INDUSTRIAL DATA PROCESSING APPLICATIONS REPORT

Applications	Modernization and Consolidation of EDP Facility
Type of Industry	Exploration and Production of Crude Oil, Natural Gas, Associated Industries
Name of User	Standard Oil Co. (Indiana) Chicago, Ill.; Tulsa, Okla.

Equipment Used	IBM System/360 Model 65 (three systems) IBM System/360 Model 75 (two systems)

Synopsis

Can a $5 billion-a-year corporation find happiness with a centralized data processing facility, especially if the "centralized facility" is in two different places, 700 miles apart? Standard Oil (Indiana) has spent a year developing that question and about five more years finding answers for it. This rather massive modernization and consolidation project is a continuing operation.

A primary objective of Standard's overall EDP modernization and consolidation project, is economic improvement to the company's existing information systems. "The goal," explains Standard Board Chairman John E. Swearingen, "is to provide the specific information needed at each level of the organization to maximize profits through a new series of control reports." The project is scheduled for completion in the early 70's.

Background to the system revision

Standard's operations include onshore and offshore exploration and production of crude oil and natural gas (500,000 barrels daily), refining, thousands of miles of pipelines, chemical manufacture and sales, wholesale and retail marketing and constant research and development.

To meet the computational work load and to ease information interchange, the data processing and computing equipment had to be arranged into a system that was (1) integrated, (2) data transmission-connected and (3) geographically dispersed. This system would include several large capacity processing centers in locations such as Chicago headquarters and Tulsa (where the oil and gas producing subsidiary, Pan American Petroleum Corp., is based.) Input-output terminal devices at other company locations would be linked to the centers by telephone lines.

Feasibility studies with various computer manufacturers took place, and their proposals were consistent in that each indicated a potential annual savings in equipment and computer operating personnel costs of about $3 million per year. A fourth supplier who came into the study toward its completion also confirmed these savings.

Rough estimates had also been made of the additional savings which might be realized by even further consolidation to a single center. It was generally agreed that these savings ($500,000 per year) were too small to allow definitive conclusions regarding the economic merit of one center. However, the estimated annual savings in equipment rental costs and computer operating personnel resulting from a conversion to a two-center facility was $2,937,000, according to J. W. Redding of Standard's EDP facility speaking to the Society for Management Information Systems Founding Conference. He also noted that Standard was spending, at that time, approximately $10,214,000.

All of the savings were found in the Chicago complex with only a slight increase in the Tulsa operations. "The indicated savings were the net effect of several factors," says Redding, "but the most significant were multiprograming techniques and software just becoming available and (also) the economy of scale resulting from replacing existing equipment with centralized larger (and consequently lower cost) computing equipment."

The technical barriers to the program were a matter of knowledge--communication technology was still in early development stages and random access storage devices were just beginning to appear. Standard, however, felt the program was justified and these technical snags could be avoided in the first stages. The cost of the two-center program was estimated at approximately $7.7 million over a 4-year period. In 1965, Standard made the decision to start.

The System

A geographically distributed company with operations in some 25 foreign countries, some Standard subsidiaries decided not to participate in the initial information studies because of personnel shortages. American International, AMOCO Chemicals and Tuloma (since merged with American) opted out. Americal Oil, Pan American, and Standard conducted planning studies to determine economic justification for improved information. (The foreign subsidiaries are eventually to be integrated into the system.)

Overall responsibility was assigned to Frank Pearce, the director of Information Services and Computer Sciences. He reports to the vice president, finance, L. Chester May. The installation of so large a system required managers of every major department in the company to take a new hard look at their operations for computer purposes.

Personnel from operations and staff departments to devote full time to determining the information requirements of their particular departments. Involved were about three quarters of the total operations.

Those who would be using the improved information system were responsible for, first, defining their requirements and second, estimating the benefit that would accrue. Each subsidiary established an Information Services Dept. which was responsible for determining costs and designing and implementing its own information system defined by their users with a minimum amount of control from the parent company's Information Services Staff.

