Applications	Personnel Reports, Payroll, Purchasing, Inventory Requisitioning, Budgeting, Management Reporting, Project Planning and Control, Lens Design
Type of Industry	Optics Manufacturing
Name of User	Itek Corp. Lexington, Mass.

Equipment Used	IBM System/360 Model 30 data processing system
	Control Data Corp. 3300 and 924 data processing systems
	CalComp Digital Graph Plotter
	Itek Graphic Display Console and Automatic Scanner

Synopsis

The Itek Corporation has a major investment in data processing, both for general purpose business processing and for the design of sophisticated optical systems used in aerial reconnaissance, measuring solar energy, high performance photographic systems and other complex optical applications.

Itek engineers use a CDC 3300 computer and a CalComp plotter to produce lens configurations and light ray analysis curves. The system has dramatically reduced lens design time.

On the business side, a separate data processing department utilizes an IBM System/360 Model 30 system that reaches into every aspect of the firm's business.

Data processing at the Itek Corp.'s Lexington, Mass., headquarters can be broken into two distinct areas, each having its own computer systems. The company's Computation Center is designed to be responsive to the needs of the firm's engineers and scientists, responsible for the design of high precision complex lenses and optical systems. The Central Data Processing Dept., located in a separate part of the building, is charged with the responsibility of meeting the needs of Itek's general data processing, including payroll and personnel processing, accounts payable and receivable, inventory control, budgeting and other general functions.

Itek Corp. specializes in photo-optics and electro-optics and was founded in 1957 with a nucleus of scientists and engineers who had pioneered the development of advanced optical reconnaissance since World War II.

A major government contractor, Itek is often called upon to develop sophisticated one-of-a-kind optical systems. Sales have increased from $6 million in 1958 to more than $100 million. The company employs more than 3,700 persons in 55 worldwide locations. Although Itek's product line is well diversified, the major interest has been concentrated in three major areas: advanced optical systems and reconnaissance, commercial reproduction equipment and supplies and industrial and consumer optical products.

CENTRAL DATA PROCESSING

Itek's Central Data Processing Dept. is responsible for the company's management information system.

