Modular training—A new emphasis

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INTRODUCTION

During 1970 and early 1971, United Air Lines and IBM implemented a PARS-based (Programmed Airline Reservations System) reservations system. This system is written in Assembly Language Coding for the IBM 360/65. The software is special purpose, dedicated to providing very fast response to remote airline reservations inquiries including: schedules and availability between cities, passenger name data, and related information. At the start of the project, there were virtually no United personnel with PARS experience, and the implementation phase included the development of a comprehensive training program. The principle objectives of this program, over and above that of preparing United programmers and operators for participation in the project, included the capability to be completely self-sufficient for PARS training at United, the ability to administer training as personnel became available to the project, and the desire to maintain a minimal staff of professional trainers.

To achieve these objectives 12 special courses were developed using the guidelines described as modular training. These courses, developed by IBM for United, were according to specific guidelines and standards. The standards emphasize that courses should be developed in short, self-contained parts, bring the student into direct contact with source information and use other media (e.g., video tapes, audio tapes, slides) to amplify material being presented to the student. This assists the student in advancing at an individual pace, and encourages self-sufficiency.

The basis for this paper is that an in-house training program can be developed which is self-sufficient. The need for outside training may exist for course development. However, generally development can be accomplished by line personnel with technical competence designing training courses in accordance with well-defined standards and objectives. Once developed, it is possible to administer the training on an “as needed” basis, and to accomplish training on second or third shift, or even on a part-time basis.

The balance of the paper presents the details relating to this particular project. This includes principles of course development, course descriptions, and the required training sequence for positions on the project. It should be stressed that no really new principles or techniques are offered, only a new emphasis or applying some old methods (and not so old, such as video modules) is advocated here.

MODULAR TRAINING

Modular training is the term used by United to describe training in terms of courses divided into specified units. A course is defined as: a set of objectives that should be achieved by a target audience together with training material, a time duration for the course, and a plan for accomplishing the training. Training courses are tutorial for programmers and operators on this project in that training is viewed as the transfer of information necessary for the student to carry out job responsibilities in a defined area. This is in contrast to training in a seminar environment by means of exchange of ideas among participants. Under the modular approach, the responsibilities for programming and computer operator positions have been keyed to the courses. Each position has an identified sequence of training courses through which a student progresses prior to full-time work assignment.

Under this modular training approach, each course is administered to a student by an advisor, an experienced person with successful completion of the course or with extensive experience within that area. The governing elements of the course are a student guide and an advisor’s guide.

The student guide is a document which coordinates the student’s progression through training material. It is designed to give the student the information
necessary for a thorough understanding of the subject, as illustrated by Figure 1.

The intent of the student guide is to direct the student through applicable training material in a given order. This includes readings in references not contained in the guide itself (technical manuals, professional journals), or viewing video tapes (including local productions keyed to specific elements of the project), as well as utilizing the guide itself for tutorial material.

In particular the video tapes are a valuable means for producing training material. Use of video tapes is to develop standard, lecture-type modules and eliminates the requirement for an instructor to repeatedly give the same stand up lectures. Video is also useful in explaining standards and procedures, which can be presented to the student as dictated by students responsibilities to the project. The advisor, however, must always be available to answer questions or exchange dialogue with the student on the basis of the information in the video tape.

By design the student guide cannot and does not function alone as a self-sufficient course, such as in programmed instruction. The advisor is a necessary and vital part of the course in modular training.

The format of the student guide includes:

A. Introductory Section
   1. Course description and intended audience.
   2. Course objectives.
   3. Prerequisite training and/or related experience.
   4. Recommended duration of the course.
   5. Advisor/student relationship.

B. Reference Material
   This section identifies all other manuals and documents needed in the course.

C. Detailed Assignments
   This section presents the series of steps which lead the student through the material. It includes reading assignments, identifies lectures, designates participation in workshops, and tests to determine how well the student is learning and applying the material. In courses involving programming, actual coding experience is accomplished by assignments which are processed on the computer.

A history log is maintained for each course containing questions raised by students during the course. This information is used to develop additional explanatory material, quizzes, or more detailed references to aid the student in acquiring a better understanding of the subject.

COURSE ADVISOR

The second key element in modular training is the Course Advisor. By design the course can be administered to a single person, to a formal class of students, or to several students who have started the course at different times. Except for formal classes, the advisor performs this role on a part time basis. As a result, line programmers can function as advisors as well as having normal job responsibilities.

