EXPERIENCE WITH EXXON'S IMPLEMENTATION OF THE JACKSON PROGRAM DESIGN METHOD

—C. M. Bernstein

In 1973, Exxon's Mathematics, Computers and Systems Department conducted an evaluation of the new technologies of program development. The project was motivated by the increasing manpower cost for software development and maintenance and the increasing business vulnerability to software failure. We concluded that a program's structure is the key to its effective development, enhancement, execution and support. Without a program's structure we could not reliably construct the program in parts, put the parts together such that their interactions would be predictable, and have the whole structure achieve its specified purpose.

Michael Jackson, now of Michael Jackson Systems Ltd., was then an ACM lecturer. We found that he had a teachable method for the logical design of structured programs and a precise notation to express them. In addition, his method was effective at attacking practical programming problems where the designer is not free to define input and output formats and user interfaces. Michael taught three program design courses at our Florham Park, New Jersey offices in the winter of 1973. The courses were well received and, together with Michael's consulting on specific applications, provided the knowledge we required. We adapted Jackson's Methodology to our environment and renamed it Program Structure Technology, PST.

It is important to remember that PST does not address the systems design process. PST is not concerned with defining the organization or contents of files, specification of input and output formats or transactions, designing data bases, or defining required processing. PST is concerned with the work of designing and implementing the program which meets those specifications. PST incorporates the technologies of top down design, structured programming, top down development and test, and structured walk-thrus.

We conducted our first in-house PST course in August of 1974 and aggressively fostered the assimilation of PST over the following three years. Over 1,000 programmer/analysts have been taught PST. All Exxon regions can now provide their own training and support. This includes training for supervisors, consulting, and the support of standards. PST is being used in both large and small installations to develop batch commercial and interactive data base applications, as well as minicomputer, process control and program product software.

The Jackson Program Design Method defines hierarchical program structures whose components are dissected. There are four basic component types:

Elementary, which are not dissected
Sequence, whose parts are executed once each, in order
Selection, one of whose parts is executed, the choice part depending on a condition
Iteration, which has only one part which is executed zero or more times

The four component types have exact analogies in data usage structures for files, records and in internal data. The program's structure is designed to correspond to the usage of the data to be processed. Alternative usages of data can be imposed on a given set of data and the alternative program structures evaluated. Each operation carried out by the program appears in an appropriate component. For example, "INITIALIZE CUSTOMER TOTAL" should appear in a component which happens once per customer. If no appropriate component exists, the program structure is deficient. Where there is a conflict between data usages to be processed by one program, the program is designed as if it were two or more separate programs. The separate programs are subsequently combined by the technique of program inversion. Where a data usage cannot be handled simply, more elaborate forms of iteration and selection must be used.

The major benefits of the Jackson Methodology are as follows:

- Reduced program complexity
- Eliminated logic errors at design instead of debugging in the testing stage or later
- Identified sensitive points in the problem specification
- Easily maintained programs
- Effective program documentation as a by-product of design
- Step-by-step methodology has enabled effective use of software to support the process

Four PST projects of varying size (.5, 1, 5.1, and 25 work years of effort) were evaluated and productivity was found to be above 7000 lines per work year in every case. This compares favorably with the New York Times Archives project's 9000/WY and the "Industry Averages" of 2000-4000 lines/WY. In the case where we attempted to measure program quality, we found less than one error per program during the first six months of production.

We have done little to the Jackson Methodology to adapt it to the Exxon environment other than minor changes in terminology and emphasis. We have complemented it with our own material on structured programming in PL/I, top down development and test, and structured walk-thrus. We have also employed different pedagogical techniques to enable programmers who are not experienced instructors to teach the PST course.

The Jackson Methodology has been extremely successful in Exxon and is now virtually a standard throughout the world. I recommend not underestimating the difficulty of teaching programmers "how to program properly" and develop an assimilation plan and a skilled staff to accomplish it.