Itek is currently using an IBM System/360 Model 30 data processing system. The mainframe has 65,000 characters of core storage. Peripheral devices include four disc drives, four tape drives, a 1,100 line-per-minute printer, and a 600 line-per-minute printer. The system runs 24 hours a day, five days a week. There is no work scheduled on weekends, but Saturdays and Sundays are used for program debugging and special runs. The system replaced an IBM 1460 card/disc system.
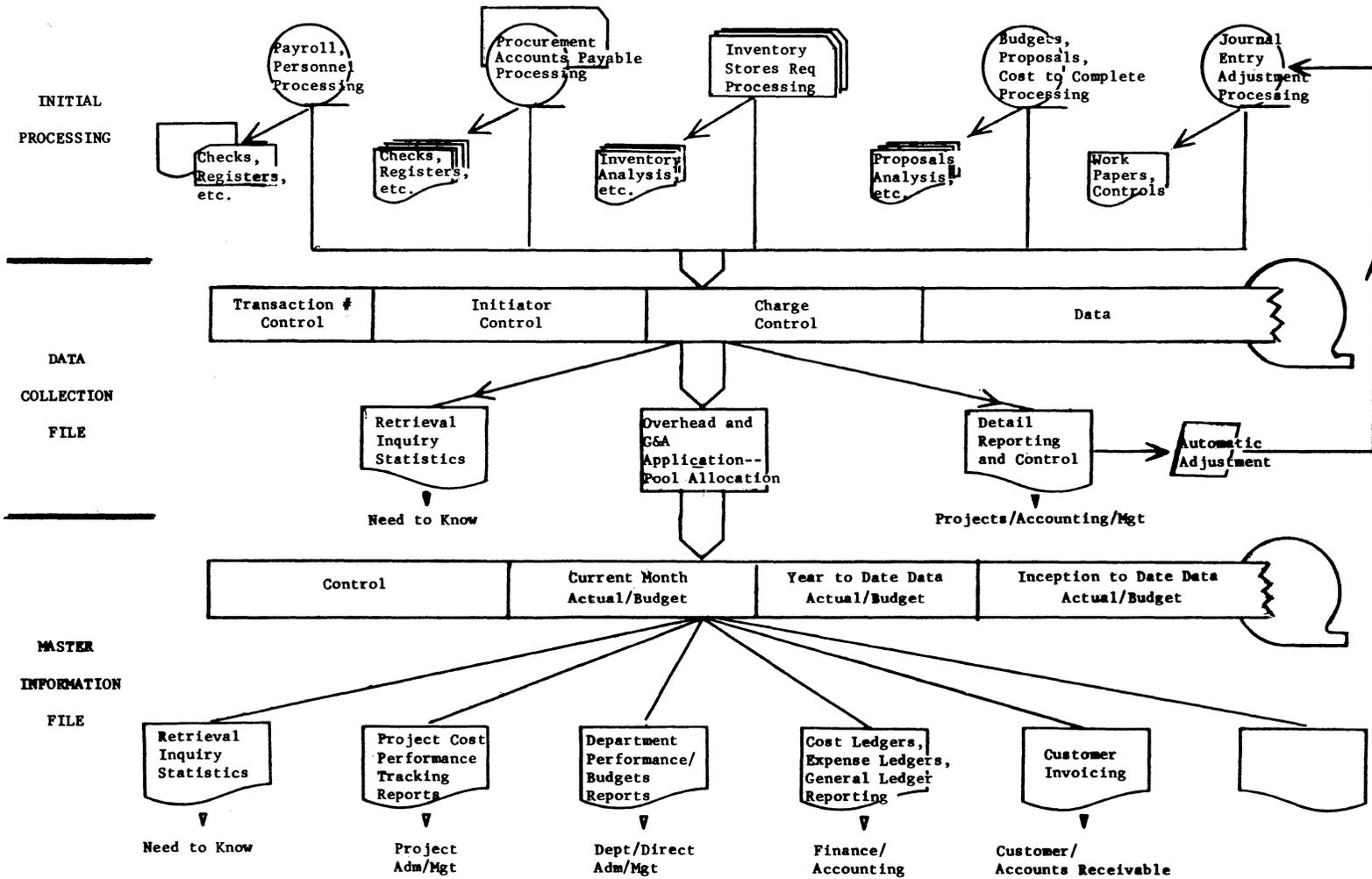
The Itek Information System is designed on three levels, aimed at three levels of management.

-- Initial Processing
-- Data Collection File
-- Master Information File

INITIAL PROCESSING

The initial processing level of Itek's three-step systems approach consists of five independent systems, each designed to collect data for a specific function within the company. The five areas encompass all financial activity at Itek, and the information funneled through them is used not only to produce numerous weekly reports but also to contribute to Itek's common data base. The five main areas of computer activity are:

1. Payroll & Personnel Processing.
2. Procurement & Accounts Payable Processing.
3. Inventory Stores Requisition Processing.
4. Budgets, Proposals and Cost to Complete Processing.
5. Journal Entry Adjustment Processing.

INITIAL

PROCESSING

Payroll, Personnel Processing

Procurement Accounts Payable Processing

Inventory Stores Req Processing

Budgets, Proposals, Cost to Complete Processing

Journal Entry Adjustment Processing

Checks, Registers, etc.

Checks, Registers, etc.

Inventory Analysis, etc.

Proposals Analysis, etc.