Each subsidiary's Information Services Dept. reported to the top administrative or financial executive in that subsidiary. This new department was charged with advising the system users in its area of responsibility of the costs of the information systems which were wanted and to design and implement the most economic and flexible system (manual or automatic) that filled the combined requirements of the entire subsidiary.

Some of the personnel who left regular duties for the project are still involved in the special assignments and will remain so until the improved systems are operational. "Most will return to line operations in their departments," says Pearce. "This is what we mean by user-driven systems." The design of the systems was made so that each system could be expanded, modified or otherwise changed as rapidly and as inexpensively as possible.

Once the decision for two large EDP centers--Chicago and Tulsa--was made, other system changes were put into effect. First, small computers would be replaced by terminals which could communicate with one or both of the centers. Second, the terminals would have limited logical capability to perform local processing functions that did not affect the data bases located at the centers. Who got the terminals? Every location throughout the consolidated company that could economically justify access to the data and programs at the Centers; functional areas requiring a common data base for updating, reporting, analysis and interrogation and last, central management (the general office of American and Pan American for interfunctional reporting and analysis.)

"Our concept of two large data processing centers servicing terminal devices geographically dispersed over the country," says Swearingen, "was predicated on a 'remote job entry' teleprocessing software capability." It was decided that Standard would be responsible for the development of this voice-message-data telecommunications network. It was determined also that Standard would have primary responsibility for the hardware and software at both the Chicago and Tulsa data processing centers and for maintaining compatibility between the two. It was to accomplish this role via chairmanship of a strong coordination group. The arrangement proved inadequate, and in October, 1967, the IS&CS Dept. took over full responsibility for the Chicago data processing center. Shortly thereafter, Pan Am in Tulsa reorganized its Information Sciences Dept. so that a single individual was responsible for the overall operation of the Tulsa Data Processing Dept. Thus, coordinating relationships were strengthened between the two centers.

Other rules were established by the coordinating group. The first target was the proliferation of terminals. In the past, subsidiary companies were free to select their own terminal devices and were responsible for developing and maintaining the necessary terminal software to allow communications with the Chicago and Tulsa Centers. This proliferation of terminal types (with software tailored for each location) made it extremely difficult to determine the cause of teleprocessing problems: Was it the terminal hardware? Terminal software? The Bell System facilities? The Center hardware? The Center software?

"The obvious failure," says Pearce, "was the terminal concept in total." Early in 1969, responsibility for all terminal telecommunications software was assigned by Standard's Information Services Dept. Standard subsidiaries now choose terminals from a limited set of low, medium and high speed machines specified by the IS&CS Dept. "Otherwise," Pearce says, "there is a strong tendency to save pennies in terminal rentals which force dollar expenditures developing and maintaining software."

Standard has developed its telecommunications network for about the same cost which the company would have incurred had it continued with WATS services. (The wait for a WATS line was described as "intolerable.") As an addition, data communications have been added to the system at relatively low cost, and have provided the added benefit of making possible high-speed data transmission to American's marketing regions and Pan Am's division office.

Hardware in the Chicago center is an IBM System/360 Model 75 and a Model 65. These are connected to 15 outlying terminals serving Standard Oil (Indiana), American Oil Co., and Amoco Chemicals. Other subsidiaries; Amoco International Oil Co. also have access to the machines.

At Tulsa, two Model 65's handle most activities and a Model 75 is dedicated to the exclusive handling of seismic data. The Tulsa units connect with seven terminals and serve Pan Am. Together, the systems handle onshore and offshore exploration and production of crude oil and natural gas; refining; land, water and underground transportation; wholesale and retail marketing; chemical manufacture and sales as well as research and development in a variety of different fields. Local, smaller computers control crude oil distillation and other refinery operations in Whiting, Ind., Salt Lake City and Texas City, Texas. Local computers also monitor the flow of fluids and productivity of wells and leases in Wyoming, Montana and Texas. Mathematical simulation improves the design of drilling platforms in adverse conditions--the strenuous climates of Alaska's Cook Inlet and the North Slope.

