QUALITY EVALUATION OF TEST OPERATIONS VIA ELECTRONIC DATA PROCESSING

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INTRODUCTION

The test operations and data analysis engineers have taken giant steps in utilizing computers and data processing methodology in the various scientific fields. This is especially true in electronic weapons systems and space vehicle and related systems being developed and proposed. Procedures, command sequences, and data collection and reduction have reached high density and are being treated via EDP. However, to what extent have related disciplines such as quality engineering utilized this same approach? How have they integrated or been integrated into this complex? What steps appear to be in the offing to insure that the attention of the electronic data processing community is focused upon this problem and can present a case suitable to secure management backing where capital expenditures, personnel, and space are considerations? More questions may be raised than answers given. However if some actions are stimulated the basic objective will be fulfilled.

TEST OPERATIONS USAGE OF EDP

The testing of complex electronic and related systems has had a series of requirements placed upon the operations team and has created a real man-computer methodology that can be the slave or master of the program. The design of the testing system normally follows a very hybrid and interwoven sequence involving many decision paths and management constraints. Some of the rationale might include:

1. Technician operation vs automatic command
2. Quantity of command and control elements per timing sequence
3. Real or near real time status displays and decision capability
4. Types and quantities of data secured
   1. Analog
   2. Digital
   3. Tape, paper or magnetic
   4. Visual vs recorded and confirmed
5. Near real time analysis and decisions on validity of results
6. Fluidity and control of change of test procedures and system test requirements
Quantity of peripherals to support the program, i.e., card sorts, printouts, key punch, etc.

Program change control to assure machine match with equipment being tested

Level of data verification and trouble shooting routines, i.e., self-test and failure isolation

Machine costs—capital vs project

Reliability

We have seen in the test field numerous interfaces with instrumentation, controls, high-speed analog and digital inputs, outputs, and computations involving test operators, all or many of which may be external to the actual computer complex.

For a fully automatic test or checkout system the programmer must understand the above and have researched the procedures and must understand the requirements. He must understand the equipment being evaluated almost as well as the design and system engineer. He must then define the complete test program to accomplish the task. Obviously this must all be accomplished (1) to a schedule, (2) within cost, (3) to meet performance, and (4) it must be reliable. How can such a demanding set of diverging requirements accommodate yet another delay like Q.C. evaluation overlays and requirements? If the checkout system requires that the computing complex control and execute a series of complex test sequences and during these monitor and analyze a detailed number of variables for incorrect performance, how does the requirement for quality approval and for acceptance of this operation become specified, funded, and certified as true by the in-house Quality Control and the customer?

THE QUALITY DILEMMA

Consider the major segments of a typical computer-controlled test operation including automatic real time performance evaluation and test certification. They are shown in Fig. 1.

How are the quality requirements integrated into this total data acquisition picture? They for the most part are not! Several organizations are noted exceptions. The normal procedure is for Engineering (a) to define the parameters to be measured, (b) define the allowable limits and then, (c) proceed to design the testing such that the test/test complex rationale leaves no unexplainable discrepancies. A data review then occurs as a later date with only some “quick look” information to verify moving on to the next phase. What, therefore, are the “Quality EDP” challenges?

The number of Q.A. and Q.C. managers and engineers available that can plan in depth in terms of EDP for quality acceptance are limited in number.

Upper management understanding and backing can be lacking in furthering Quality's role.

Figure 1. Major segments of a typical computer-controlled test operation.
The ability of Q.A./Q.C. to understand and to make significant technical contributions to the data mix. Too often this is only a paper mill increase at best and does not improve product, insure test results, or customer satisfaction.

This lack of understanding results in lack of trust in the data evaluation and long laborious manual data reviews are required to accomplish that which a computer can accomplish is several seconds.

What must Q.A. managers do to become capable in these fields?

They must develop competency in planning, analyzing, understanding, and contributing to test requirements, procedures, plans, and customer reviews.