Under United’s approach, only one person devotes a full-time effort as the advisor for basic courses, and line programmers act as advisors for advanced courses. Each manager furnishes the advisor for advanced courses for students who will receive assignments in that manager’s area. Only senior, experienced personnel are used as advisors. This represents one of their job responsibilities, and is a means of providing further experience in the management aspects of dealing with people.

The advisor has three primary responsibilities:

1. To serve as a point of reference for any questions the student may have on the course material. The advisor may not be able to answer every question, and may have to get the answer from another source. In any case, the response is on a timely basis.
2. To administer quizzes and exams to the student as required in the course sequence. The results are always reviewed with the student to insure complete understanding.

From the collection of the Computer History Museum (www.computerhistory.org)
3. To emphasize the most pertinent parts of the course relative to the student's work area, and to evaluate the student's understanding of the course. Here, the advisor's function is to tailor the course to the student's needs. The advisor takes the initiative in discussing the important aspects of the course instead of passively waiting for the student to ask questions. By probing the student's thought process the advisor can fill in any areas of weakness and correct misunderstanding. Normally, the advisor spends \( \frac{1}{4} \) to \( \frac{1}{2} \) of the student's assigned course time, depending on the advisor's familiarity with the course and the extent of the student questions. For example, if a student is training on a half-time basis, the advisor can expect to spend \( \frac{1}{4} \) of that time in an advisory capacity. The advisor also provides up-to-date technical information on the system, which minimizes the problems associated with technical obsolescence of training material.

**CAREER PATHS AND COURSE PROGRESSION**

The United PARS project provides training for programmers, data base personnel and computer operator personnel. This section describes each job and the training sequence required.

There are seven areas of programming responsibility:

1. **Application Programmer**
   Develops programs in a real-time environment which accomplish the airline reservations functions. These include display of airline schedules, availability of seats inventory control, flight information, and programmatic exchange of information with other airline reservations systems. Programming is done in ALC, the assembly language used for coding on the IBM 360 series.

2. **Schedule Change Programming**
   Includes an understanding of batch processing as well as real-time programming, and has significant impact on many system data records. These include modifications to flight schedule information and development of information used to reaccommodate passengers. Programming in ALC under DOS and OS is included.

3. **System Support Programmer**
   Has responsibility for the generation and maintenance of systems, both OS and DOS, PARS off-line support, together with file maintenance and management reports. Programming languages include PL/I and FORTRAN.

4. **Control Program Programmer**
   Has assignments in input/output for disk and tape, CPU scheduling, queue processing for input, ready and deferred lists, interrupt handling and on-line data collection.

5. **Communications Programmer**
   Is involved with control and coordination of communications between remote sites with CRT terminals as well as with the other computer systems. There is heavy involvement with hardware such as IBM 2703, WE201B modems or equivalent, IBM 2948, and the IBM 2915 or equivalents.

6. **Performance Evaluation Programmer**
   Analyzes the PARS system performance by measuring and interpreting system characteristics including input/output message size, program core residency time and execution time, file accesses and queueing. Simulates the system by means of model(s) and predicts system performance relative to proposed modification.

7. **Coverage Programmer**
   Has primary responsibility for the diagnosis and immediate correction of on-line software malfunctions, as well as monitoring on-line system software integrity. Programming occupies a relatively small amount of time.

Two Data Base jobs pertain to information records in both the on-line and off-line systems. Programming experience is not required for these jobs:

1. **Data Base Specialist**
   Has the responsibility for the integrity of all passenger information in the on-line system. This can involve restructuring parts of the data base as a result of airline rescheduling as well as corrections to erroneous on-line information.

2. **Data Base Coordinator**
   Has responsibility for maintaining airline schedule information, pilot data information and communications tables. These are processed in the off-line system.

**Computer Operations** involves three tasks:

1. **Data Control Clerk**
   Receives and monitors off-line processing jobs, maintains tape and disk libraries, and JCL card decks for off-line jobs.

2. **Computer Equipment Operator**
   Operates all equipment in the off-line-system.

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and assists in monitoring the on-line system activities.

3. Console Operator
Has responsibility for operating the hardware in the on-line system. Monitors and controls system configuration, and applies corrective action for hardware failures.