Most of this data is channeled via communications networks to the centers where it is updated and stored in data banks on punched cards, magnetic tapes, drum and disc files. The telecommunications system with its scattered terminals makes the data library available to management throughout North America. Throughout North America, the data may be printed on paper or displayed on graphs, charts, engineering drawings, maps and other forms. A security system protects the stored data from unauthorized access. The system is not, however, perfectly trouble-free.

"Experience has shown us," says Pearce,"that the reliability of our telecommunications computer environment is far less than ideal. The design of application information systems must take this non-ideality into consideration."

Pearce points out that two specific areas of characteristics to be met by applications systems design are flexibility from a subsidiary user's viewpoint without the need for the user to understand Job Control Language or programing; adequate documentation for the computer center personnel so they may interface directly with the system users for normal runs, restarts and return.

And he also stresses that the need for more and better information was not immediately necessary at top management levels, but at functional levels the IS&CS group was primarily concerned with building functional information systems. This was somewhat complicated by the fact that each subsidiary's information needs are unique to that particular subsidiary. Thus the operating rule: an application system must be manageable by the users and Center operations personnel with only occasional involvement by the people who designed and implemented the information system.

The design and implementation of the many applications systems that make up Standard's EDP and reporting activities continue to be defined by the system users. Since their needs are acted upon by each segment of Standard's IS&CS Dept., it is useful to examine the activities of each of the areas that comprise this department.

Each of the 10 IS&CS cost centers of the parent company (not including subsidiaries) has a role in maintaining and supporting the data processing functions. When the project started, the department consisted of about 10 persons. It now numbers about 300.

Systems Planning and Coordination and Operations Research (and Technical) have similar responsibilities. Systems planning assumes responsibility for those information systems where the primary effort is establishing and managing a frequently updated historical data base. Operations Research, on the other hand, assumes responsibility when the major activity is analysis of that data base to be used in assisting management decisions. "It's the rare system in which both organizations are not actively involved," adds Pearce.

Both organizations share responsibility for designing and implementing consolidated company information systems and both managers chair a consolidated company coordination group. Each is a member of the other's group.

These coordination groups (which are made up of counterpart representatives from each subsidiary) meet on a bi-monthly basis and discuss common problems and individual successes--a method of sharing knowledge: the groups comprise Standard's leadership personnel throughout the consolidated company in the area of information systems design and implementation. The groups jointly agree on the need for additional hardware or software capabilities; suggest deletion or additions to the Data Processing Standards Manual, recommend purchase of software packages from 'outside' concerns and recommend education programs and comment on the ones proposed. "Messrs. Stokes and Hoffman," (respective managers of the group) Pearce adds, "are instructed to do everything in their power to assure that 'reinvention of the wheel' is minimized."

Since Standard was moving ahead of the current state of the art, it seemed advisable for the company to establish its own computer education group. This Education and Development group was created in 1966. It has been subjected to perhaps more trauma due to the need for a particular skill-teaching--than the other cost centers. Pearce elaborates: "It has been difficult to obtain personnel with the desirable teaching skills and computer knowledge to meet our requirements."

What to teach is decided via proposals for advanced courses made to the Applications Systems and the Operations Research Coordination Group by the Manager of Education and Development. The views and recommendations of these two groups have a strong influence on the overall content of the more advanced education programs. The organization is not responsible for education and development of persons (1) outside Standard or subsidiary Information Services Depts., (2) computer operations personnel or (3) operations research personnel, but stay aware of such areas and assist those responsible for the courses.

The facilities organization, led by D.E. Crowley, plans, designs, operates and maintains the telecommunications and data processing network. This organization is responsible for the System/360 general purpose computers "for the forseable future."