Work Papers, Controls

Transaction # Control	Initiator Control	Charge Control	Data

DATA

COLLECTION

FILE

Retrieval Inquiry Statistics

Overhead and G&A Application-- Pool Allocation

Detail Reporting and Control

Automatic Adjustment

Need to Know

Projects/Accounting/Mgt

Control	Current Month Actual/Budget	Year to Date Data Actual/Budget	Inception to Date Data Actual/Budget

MASTER

INFORMATION

FILE

Retrieval Inquiry Statistics

Project Cost Performance Tracking Reports

Department Performance/ Budgets Reports

Cost Ledgers, Expense Ledgers, General Ledger Reporting

Customer Invoicing

Need to Know

Project Adm/Mgt

Dept/Direct Adm/Mgt

Finance/ Accounting

Customer/ Accounts Receivable

Itek's Central Data Processing (CDP) department does all the computer work for 7 of the company's 11 divisions. The other four have their own data processing facilities. Because of the amount of input coming into CDP, strict control functions have been instituted to ensure that deadlines are met, and information processing goes smoothly.

All incoming data is prepared by clerical staff members in the departments generating the input. Each batch of material is forwarded to the data processing department with a Central Data Processing Transmittal Cover Sheet, filled out in the generating department. The cover sheet contains the name of the person responsible for forwarding the batch of documents, the department number, telephone number, date, the division. The body of the cover sheet contains a description of the work to be processed, and the period of time that the batch of documents cover. The header document is two parts; one for the department, the other for CDP.

Itek		NO. 02510

C.D.P. TRANSMITTAL CONTROL COVER SHEET

FROM:

NAME _Elisa Pimicangelo_ DEPT. NO. _1-840_ TEL. NO. _2782_ DATE _1-9-69_

DIVISION:
- [ ] 01 CORPORATE
- [ ] 02 ADVANCED TECHNOLOGY LABS
- [ ] 03 LEXINGTON RESEARCH LABS
- [ ] 04 PHOTOSENSITIVE MATERIALS
- [ ] 05 POLYMETRICS

- [✓] 10 OPTICAL SYSTEMS
- [ ] 20 ITEK BUSINESS PRODUCTS
- [ ] 30 PENNSYLVANIA OPTICAL
- [ ]
- [ ]

- [ ] 31 WAYNE-GEORGE
- [ ] 32 ROLOR
- [ ] 40 A.T.I.
- [ ]
- [ ]

TYPE OF DOCUMENT:

CLASS	TYPE/DESCRIPTION	PERIOD COVERED
[ ] ACCOUNTS PAYABLE		
[ ] PAYROLL		
[ ] ACCOUNTS RECEIVABLE		
[✓] COST ACCOUNTING	_Distribution Adjustment Sheets_	_w/E 1-3-69_
[ ] PROPERTY ACCOUNTING		

When the input arrives at data processing, it is logged-in, time-stamped and given a job number for scheduling. The information is then keypunched and verified, and finally sent to the computer for processing.

Each division within Itek is given a unique code which is a two-digit number. Code 01, for example, refers to any processing done for the company on a corporate level; 10 indicates an identification for the Optical Systems Div. In addition, each project or department is assigned a unique four-digit number for recognition by the computer. Elements of cost are also broken into two-digit numbers, with 01 through 39 serving as labor codes; 50 through 59 materials and subcontract codes and 60 through 79 are used to code other direct charges.

Each document processed through the computer is assigned a unique transaction number which is sequential. Thus, an employe's paycheck may be numbered 10011, the next check or transaction will be numbered 10012.

The coding system enables Itek to refer back to the computer for an individual transaction. The company has complete files on magnetic tape of every transaction that has occurred since September 1967, when the system went on the air.

Payroll & Personnel Processing

Itek's payroll and personnel processing system is interlocking, with four major personnel functions contributing input.

Every Itek employe is required to fill out a time sheet weekly. The sheets are first approved by the department or project manager, then forwarded to the division's payroll department where they are batched and a header sheet prepared. All time sheets must be logged into the data processing department by noon each Monday. They are either mailed from remote locations, or hand-carried by the payroll clerks in Lexington.

