EVALUATING SYSTEM PERFORMANCE AT TRIMIS

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Abstract.

The Tri-Service Medical Information Systems Program was begun by the Department of Defense to acquire and install automation systems in military hospitals, while reducing the real costs to the Government. The Program's managers emphasize functional and economic analysis to insure that this goal of cost control is met. The experiences of the Program can provide valuable information to other hospital groups which are considering changes in their automation systems.

Introduction.

One major issue facing managers today is doing more with less. Financial reserves are diminishing and markets contracting, facing businesses to achieve the maximum results with available dollars. This is as true for the Government as it is for the private sector. Public resources are also limited, and fiscal constraints require management decisions which maximize output for those resources consumed.

The Tri-Service Medical Information Systems (TRIMIS) Program was established by the Department of Defense in 1976 to acquire and install effective and efficient automation systems in the hospitals and clinics of the Military Services, at the lowest overall cost to the Government. The cost reduction objective is being achieved through a central management process which emphasizes the evaluation of procured systems. Since 1976, the TRIMIS Program Office has followed this management philosophy of measuring the benefits to be derived from automation compared to the costs of obtaining these. The TRIMIS Program Office manages its activities to obtain the maximum benefits for the resources expended, while continuing to install functionally effective medical automation systems.

The Evaluation Process.

Functional evaluation in the Program Office is conducted to assist managers in making decisions to install multiple copies of the TRIMIS automation systems. To accomplish this overall purpose, functional evaluation is oriented on the following objectives:

- To support development of requirements which economically meet functional user needs

- To support decisions for project continuation as required by life cycle management

- To support advances in the process of evaluating health care information systems.

The functional evaluation process is structured to correlate to the major phases of Department of Defense (DOD) life cycle management.

During concept development the potential users define functional objectives for the automation system. These objectives are the projected benefits intended to be derived from the automation. After the objectives have been specified, the same users develop measures and indicators of the benefits. Evaluation in TRIMIS is based on these three items.

During definition and design, the predicted benefits are used in the preliminary economic analysis. The results of this analysis can both support the feasibility of continuing the project, and direct areas of emphasis to enhance benefits.

When system development is underway, the preautomation data are collected at the prototype sites. These data serve as the baseline for the ultimate determination of real functional effects of the automation system.

Also during this phase, after the prototype system is installed, the TRIMIS Program makes regular site visits to monitor the implementation. These visits serve two purposes. The first, is to allow correcting site conditions which are inhibiting the effective use of the new system. The second, is to determine when the operation has settled enough to begin post automation data collection.

The second period of data collection addresses the same set of measures and indicators used during the preautomation effort. The intent is to measure the operational results of the automation system, and to develop a set of quantified benefits. Although the effort is to quantify as many of the benefits as are reasonably possible, non-quantifiable benefits will also be examined. The decision to install more copies of the automation system will be based, in large part, on both the net benefits derived (over the costs incurred), and the other non-quantifiable results. At TRIMIS, an updated economic analysis is prepared based on the final evaluation report. This

analysis assists the Program's managers in their decisions for continued system deployment.

Status of Selected TRIMIS Evaluations.

As of July 1983 the TRIMIS Program has completed evaluations of the following systems: Laboratory, Computer Assisted Electro-Cardiography and Teleradiology. By October 1983, TRIMIS anticipates completing the evaluation of the Radiology system. These automation systems are self-contained and functionally specific. The results of these evaluations have been used to decide if further installations were warranted. Space does not permit an exhaustive discussion of all evaluation results. Only the most significant information is included in this paper.

Computer Assisted Electrocardiography.²

The TRIMIS Program Office installed a computer system for the analysis of electrocardiograms (ECGs) at 18 medical treatment facilities (MTFs) in the Southern California area. The Computer Assisted Practice of Cardiology (CAPOC) system has one central computer which provides ECG interpretations for MTFs within the same geographic area. From remote sites the ECGs are transmitted over telephone lines, analyzed, and then printed out within about 15 minutes at the site where the ECG was taken. The computer generated interpretations can also be confirmed by cardiologists at the central site and then returned. The objective of the automated ECG system is to improve cardiac diagnosis and treatment in the large number of MTFs which do not have cardiologists on their staffs.