The training required for these positions is summarized in Figure 2. IBM/360 training is also shown

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**Figure 2—Career path training sequence**

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**TOTAL TRAINING DAYS FOR REQUIRED COURSES**
25 35 50 45 55 50 80 10 3 5 10 10

**R** = Required
**D** = Desirable

Subscript indicates course sequence number

*Not required for all System Support Programmers*
in presenting the training progressions. The total training days associated with the IBM/360 training and the PARS training identify the time needed before an individual is ready to accomplish productive work.

For example, a programmer with no 360 computer background would require both IBM/360 and PARS training. For applications programming, 40 training days would be required. If the programmer already had IBM/360 experience and no PARS experience, 25 training days would be required. The description of PARS training courses is given in the Appendix. Both the training results and the training duration are good as evidenced by high comprehension rate and minimal training period.

SUMMARY

As a part of the implementation of a PARS system, United Air Lines has developed a comprehensive training program using the modular method with three objectives:

1. United is self-sufficient for PARS training (Note: PARS training requires IBM 360 knowledge as a prerequisite).
2. Training is administered as people are available.
3. Training is accomplished with a minimal professional training staff.

Twelve courses were developed to achieve these objectives for the different job responsibilities within the project. More than sixty students were successfully trained with this method.

An advisor is a key element in administering modular training. The advisor is responsible for tailoring the basic course to reflect the content of the student’s assigned area, and to monitor the student’s progress. Drawn from the line organization, the advisor is proficient in the assigned area and monitors the student’s progress by answering questions, administering quizzes, and probing the student’s understanding of the subject matter.

Modular training with professionally competent personnel acting as advisors eliminates the need for formal classes, and training can be administered on an “as available” basis, although a class can easily be accommodated with this method. In addition, the advisors have line responsibilities and thus the need for a large, dedicated training staff is eliminated. Currently, at United one person has full-time basic training responsibility for the 70-80 project programming staff.

Advanced training advisors are furnished by the area to which the student is assigned.

Generally only senior persons are advisors and represent a part of the responsibilities of a senior position. Being an advisor usually affords first exposure to working with people in a management mode, which is good experience if further advancement along supervisory lines is desired.

In particular, however, it was found that:

1. An advisor is indispensable to the program, and cannot be passive. The advisor must actively monitor and encourage the student’s progress. Experience has shown this method has favorable results.
2. Prior to starting the training, there should be a review meeting between the student, the assigned manager and the advisor. The review will include the sequence and duration of the courses for the student, the approximate expected progress (relative to whether the student will be in training full-time or part-time), and the role and responsibility of the advisor(s).
3. Practical problems, and quizzes which reflect the course objectives are essential, especially for programming courses. A simulation of the real environment is necessary for coding and debugging problems. The course content must be tutorial and serve as a transition into the work environment.
4. Insofar as possible, training, especially the advanced training, should be on a part-time basis. This gives the student a better opportunity to assimilate the many new concepts and terminology as training exposes them. In fact, terminology is a major factor on this project, because the student is not only using EDP terms, but also the special vocabularies associated with airlines and with the PARS system.
5. Update of course content caused by system change is best accomplished by line personnel. In this case they act as advisors but without students, and have the responsibility for updating the applicable course content.
6. The student guide/advisor functions best in a non-development environment. In a totally developmental environment, scheduling is a problem. Estimates of required program development time always seem to neglect factors which were not expected to occur (sickness, machine downtime, etc.) In either case, the line must be staffed to accomplish both programming and training requirements.
Overall, modular training has worked reasonably well for the United Airlines PARS project. The primary objectives have been satisfied by a minimal professional training staff and utilization of line personnel in the training function. The advisory responsibility takes time, however, and an advisor's schedule must include time for training in addition to normal line responsibilities if modular training is to function properly. This same method should also be able to work for other projects. A student guide need not necessarily be a reference unto itself, it may be a series of references to other manuals, documents, video tape, et al. Video tapes, in particular, afford the means of augmenting course material and making it available for training around the clock. There currently exists a dearth of organized information and material which can be used to construct a course. There is no prophet for rewriting a document which can be used in its present format with directions as to applicability. Both the student guide and the advisor furnish this direction to the material and provide tailoring specific to requirements.

APPENDIX A

Course descriptions

This Appendix presents a description of the 12 courses that were developed at United Air Lines. These specific courses are applicable only to a relatively small group of PARS users.