The time sheet data is keypunched, edited and balanced against a predetermined balancing figure determined by the computer (which is programed to know what the straight time figure for the entire company should be). Paychecks are then run, along with a year-to-date earnings and deduction report for each employe. The report is forwarded to the payroll department to answer employe inquiries.

New employes are added to the system by the division personnel departments which forward new employe historical information to the data processing department. Each employe is assigned an employe number by the division. Besides new employe data, the personnel people are also responsible for reporting changes of status such as promotions, increases, changes in departments, transfers, dependency and deletions, as well as any payroll adjustments. Employe history is stored on tape master files.

Besides payroll and personnel, the insurance department and the company's credit union also report changes of status to the Central Data Processing Dept. (CDP). The insurance department reports all retirements, new people who've been added to the insurance program and beneficiary changes. The Credit Union reports deductions, new memberships, loans and payments.

The tape files contain a complete and accurate listing of every employe, his background, and history with the company. The system is designed to automatically inform the personnel department and the employe when he's due for a physical examination, when he's eligible for insurance benefits (after four months with the company), stock purchase plan, and other company benefits.

This information is output during the normal payroll run, and the message forwarded to either personnel, payroll, the credit bureau or the insurance department.

In all, the payroll and personnel system generates more than 50 different reports on a weekly, monthly, quarterly and yearly basis. A small sample includes:

        Personnel Rosters
        Average Amount of Increases
        Total Amount of Increases
        Automobile Ownership
        Average Amount of Sick Time (for the year or perhaps a specific week within
                                a year)

The depth of salary and personnel information enables Itek's wage and salary committee to evaluate the company's performance over a given period, helping them keep the company competitive with other firms in the area.

Procurement and Accounts Payable Processing

The procurement and accounts payable processing system is designed to pay vendors and enable Itek to meet its financial commitments.

Input to the procurement and accounts payable system consists of purchase orders, transmittals, invoices, company expense accounts, accounting adjustments and other journal entries.

Input is forwarded to CDP with the normal cover sheet. Deadline for all transactions is Thursday. The program is run on Friday. All vendor numbers on purchase orders are assigned by the purchasing dept.

All outstanding purchase orders are stored on disc. Unique codes are assigned to the type of service or product involved.

The output from the system includes:

Checks to pay both vendors and employe expense accounts.

Monthly list of vendors with vendor number. (Used by personnel in the purchasing department when ordering.)

Accounts Payable Distribution Report, by voucher number and vendor. (Used by the accounts payable department to determine principle suppliers and to determine who has and hasn't been paid.)

A list of checks outstanding indicating what checks have cleared.

Accounts Payable Cash Forecast indicating what will be payable over the next 30 days.

Outstanding Commitment Reports -- Purchase orders which have been initiated without receipt of the goods by Itek. (Enables Itek to determine how much money the firm has tied up in goods ordered but not received.)

The only exception to Itek's use of a universal cover sheet is in invoice processing, where clerks in the accounts payable department fill out a special cover sheet for each invoice containing the vendor number and name, the voucher number, the amount of money involved, a tax code indicating whether or not the item is taxable, department and division codes and a category code indicating the service or product involved. The simplified form is designed to take the burden off keypunchers who would otherwise have to scan the invoice for the information.

The total of all the input in the procurement and accounts payable system is used to update the master tape files, and produce reports designed for higher level management.

Inventory Stores Requisition Processing

The inventory stores requisition processing system is designed to control materials on hand and needed. When a department or project manager needs materials, he fills out a store requisition and forwards it to the stores control dept. Stores control fills the order and forwards the requisition to cost accounting. Cost accounting balances the figures, batches the requisitions, and forwards them to data processing where they're logged-in, keypunched and run through the computer deleting the item from master inventory file.

If the stores requisition dept. doesn't have the item in stock, the requisition is forwarded to the purchasing department where a purchase order is written. A copy of the purchase order is then sent to CDP to update the outstanding commitment file. When the goods are received and placed in inventory, the invoice is processed through the accounts payable system and deleted from the computer's outstanding commitment file -- in essence debiting inventory and crediting cash.