The evaluation of this project showed that the major benefits of automation are access to, and efficiency and quality of ECG services. The following specific impacts on the delivery of patient care were documented:

- improved access to cardiologists at small medical treatment facilities
- support for non-cardiologist physicians in reading electrocardiograms
- decreased time to receive an ECG interpretation at remote treatment facilities
- increased availability of prior electrocardiograms for comparison with the current ECG
- time saved in reading ECGs
- improved technical quality of the ECG tracing
- increased legibility and consistency of the ECG report
- fewer lost ECG tracings and reports, and
- improved accuracy of reading (especially for normal tracings).

The costs of obtaining these benefits were from \$12 to \$18 per ECG. This range depended on which type provider reviewed the reports, and what response time was required.

Teleradiology.³

Teleradiology is an automated system in which an electronic representation of an X-ray image is transmitted via telephone lines from one location to another. The TRIMIS Program Office and the Bureau of Radiological Health (Public Health Service) conducted a six-month experimental field trial of a teleradiology system designed by the MITRE Corporation, to evaluate its functional and technical use in a routine medical practice setting. The evaluation of the field trial showed that the major benefit was reduced turnaround time. The experiment also validated the basic operational concept of teleradiology. The following specific results were obtained:

Turnaround Time - X-Ray Request/Report Cycle

The data collected during the post-implementation period suggest that turnaround time could approach 24 hours for routine exams, and one hour for STAT exams. Inputting films required approximately 10 minutes each, and telephone line transmission took an additional 15 to 30 minutes per exam. The field trial figures demonstrated that installation of the teleradiology technology can not, itself, result in reduced turnaround time. Protocols must be established for inputting films regularly, radiologists must be available to interpret images on a routine basis, and reports must be delivered to providers promptly and read by providers upon receipt.

Significance of Prompt Receipt of Interpretations

At the time that an exam was requested, providers predicted that in 73% of cases a prompt receipt of a radiologist's interpretation would have some effect on their opinions or decisions regarding patient care. Timely interpretation receipt was considered "very significant," essential to patient care decisions, in only 8% of cases.

At the time the providers actually reviewed the teleradiology interpretation report, they were asked what effect this had on patient treatment or disposition decisions. Providers indicated that in 42% of the cases there had been no effect on patient care. In another 43%, the reports increased the clinical confidence of the providers. Of the remaining reports some were reported to have had a major effect on care (6% for routine physicals, 8% for emergency exams, 10% for other diagnostic exams, and 7% for exams performed "for the record" or as follow-up procedures).

User Acceptance of Teleradiology

Acceptance by Primary Care Providers. Overall, providers' comments were positive with most derived from the system's potential utility rather than

actual benefits realized during the field trail. Providers believed that the system could be valuable were turnaround time reduced to a few hours or to a single day. Also, at some of the sites, providers felt that 24-hour availability of interpretation services would be important.

Acceptance by Receiving Site Radiologists. The radiologists who had participated in the field trial felt that the quality of images received was generally good and that image resolution was usually adequate.

Acceptance by Technicians and System Operators. The technicians who used the system at the transmitter sites felt that once the system had become reliable, it had been easy to use, although expressing the feeling that film input was tedious and time consuming.

Feasibility of Routine Use. From work sampling and time study data, one could infer that both small, moderately busy, and large X-ray departments should be able to accommodate a teleradiology system into their daily schedules without an increase in staff.

System Costs. Since this was an experimental field trial, and not intended for other installations, costs measured were not felt to reflect those for an equivalent operational system. As a matter of interest, the cost of using the experimental teleradiology system in the field trial sites was found to be approximately \$7 per X-ray exam. These costs would, of course, vary in different settings and with a refined system.