It should be noted that because the courses are tutorial, quizzes form an important part of the course, being geared to the course objectives. The student is expected to achieve certain defined objectives, and the quiz results represent, in part, how well the material has been learned, as well as performance evaluation.

Training in PARS requires a knowledge of the IBM 360 hardware and Assembly Language Coding (ALC). These are prerequisites for all the PARS Programming Courses. Commercial video taped courses, augmented by material particular to United's needs, satisfy these requirements.

The PARS courses are divided into two sets; a basic set which all programmers attend, and the advanced courses, which are attended on an "as needed" basis. The first three courses listed below are the members of the basic set; all others belong to the advanced set for programming except the operator course, which is independent. Sixteen video tapes have been produced by United to augment the basic PARS training. These were produced based on an evaluation of the information in the history log, an invaluable tool for developing training modules such as programming techniques, project procedures, and the like. In addition, the video modules are always available to the student on an around the clock basis, thus helping to free training from the prime shift dependency.

1. PARS System Description—3 days
   This course presents the basic PARS hardware and software descriptions, as well as concepts and terminology associated with the airline industry as well as PARS system. Emphasis is placed on providing the fundamental information concepts and terminology needed in other courses.

2. Applications Programs—5 days
   This course presents the functions of all PARS application program packages including programs within each package, and describes the data records required by each program explaining how these records are accessed and data is manipulated. It relates airline reservations agent actions and needs to the manipulation of the applications programs and the data records.

3. Airlines Programmer Environment—17 days
   This course is divided into three major areas corresponding to the types of programmer activities in this real-time PARS environment:
   1. Program Development
      The availability and use of programmers tools such as: entry control block, macros, and conventions.
   2. Program Maintenance
      The PARS Program Library System, the steps involved in entering programs, the inputs necessary for program maintenance.
   3. Program Testing
      The concepts and procedures used in testing, in generating test inputs and in interpreting test results.

   The course environment is designed to resemble, as closely as possible, the expected environment in the development group. The subjects discussed at length are those dealing directly with the job of application programming.

   Upon completion, the student is capable of productive assignment in applications programming within the PARS environment.

4. ACP Fundamentals—5 days
   This course introduces the programming techniques such as queuing, priorities, message flows, and related items used by the Control Program.
Upon completion the student is able to relate the functions of the ACP program to his present assignment.

5. ACP Internals—15 days
Airline Control Program Internals is concerned with program listing level discussion, by topic, of each of the functional units of the airline CP. This includes communications, hardware input/output, and services and facilities provided to application programs.

Upon completion the student is prepared to accept assignment in any functional area of the Control Program. The student will lack only what can be gained through experience.

6. Schedule Change Input Data Preparation—3 days
Editing and validation of modified schedule information is the main objective of this course. Upon completion the student is able to prepare the input data required for Off-line Schedule Change.

7. Off-Line Schedule Change—5 days
Topics covered include concepts of off-line schedule change; off-line schedule change input and processing, and a detailed analysis of the off-line schedule change programs.

Upon completion the student is able to communicate in the language of schedule change with non-programmers and other PARS Application Programmers, use to use the appropriate documents to extract the details of the schedule change programs assigned as the student's responsibility.

8. On-Line Schedule Change—5 days
This course presents the functions of all the on-line schedule change programs, defines the data records affected by the on-line schedule change and describes how they are affected, explains the four logic phases of the on-line schedule change, and relates the programs and data records involved to each phase.

9. Communications—5 days
This course presents PARS Communications in general, and specifically as applied in United's PARS System. This system exchanges communications with two other United Air Lines On-line Computer Systems. In addition PARS Communications is covered from the functional level to a detailed program level which describes the interrelationship of the programs, tables and data records involved.

10. Data Collection—5 days
This course describes the functions of the Data Collection Programs and defines the facilities provided by these programs, explaining how system, file, program and message variables are collected on-line, and reduced off-line. It identifies listing variables which are out of line from data collection reports and determines from these variables how system performance can be improved.

11. Data Base Management—20 days
Data Base Management covers four major file support functions and data base generation. These include: Pool Directory Generation and Maintenance, Recoup, Capture/Restore, Fixed File Reorganization and System Test Compiler.

12. System Operator Training—5 days
This course describes, in general terms, a typical PARS hardware configuration and the PARS software system. In addition performance of the following operator tasks is explained: program library maintenance and update, testing, system load, all other off-line and on-line operator activities, interpretation of error messages, and use of functional messages appropriate to a given job.