The weekly output of the system includes a store requisition report which lists all charges by department. The reports go to each department and project manager enabling them to see exactly what was spent and for what. Additional copies of the reports are sent to the cost accounting department for evaluation.

Budgets and Contract Proposals

Yearly, every department and project is required to submit its proposal for the following year. Budgets then go through various levels of approval.

The budget proposals are sent to CDP from financial planning. They are keypunched, edited and balanced. The output is the forecasted budget for each department which enables Itek to measure the performance of each department or project throughout the year against proposed budgetal goals. Each transaction funneling through Itek's system is charged off against a department or project, by merging the data contained in payroll, accounts payable and inventory master files, weekly, monthly, quarterly and yearly comparisons can be made between projected vs. actual performance, and department and project managers can evaluate their own performance.

Itek does a high percentage of its business with the government and is often required to submit proposals. The cost, price and estimating dept. evaluates what will be needed in a proposal and estimates the number of man hours and amount of material a job will require. This input is forwarded to the data processing department where the computer is used to extend the figures and come up with a firm estimate of the exact cost of a job.
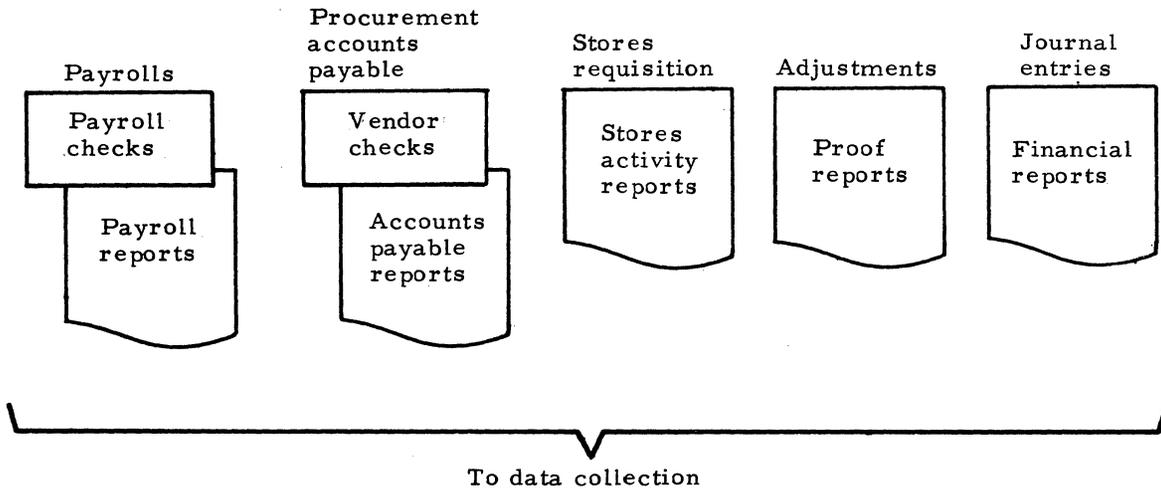
Once the contract has been negotiated, and a final contract drawn, the data from the cost to complete file is updated along with the master files to reflect any changes made in the negotiations. Output from the system is used to upgrade or downgrade budgets, increase personnel where needed, or to plan for material requirements that might be needed.

Journal Entry Adjustment Processing

The fifth system on the initial processing level is Journal Entry Adjustment Processing which covers the company's general and expense ledgers. It includes a number of financial areas not included in the other four systems such as depreciation, monies to be set aside for expansion, tax withholding, and numerous other accounting functions. The system also serves as a means of entering corrected data into the master files. Itek has built an automatic adjustment technique into its system. By and large the reports generated on the initial processing level are used on all three levels of management.