Medical Laboratory.⁴

The TRIMIS Program Office has installed a computer assisted medical laboratory (TRILAB) system in three military hospitals. This system is designed to support internal management processes, interface with automated clinical test instruments, and support terminals in wards, clinics and other facilities outside the laboratory.

The evaluation of the TRILAB system in operation at these facilities has shown the following benefits for both the hospital and for patient care:

- Time devoted to information handling in the clinical laboratory was approximately 2.6% lower using TRILAB
- Turnaround time, between receipt of a request and the forwarding of a test result to the providers location, decreased for routine tests, and remained essentially unchanged for STAT or urgent tests
- Telephone calls to the laboratory by providers who were inquiring about test results were reduced to almost half the volume
- Laboratory staff time spent on record keeping was reduced. Providers felt that there was less

time wasted due to fewer repeated tests resulting from delay, lost results, inaccurate results and laboratory inquiries. Nursing staff time was also reduced both as a result of fewer telephone inquiries, and fewer documents to file in patient charts.

As a consequence of these specific improvements, the evaluation projected almost \$80,000 of annual benefits to the laboratory, and almost \$360,000 for other hospital activities.

Evaluation Lessons Learned.

In addition to the results from the projects presented above, the TRIMIS Program has learned much about the process of conducting evaluations. Two significant topics to be discussed are: structured implementation monitoring, and benefits realization.

Structured Implementation Monitoring

The basic purpose of TRIMIS evaluations remains to provide information for managers on which to base installation decisions. An appropriate decision requires that the information accurately portray the true situation at the site. The automation system should have become fully operational, and a part of normal daily activities. TRIMIS evaluations have always included implementation monitoring, which is site visits to check the progress of system use. It soon became clear, however, that these were not adequate to decide when to conduct the post automation survey. Some systems were installed smoothly and were accepted by the staff readily. The final evaluation of these systems could begin in a few months. Others required up to a year before they were a normal part of day-to-day operations. The timing was critical, since if the site were visited too early then inaccurate data would be collected. If too late then the benefits of a wider installation of the system were delayed. To resolve this problem, TRIMIS developed structured implementation monitoring. Under this technique user objectives for the system are transformed into performance goals. These are then used to develop measurable, specific performance criteria. The criteria are such things as percent of terminals in use, number of duplicate manual operations continuing, or changes in productivity. Thus during each site visit, samples of data are collected to measure these performance criteria. When the measurement shows that the goal has been met, the site is ready for the collection of all post automation data. Through structured implementation monitoring these activities can be managed to support the optimum decision.

Benefits Realization

No matter how well designed, nor how well managed during development, the only value of an automation system is the operational benefits provided to the site where installed. TRIMIS experiences have included some installations where effective automation systems were inhibited from

delivering benefits due to site conditions. Benefits realization, as an outgrowth of evaluation, is being developed to deal with such circumstances. Many sites found that changes in the estimated workload, management turnover, and inadequate training were preventing the automation systems from operating satisfactorily. These same conditions prevented the expected benefits from occurring as well. TRIMIS plans a pilot test to fully develop benefits realization. Such a program as presently envisioned will include:

- Advance orientation of senior site managers on what to expect from the system, and what commitments are necessary from their facility
- Standard training protocols and curriculums to establish a common basic knowledge
- Standard site preparation procedures and schedules to insure timely readiness for installation
- Earlier and more frequent implementation monitoring, not limited to prototype sites, to identify problem areas and propose solutions
- A partnership among the sites, Services and the Program Office - committed to effective operations.

It is anticipated that the benefits realization process will go beyond the implementation period, toward realizing the maximum possible benefits from automated health care systems.

Conclusion.

The TRIMIS Program was established in 1976 with the goal of installing medical automation systems in the Military Services' hospitals and clinics, at the lowest overall cost to the Government. The functional evaluation process assists program managers by identifying potential benefits early in a project's life cycle. The process also contributes to implementation at the prototype sites, and finally provides the information needed to decide if more sites will receive the system. Through functional assessment the TRIMIS Program Office manages activities to obtain the maximum benefits for the resources expended, while continuing the install functionally effective medical automation systems.

References.

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