Important to Facilities are forecasts of requirements. From the forecasts, Facilities attempts to answer such questions as "When will an on-line real time environment be required and what intermediate stages will be necessary between the present capabilities and this 'ultimate'?" The group moves forward by aggressive planning and continually improving functional capability and reliability. The sub-organizations under the Facilities Group are Communications, Computer Support and of course the Chicago Data Processing Center which has its own subset of supporting organizations.

First, Communications, under the leadership of R. M. Hoffman, is charged with the plan, design, implementation, operation and maintenance of an efficient and reliable telecommunications network, in order to satisfy the current and projected voice-message-data communications requirement of the consolidated company. It is directly responsible for the local telephone system which serves all the Standard Affiliates in the Chicago loop area.

Hoffman is also chairman of the Telecommunications Coordination Group which includes representation from each subsidiary company, each of whom is responsible for advising Hoffman on the requirements of his subsidiary. (These representatives are responsible for the design and implementation of all telecommunication facilities which service his own company.

Hoffman and his staff maintain close relations with the Computer Support organization, directed by V. J. Groth. Computer Support attends to system software modifications and additions, maintains compatibility between Standard's major data processing centers and provides software for the terminal devices to allow communication by teleprocessing with the Centers. This organization is responsible for modifications and additions to IBM's operating system and scheduler. The group designed and implemented (and currently maintains) the Remote Job Entry System which allows telecommunications between many terminal types and the centers.

Creating the necessary software to support both these functions is the responsibility of Computer Support Personnel. The group revised IBM's MVT scheduler to relate internal dispatching priority to individual job characteristics. Chairman of the Standard Review Committee is a member of Computer Support.

However, certain of these responsibilities are delegated to other organizations. For instance, Pan Am is responsible for its software for IBM 1800's located at its Division offices. The stipulation is that adequate documentation must be provided to Computer Support so that the terminal may be added to the corporation's specified set. V. J. Groth chairs the Facilities Coordination Group, whose responsibility it is to see that this kind of information is shared within the company.

The Chicago Data Processing Center can best be examined in terms of the sub-organizations that keep it running: the Facilities and Application Support group, the Coordination and Control Group and Machine Operations.

Facilities and Application Support is divided into two operating segments: one is inwardly directed toward the Center, the other is directed toward the Center users. The "inner-directed" staff is concerned with installation, trouble shooting, record keeping and maintaining all IBM-provided system software. Occasionally the staff provides technical assistance to machine operations personnel when a particularly thorny System/360 problem arises. Another responsibility of this sub-organization is developing a broad, overall expansion plan. They are pondering questions such as: Should the next increment be another Model 65? Or a Model 85 to replace a 65? Is large core storage economically attractive and under what circumstances? Should there be a separate processor to handle the telecommunications function? The group must calculate the exact hardware configuration to be installed through time.

Activities directed toward users include consultation to help resolve problems; developmental studies on high level languages, job control language, utility programs, etc.; and publicity for any generally useful information which results. Specific utility programs (not available from IBM or elsewhere) are designed and implemented by this group. The organization represents Standard's primary interface with users. To assist in data management during system development and for improved information systems, the group requests and analyzes periodic forecasts of computer requirements from all Center users for two years in advance.

Finally, Machine Operations recommends changes in hardware and software. In cases of overload situations, the group is responsible for finding other ways for processing the excess work, either outside or at affiliated Centers. Machine Operations interfaces with those using the Center, with Coordination and Control (for Scheduling) and with IBM maintenance engineers. Another item on its responsibility roster is minimizing the costs associated with the Chicago Data Center equipment through alternatives of rental, lease purchase-leaseback or purchase via negotiations with suppliers and lessors.

These are the groups constantly involved in the accelerated design and implementation of the application systems required by the ultimate users of the system.

Since this is a continuing and dynamic activity, change continues to evolve: changes in emphasis, changes in skills. Looking into the future, Information Services and Computer Sciences is able to prognosticate thusly:

1. Direct entry of source data at its source using keyboard and visual display terminals will gradually supplant mailing hard copy to a central location for keypunching.