In order to make an adjustment to data already contained in the master files, a department or project manager fills out a distribution adjustment sheet listing the individual transaction number, the hours (labor) or dollars (material/other) as they were and as they should be, and states the reason for the change. He then sends the two-part form (one copy for the requestor, one for the accounting department) to the division accounting department which approves the changes, batches the distribution adjustment sheets and forwards them to data processing. The system will search the Data Collection library for the transaction, perform certain audit functions, calculate a debit/credit entry (zero balance), capture all necessary data from the original transaction, pass this entry to the current week's data collection file, assign a new transaction number, and the adjustment has been accomplished. This system provides the necessary audit trail for all such adjustments.

INITIAL PROCESSING

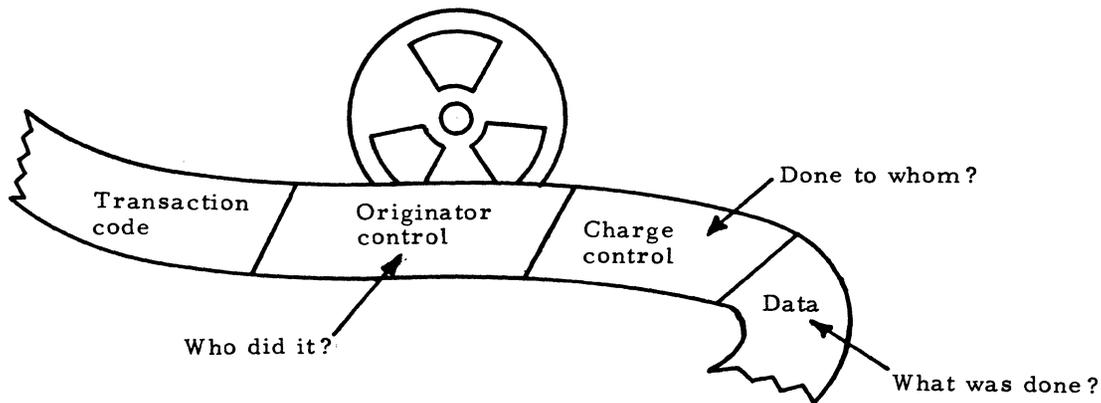| Payrolls	Procurement accounts payable	Stores requisition	Adjustments	Journal entries
Payroll checks	Vendor checks	Stores activity reports	Proof reports	Financial reports
Payroll reports	Accounts payable reports			

To data collection

DATA COLLECTION FILE

All of the data collected and reported on in the initial processing level is stored on the data collection file. The key to accessing data at this level is the unique transaction control number assigned by the computer to each transaction. In addition, the tape stored master records contain an initiator control which could be an employe or vendor number, a charge control indicating what department or project is responsible for the transaction and finally, the data itself. In most operations, Itek processes current data through the computer's disc system, then stores the data on the magnetic tape master files with a weekly disc to tape run.

Output on the data collection level covers three areas:

1. Retrieval inquiry statistics
2. Overhead and general & administrative pool allocations
3. Detail reporting and control

DATA COLLECTION FILE

Transaction code   Originator control   Charge control   Data

Done to whom?

Who did it?

What was done?

Retrieval Inquiry Statistics

Inquiry statistics are issued on a "need to know" basis only, and are issued to department or project managers and above. Three major reports are produced in this area:

-- A monthly cost status report reflecting the actual costs incurred in a department or project, including labor, materials and other direct charges compared to budget.

-- A weekly labor analysis of labor costs by department or project.

-- A monthly material and other direct charges report reflecting materials used in a department or project.

Overhead and General Administrative

Some of Itek's contracts with the government stipulate that the company can deduct a certain amount of its overhead and general administrative costs. The deduction percentage of each transaction is stored in the computer's tape files and is used to produce the exact deductable costs for each function.

Detail Reporting and Control

Detail Reporting and Control is also aimed at project and department managers, as well as the accounting department. The computer pulls each individual transaction from the tape, organizing the transactions by departments to produce a Detail Material and Other Direct Charges Report which is issued weekly to management. The report reflects every transaction involving each individual department. With it the department or project manager can check back each transaction. The accounting cycle for all activity at Itek is weekly ending on Friday evening. Detail reporting is completed by Monday of the following week.

