Graduate School of Business Administration, UCLA. A substantial part of its funds have been used to support WDPC educational projects. It also sponsors conferences and symposia in business management, a travel and research grant program.

ORGANIZATION

Administratively, the WDPC is a division of the Graduate School of Business Administration, University of California, Los Angeles. The Director of the WDPC reports to the Dean of the Graduate School of Business Administration. All WDPC personnel are regular members of the University of California faculty and staff.

In addition to the Director, the staff includes an Assistant Director, a Chief of User Services, a Chief of Technical Development, programmers, technical staff, computer operators, clerical personnel, and IBM Research Assistants. These Research Assistant appointments are supported by an additional grant from the IBM Corporation. They are intended to provide an opportunity for outstanding graduate students to carry on research and to assist the Center in fulfilling its objectives.

Participating institutions are represented in the administration of the Center through membership in the WDPC Advisory Committee. This committee advises the Director on procedures and policies affecting research projects originating at these institutions and makes recommendations for the selection of IBM Research Assistants from the participating institutions.

A UCLA Faculty Advisory Committee, composed of members of the faculty at the University of California, Los Angeles, advises the Director on problems and policies pertinent to UCLA activities at the Center and on the selection of IBM Research Assistants from UCLA.

OBJECTIVES

The primary objective of the WDPC is to encourage and support education and research in business management, particularly in those areas where the use of modern data processing can be an important advantage. To fulfill this objective the Center devotes considerable effort to the development of new and improved data processing techniques of general value, but which will substantially benefit the study of business problems. Basic research has been conducted by Center personnel in machine learning techniques, information storage and retrieval theory, memory organization, compiler and assembly programs, problem-oriented coding systems, and multiprogramming theory.

Additional research by IBM Research Assistants and by members of the faculty of the Graduate School of Business Administration is being devoted to the development of techniques that will facilitate a quantitative study of business problems. Such projects include, for example, simulation of job shop scheduling problems, development and analysis of a competitive management decision game involving the interaction of a number of firms, and a detailed "information" model of a single enterprise.

A secondary objective of the WDPC is to facilitate the application of electronic data processing techniques to research and educational problems in other academic fields. Projects are currently being conducted by personnel from UCLA and participating institutions in such fields as, for example, sociology, medicine, physics and oceanography.

PARTICIPATING INSTITUTION REPRESENTATIVES

Each WDPC participating institution has appointed a WDPC Representative. The functions of these representatives vary according to the interest of each, and according to the particular requirements of the institution. In general, however, each representative is in charge of the work of any IBM Research Assistants on his campus, and he is the source of information concerning the WDPC services. He is cognizant of the educational and research activities on his campus that are using the WDPC, and will usually be in touch with all data processing activities there. Often he will be the faculty sponsor of a Computer Club, and usually can guide other student organizations that might be interested in computers.

In some cases, where the representative has special knowledge of programming, he will also act as a consultant for projects using the WDPC on his campus. In other cases he will have the assistance of a professional consultant who has been hired for this specific function.

RESEARCH ASSISTANTS

Each year several Research Assistant appointments to graduate students are made with funds provided by the IBM Corporation. They are half-time appointments requiring approximately twenty hours a week on the job. All applications for these positions are reviewed by the WDPC Advisory Committee and appointments are made on the basis of its recommendations. In general, the work of the Research Assistants has been to help the Center fulfill its mission by undertaking or assisting with projects and performing duties approved by the Director and the Assistant Director. The work done by the Research Assistants is a vital and integral contribution to the successful functioning of the Center. Normally this work consists of such varied tasks as teaching the FORTRAN Programming System, assisting users in the analysis and programming of their projects, writing and correcting production programs, assisting the Chief of User Services in the handling and proc-

essing of jobs, assisting Staff Programmers, and conducting tours, demonstrations and lectures.

Research Assistants studying at the University of California, Los Angeles work and maintain offices at the Center. Those studying at participating institutions work at those institutions under the direction of the WDPC Representative.

IBM Research Assistant appointments for the 1961-62 academic year were made to the following students:

CHARLES W. ALBERNI, Business Administration, UCLA
EDWARD C. ARBUCKLE, Business Administration, University of Washington
MAHABIR M. BAJAJ, Business Administration, UCLA
MYRON H. BUCHANAN, Business Administration, UCLA
RICHARD J. CAMPBELL, Business Administration, University of Washington
MYRON C. CURTIS, Mathematics, UCLA
L. DALE GREEN, Business Administration, Stanford University
WELLS A. GROVER, Business Administration, University of Washington
ROBERT W. HAGIN, Business Administration, UCLA
MARTIN A. HAMILTON, Statistics, University of Wyoming
JACK C. HAYYA, Business Administration, UCLA
ROBERT WEN HSU, Linguistics, University of California, Berkeley
KENNETH M. LOCHNER, Mathematics, Montana State College
BRIAN G. MIDDLEDITCH, Electrical Engineering, University of California, Berkeley
YVES NANOT, Business Administration, UCLA
GENE P. SACKETT, Psychology, Claremont Graduate School
EDWARD SANFORD, Economics, Claremont Graduate School
MITSURU TAMURA, Business Administration, University of California, Berkeley
JOHN M. VINCENT, Law School, UCLA

USERS' SERVICES

A very large portion of the WDPC staff is engaged almost entirely in providing service to users. Their activities range from an extensive mail-order job handling and telephone consulting service, to the actual operation of the computer. Also included are EAM consulting, on-campus user program consulting, and publication and distribution of the WDPC Users Manual.