2. A gradual transition is in the offing, from a batch environment toward one which also requires an 'on-line, real-time' environment. This will occur, application by application as dictated by economic necessity and not as a massive changeover.

3. Many more application systems will evolve and will have a highly operations research flavor. Further expansion of functional data bases will be necessary to fill the gaps.

4. Improved information systems for higher levels of management (above the functional level) will evolve, as these individuals learn more regarding the functional systems and how their use can improve overall strategic planning.

To elaborate: first of all direct entry would staunch the paperflow, especially a problem at Pan Am, as that organization codes and keypunches most of its information. Data would be entered at terminals, stored on tape with identification and then sorted by data type, edited and filed in a random access file. In Standard's credit card operations an account number eventually would pull a 2-month history of an account out of a computer file and display it on a CRT.

An on-line, real time environment is valuable wherever critical, up-to-the second information is required. This would probably not apply to crude oil terminals, however, as it takes up to two months for crude oil to reach an automobile gasoline tank. There is little need for instant information there.

Amoco Chemicals is another subsidiary where such a plan would be beneficial. The chemicals industry is both blessed and cursed with a fluid inventory situation. Sales personnel would be able to determine if a large quantity of blue-grey polyester, for instance, were available for immediate shipment.

A fuel oil supplier would find such a service useful -- a customer call would act to dispatch a fuel oil shipment. Standard EDP spokesmen emphasize the advantages of remote batch processing for items where a one or 2-hour turnaround time was allowable. This kind of system input would prevent machine time tie-up. All the real-time functions would pull information off random access memories.

An obvious area where on-line real time would be desirable, is the Standard Oil credit card application where points are scored for customer quality. Instant credit clearance would minimize bad risks and facilitate in-house credit checking. "Note," says Frank Pearce, "that a gasoline credit card leads to other credit offers from the issuing organization. In the past, it took up to two years to get those credit card leads. Last year, where a prototype system is already in operation, the same operation took four months."

"Greater operations research flavor" the third objective for the future, refers to greater dependence on simulation -- mathematical models, line progressions, and critical pathing. For instance, Standard uses a highly complex bidding system for government fuel supplies. Information needed includes a history of other companies' bids, alternate sources and transportation costs versus Standard's, so that an optimum bidding price is arrived at. Since about 1965, the company has quadrupled its business and increased profits eight times with the assistance of the method. The same technology is used for offshore lease bidding.

The improved information systems for higher management levels is dependent upon the increasing availability of information at the functional level. As work is accomplished on systems that apex at the subsidiary functional level, Standard feels that the data for top management will have taken care of itself. "The point is," says Pearce, "that we are only at the first stage of developing an improved information system for the consolidated company."

Board chairman Swearingen puts it another way: "In our four years since development of our total system got underway, there was 'a period of informational revolution' as opposed to the phase we are now in, which is looked upon more as a period of 'evolution.'"

Where will the talent for all this evolution come from? Where has the talent for the previous revolution come from? From Standard's in-house talent retrieval system, called TASK. The data gathering for this skill-retrieval system began in 1965, and the project is scheduled for completion by the mid-70's. The system is the one exception to Standard's rule about uniform, interchangeable systems, as it is not available to everyone on an interchangeable basis.

Data on Standard personnel have been gathered from three sources: payroll, the benefits section and supplemental data which includes information on skills, performance, years of college, supervisory judgement of performance, etc. Payroll records alone have already provided enough information to fill management's need in the system so far.

Staff coverage was thorough, as much of the data came from payroll sources and every subsidiary had payroll information organized. All the information gleaned from the payroll system is punched into cards ("automatically, as it comes down the pike," Pearce adds), and the system is sealed from the unauthorized.