They must move out to provide systems test planning with inputs to insure that Q.A. will be an accomplished factor in EDP evaluation programs, both analytically and factually.

They must provide a complete technical service to systems test, not just a paper service, or rubber stamp on results not understood.

Q.A. must become machine conscious in terms of EDP utilization for data summaries, quality control history records, calibration requests, customer mandatory product control, and customer acceptance review. This implies that machine techniques, instrumentation, error analysis, circuit design, workmanship, calibration, and checkout procedures have all been reviewed in depth and approved and Q.A. has only to review the results of a computer status report to make a "buy" decision and obtain customer concurrence.

Here is where the technical and management decision lies. Do the Quality organizations existing today in most hardware producing establishments have the opportunity and management backing to gear up technically to meet and utilize the EDP that computer engineering is refining. Can they then adapt these to quality systems and detail hardware evaluation? We must each answer this based upon our own experiences and known organization. I suspect that the answer will be "NO" more often than not, however, there are certain exceptions that are pointing the way.

POTENTIAL SOLUTIONS

The following represent some thoughts that lead to an increase in communications and technical understanding of the changing evaluation methodology, i.e., real time computer data analysis and quality acceptance of product.

The buy-off criteria for most electronic systems performance and configuration must be designed from inception to accommodate in real time electronic data processing, analysis, and acceptance.

In-house quality organizations should have a strong but technically sound initial input into final system sell-off criteria. This requires a broad-based systems-oriented engineering capability with strong test and EDP background plus strong management backing.

Customer buy-off criteria must be adaptable to EDP and must be completely knowledgeable and must accept such output as evidence of satisfactory performance. In some fields where enormous quantities of data are produced and analyzed this is mandatory to economical operation.

Public acceptance of such techniques will also need to be cultivated, particularly where safety or welfare are concerned. Many agencies are already engaged in EDP techniques, such as banks, ticket information, billing, automatic machine tool operation, etc., and extending this to other disciplines is only a matter of time and economics which can be hastened through extensive missionary activity which is shaped to provide increased service, lower cost and decrease schedule span for Q.A. operations.

CONCLUSIONS

If the above potential solutions are to be considered seriously, these actions should be actively pursued to insure a continued growth and increased Quality Assurance role in the utilization of EDP.

This can be done if you:

1. Learn EDP.
   Think EDP.
2. Talk EDP.
3. Teach EDP.
4. Encourage engineering and manufacturing counterparts to do likewise.

5. Include EDP as part of your quotes and budgets but be really ready to technically and economically defend them by convincing yourself that the application is correct. Wrongly applied, your case can be pulled down around your ears.

6. Update your management as required. This must be skillfully done; such a seed needs careful planting, tender loving care, and much hard work in upward communications. Here, among others, films, items about potential competition usage vie related fields, i.e., case histories, visiting experts, and participation in EDP meetings, are in order.

7. Consort with the enemy. Find out what engineering, design, manufacturing, the customer is doing and planning in EDP. Take the initiative and assist and help design better techniques and applications that will, then, be completely acceptable to you — "quality."

8. Call upon the services of EDP organizations to assist with (a) meetings, (b) arranging speakers for programs, and (c) as a source for technically qualified assistance. Services are available for defining, reviewing, and planning implementation for extending the use of Electronic Data Processing disciplines deeper into the acceptance of product sphere for which Quality has final authority.

Since I have been operating in the role of the enemy for a number of years, i.e., electronic systems test operations and evaluation, the above is offered in the hope that this will provide incentive in many organizations to investigate and accept the tremendous technological advantage that the proper application and utilization of Electronic Data Processing will make in almost any major industrial effort involving equivalent systems sell-off and involving many parameters and technical judgements. The return in

- Performance
- Cost savings
- Schedules
- Reliability
- Technical satisfaction

will be your reward as well as your management's and will provide an important contribution to advancing and cross pollinating the Quality and EDP mixture to the betterment of each.