MACHINE FACILITIES

The installation at the Western Data Processing Center includes the following machines:

7090 Data Processing System

- 1 7100 Central Processing Unit
- 1 7302 Core Storage Unit
- 1 7606 Multiplexor

- 4 7607 Data Channels
- 20 729 (Model 4) Tape Units
- 1 711 Card Reader
- 1 716 Printer

Off-Line Peripheral Equipment

- 1 714 Card Reader
- 1 720 Printer
- 1 1401 Data Processing System
- 1 740 Cathode Ray Tube Display and Recorder
- 1 722 Punch

Electric Accounting Machines

- 7 026 Keypunches
- 1 024 Keypunch
- 1 056 Verifier
- 1 519 Reproducer
- 1 101 Statistical Machine
- 1 557 Interpreter
- 1 089 Collator
- 1 083 Sorter
- 1 407 Printer

Remote Data Transmission Equipment

- 2 026 Data Receiving Card Punch
- 2 1001 Data Transmission Terminal
- 1 1009 Data Transmission Unit

OPERATING PROCEDURES

The facilities and services of the WDPC are generally available to any faculty member or faculty-sponsored research project at UCLA or participating institutions. One half of the machine time available is given over to jobs originating from participating institutions; and the other half is used for jobs from UCLA. Users from UCLA and nearby participating institutions can discuss their projects and programs with the WDPC Program Consultants. Users from more remote institutions submit their jobs by mail, and usually can obtain consultation either from the WDPC Representative at their institution or through the mails from a WDPC consultant. In addition, many users from participating institutions travel to the Center to conduct all or part of their research. While here they may avail themselves of the Center's library, educational and consultation services. Programming manuals are available, and office space can frequently be arranged.

EDUCATIONAL PROGRAM AND SUPPORT

The Center is actively engaged in support of many educational projects. In this area there is close cooperation between the Center and the UCLA Com-

puting Facility, Numerical Analysis Research, the Engineering Computational Laboratory, and the Departments of Business Administration, Engineering, and Mathematics. The WDPC facilities are used not only for projects in the regular curriculum, but also for the solution to data processing problems in master's and doctoral thesis preparation. In addition, several university evening extension courses in digital computer programming use the WDPC extensively and regularly.

Many courses in the UCLA Graduate School of Business Administration actively use the WDPC facilities. Among them are:

- BA 115 Business Statistics
- BA 116 Statistical Inference in Business
- BA 117 Business Indexes and Time Series
- BA 118 Introduction to Operations Analysis
- BA 119 Electronic Computers in Business
- BA 133 Investment Principles and Policies
- BA 199 Special Studies in Business Administration—Game Theory
- BA 210 Seminar in Operations Research
- BA 214 Selected Topics in Data Processing
- BA 217 Quantitative Methods of Business Forecasting
- BA 218 Selected Topics in Business Statistics
- BA 298 Studies in Business Administration
- BA 299 Research in Business Administration
- BA X419 Business Data Processing on Automatic Digital Computers

Among the many other courses at UCLA that also use the WDPC facilities are:

- Mathematics X435 Fundamentals of Coding for Automatic Digital Computers
- Engineering 198-II Special Courses
- Meteorology 151 Principles of Weather Analysis and Forecasting

Among the several courses at WDPC participating institutions that use the WDPC facilities are the following:

Colorado State University

- Programming Digital Computers
- Math 115—Computer Programming
- Math 13—Class Training for Computer Programming

Utah State University

- Engineering 167—Introductory Programming
- Programming Class

University of California, San Diego at La Jolla

- Fortran Training Project

Stanford University

- Business 367—Introduction to Electronic Data Processing

The UCLA Executive Decision Game #3 has been played at the following WDPC participating institutions during the past year.

California State Polytechnic College	Sacramento State College
Claremont Graduate School	University of Oregon
Colorado State University	University of Utah
Long Beach State College	University of Wyoming
Montana State College	Utah State University
New Mexico Highlands University	

TRAINING

Although the WDPC is not a teaching department, several noncredit courses in data processing are regularly offered. About once a month, a one-day class in Beginner Fortran Programming is offered, and about once every other month, an Advanced Fortran Programming class is held. These classes are open to any user or potential user of the facilities.

Occasionally, special seminars in both technical and non-technical subjects are held for WDPC staff and users. In addition, and by special arrangements, WDPC staff has conducted Fortran classes at participating institutions.

For the Beginner class, an auto-instructional (teaching machine) program has been written and tried. After suitable revisions, it will be available for use at UCLA and at all WDPC participating institutions.

PUBLICATIONS

WDPC USERS MANUAL. In order to inform users about procedures to be used in handling and processing their jobs at the Center, a WDPC Users Manual has been published. This manual replaces the several "Procedures" and "Memoranda" that previously described the WDPC operating system.