The information is stored in random access files on disc. Certain signatures have to be gathered before the system information is made available. Too, all subsidiaries may add information and the parent company may not access this information without the subsidiary knowing about it. When management needs a man with certain experience or abilities, they may ask for the file update or report and file or the job classification of all persons making over $10,000 per year who speaks Swahili. The requirement is that the queries are kept within the framework of the system. "We were aware of the danger of TASK's being turned into Big Brother, and we are guarding against this," Pearce says. Jack M. Tharpe, vice president, employe and public relations for Indiana Standard, stresses the point that "just anything" cannot be put into the system, or called for, by just anyone. Of approximately 47,000 employes, 40,000 are in the TASK system. Still missing is detail on educational background, for which forms are being prepared. The system has proved useful, and to illustrate, Indiana Standard has discovered that any language needed thus far can be translated by staff in the headquarters building. About 10 more items of information will be added to make the listing complete.

There are considerable other corporate additions to be made in the future: "Subcenters are a-borning," says Pearce in a prophetic tone. According to the IS&CS group, it is apparent that many small goegraphically dispersed organizations need rapid access to the program and data bases at the Centers for economic reasons. Many slow-speed non-programable terminals (such as Teletype) will be connected to the Centers for this and other reasons

such as direct data entry. Many of these slow speed terminals will be sending information to and requesting reports from the terminals of the main Centers.

An example of an operating sub-center is, for instance, Detroit. Detroit is a satellite of the Chicago Center and System/360 Model 30's do the local processing there. Detroit serves a large area and terminals monitor gas and oil deliveries and so forth. What's needed are decision-making abilities at the terminals, so that answers to Detroit's data questions can be answered on site. In the Standard definition, subcenters go in two directions -- to terminals and to headquarters.

In Whiting, Indiana, the staff can reset process control computers from calculations performed off line. It saves only a minimum of people, but considerable cost. The standard IS&CS sees terminals becoming more and more complex. This is one of the reasons that the company continues to explore other manufacturers' terminals; they are always considering improved cost/performance characteristics.

"The GE terminals look appealing," says Pearce and adds, "Standard must unbundle too, now that other suppliers' equipment quality has improved. And we must continue to structure our systems."

One item that Standard is after is a piece of hardware that sits between an IBM computer and a terminal of another breed which is, in effect, a master translator. It would queue and signal incoming information from, for instance, RCA and Univac terminals and flag appropriate handling situations for the IBM computers. This front end processor would allow Standard to use other manufacturers' equipment and abilities--as other suppliers are ahead of IBM in specific areas.

However, Pearce has advised his staff that "If you are inclined to worry about near-catastrophies, go to bed some night considering where we would be today had we decided on any other supplier than IBM."

What model--65 or 85--will be chosen to contain the expansion in Chicago, is still under discussion. The choice will be assisted by a job stream simulation. Full implementation of Standard's dual systems are scheduled to be complete in 1972.

"There are always service centers," a spokesman adds. What Standard takes into account is the possibility of the machinery going down. The backup at one center must be able to handle the other. If Chicago goes out, the work can be teleprocessed to Tulsa. The data base can be moved back and forth to make room for more production (linear programing and so forth). The two systems must continue to be compatible; primary control however, resides with the parent company.

It is possible to move sections of the Pan Am processing to Chicago; the EDP staff figures that they're still only using from 40 to 50 percent of the central processing power. Any by the end of 1970, Standard estimates that all locations which were originally thought to be potential terminal locations will be communicating with one or both centers via medium or high speed telecommunications.

Throughout all of Standard's computer studies, centralization structuring and honing the information flow, the user is never very far away.

"Remember," Pearce reminds his staff, "that subsidiary personnel are measuring costs and benefits, application by application, whether it be telecommunications or center computation costs. The lower we can push our costs, the more likely it will be that an application area or an extension of an application area will be justified.

"The point is...that we are only at the first stage of developing an improved information system for the consolidated company. When we complete this first stage well and in a timely fashion, I envision no end to profitable future extensions in the directions indicated above."