PROGRESS REPORT 1. The first progress report covered the operations of the WDPC from its beginning in 1956 through January, 1959.

PROGRESS REPORT 2. The second progress report covered the operations of the WDPC from February, 1959 through June, 1960.

FAP REFERENCE MANUAL. This manual defines the Fortran Assembly Program (FAP) symbolic language, and describes many of its uses.

GENERAL INFORMATION BOOKLET. For users' and the general public's information, this non-technical booklet describes the history, structure and policies of the Western Data Processing Center.

NEWSLETTERS. In order to keep interested parties informed about current events at the Center, the Newsletter is sent out to various individuals in universities and colleges, and to interested personnel in business and industry.

CONTRIBUTIONS TO SCIENTIFIC RESEARCH IN MANAGEMENT. As part of the 1959 dedication of the Western Data Processing Center, a series of papers was delivered at a two-day symposium. These papers, covering the Economics

of Management, General Theory of Management, and Particular Fields of Management, have recently been published in one volume entitled *Contributions to Scientific Research in Management*. Copies of this volume may be obtained from the Center at a cost of \$2.50, tax included (payable to The Regents of the University of California).

EDUCATIONAL MATERIALS. Specially prepared instructional papers have been published for use in classes offered at the Center. Currently in use are the Beginning FORTRAN Programming Class Outline, and the Advanced FORTRAN Programming Class Outline.

JOB HANDLING FORMS. In order to assign job numbers and to allot machine time to WDPC users, the following forms have been published:

- WDPC Job Number Request Form
- Standard Job Time Request
- Special Job Time Request

PROGRAM WRITE-UPS. A number of program write-ups are available to users of the Center. Among those available for distribution are:

- FAP Buffered I-O Subroutines
- Correlation Analysis Program (WDCORR)
- Questionnaire Analysis Program 4 (QUAP 4)
- BIMD 01 through BIMD 26*
- QUAP Key Punching Data Form

VISITORS

Because of the widespread interest, many people have visited the Center to view the IBM 7090 at work, and to better understand the WDPC's operations. While the 7090 System is in operation, the activities in the main computer room may be seen from either of the two large viewing areas. The casual visitor may hear a recorded explanation of the equipment and its uses by pressing a button in the large area, or he may ask questions of any staff member. In addition, tours conducted by a member of the staff may be arranged for groups or individuals who have a special interest in the Center.

TECHNICAL STAFF RESEARCH

Technical Staff research projects are directed toward the design and incorporation into the WDPC operating system of those programs and programming techniques that will enable WDPC users to make the most efficient use of the computer in their research and educational projects. In the past, these projects have centered around problems in the Monitor System, the input-output system, and the assembly of symbolic programs. Many of these projects have resulted in programs that are now in general use both at WDPC and other installations.

* These programs were developed at the Center by the Division of Biostatistics, Department of Preventive Medicine and Public Health, School of Medicine, University of California, Los Angeles.

Current projects, and projects scheduled for attention in the near future include:

1. Improving the current Fortran Monitor System
2. Modifying and installing a system of off-line CRT routines
3. Preparing for the IBM Commercial Translator System
4. Selecting and installing a set of linear programming systems
5. Investigating the DYNAMO Economic Simulator Program
6. Investigating the SPS-I Simulator Compiler
7. Preparing for the IBM 1401 Data Processing System
8. Experimenting with remote data transmission equipment
9. Research on multi-programming

PARTICIPATION IN SHARE

WDPC is an active participant in SHARE, a voluntary association of IBM 704, 709 and 7090 users organized to share procedural and programming techniques applicable to these IBM machines. The following Center personnel serve on these SHARE committees:

PHILIP A. CRAMER

Chairman, Commercial Translator Committee

Member, Statistical Committee

DONALD P. MOORE

Member, FORTRAN Standards and Evaluation Committee

Member, Symbol-Manipulation Committee

HARRY L. COLMAN

Chairman, Installation Training Problems Subcommittee

USERS' PROJECTS

As of June 1961, approximately 900 WDPC Job Numbers have been issued. Of these, approximately 500 are still active.

The remainder of this report covers these projects. All active Job Numbers and titles that have not been closed out are listed. On many of these projects, a brief report is printed. This report has been omitted for those projects which do not vary significantly from that published in Progress Report 2. It has also been omitted on those projects for which no report has been received.

The entire section is divided according to the broad academic fields, with projects listed within each field by job number. Inquiries on specific projects should be directed to the user.

WDPC ADVISORY COMMITTEE

Dean GLENN OVERMAN
Arizona State University
Professor LAWRENCE C. LOCKLEY
University of Santa Clara
Professor JULIAN FELDMAN
University of California, Berkeley
Professor JAMES ROSENZWEIG
University of Washington
Professor O. NEILSEN
Stanford University
Professor RICHARD L. WILLIAMSON
University of Southern California

Rev. RICHARD E. MULCAHY
University of San Francisco
Professor PAUL JEDAMUS
University of Colorado
Professor DANIEL VANDERMEULEN
Claremont Graduate School
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Vice Chairman

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