MASTER INFORMATION FILE

The final level of Itek's information system is the master information file level. The file is designed for top management and is a pooling of the data collected on the initial processing level and data collection file level. Much of the detail used to produce reports on the first two levels is dropped on the master information file level. Thus, the control number at the third level is a department or project number (sequential and indicator numbers are dropped). Reports issued at this level also drop much of the detail contained at levels one and two, in favor of summaries more attuned to top management's needs.

The tape files contain data on the current month, both actual and budget, year to date data, both actual and budget and finally, inception to date (for projects) data -- actual and budget.

Reports produced on the master information file level include:

-- Retrieval Inquiry Statistics available on a "need to know" basis on a higher level than those produced on the data collection file level.

-- Project Cost Performance Tracking Reports for all Itek projects (produced weekly, monthly, quarterly, semiannually and annually).

-- Department Performance vs. Budgets Reports (comparing actual performance for all departments with total budgets).

-- Cost, Expense and General Ledger Reporting for finance and accounting.

-- Customer Invoicing to handle customer accounts receivable.

The third phase of the system summarizes the Data Collection data so that originator information is dropped. This provides for the accumulation of data by operating entity (Project/Department) by element of cost. This information (actual and budget) is accumulated by week, month, and to-date, and provides reports through eleven levels of summarization; for example, department activity is summarized up through special groups, directorates, and company. Project activity can be structured down (for up) through eleven levels of structuring either automatically or randomly or across plains.

Customer billing, retrieval capabilities, and management level summary reporting are available.

The key to the system is the uniform flow and control of data. All input enters the system at the initial processing stage and is accumulated, manipulated, summarized and edited within the computer system framework in the same manner regardless of its source. All management, operating and financial interests within Itek are supplied the same data from common files.

LENS DESIGN SYSTEM

Itek's Optical Systems Div. in Lexington uses a systems approach to the design, fabrication and testing of the highly precise lenses it produces.

Itek first turned to computer aided design in 1962, using a small Digital Equipment Corp. PDP 1 with data display output. The system was used by engineers to trace the pattern of one ray of light to see what effect that lens would have on the ray. In 1963 the company installed a CDC 924 Data Processing System with 16,384 words of core storage. Itek developed an entire programing system as well as programing language called OPUS (Optical Utility System) designed specifically for optical wave analysis. In essence, the system measures and calculates design parameters indicating what kind of image quality a lens system is likely to produce. Up to 50 parameters and 40 aberrations can be handled automatically using the OPUS system.

In 1966 Itek took delivery of a Control Data 3300 with 262,144 characters of core storage. The 3300 increased Itek's ray tracing capability 15 times, and enabled the company to keep up with breakthroughs that had occurred in the optical systems industry. The 3300 has four disc drives, with a disc pack capability of 8 million characters per each pack, five tape drives, a 1,000 line-per-minute printer and a CalComp graph plotter which plots 180 inches per minute.

The 3300 operates in a multiprograming mode and can run as many as eight jobs simultaneously. Memory, processing and input/output resources are shared on a priority scheduling basis. The Computation Center processes an average of 200 jobs daily, with nearly 50 percent of the total computer time spent on complex lens design applications. Turnaround time, from the time the initial input is prepared, to the output of a lens analysis seldom runs more than two hours.

Augmenting the 3300 is a CDC 924 computer with 65,536 characters of core memory. The 924 has magnetic drum storage of 2 million characters and is on-line to a 185 line-per-minute printer and a 120 inch-per-minute digital plotter.

Rounding out the computer room are two pieces of Itek-developed equipment -- a graphic display console utilizing a cathode ray tube for on-line analysis of optic systems in various stages of completion, and an automatic scanner which is used to evaluate the performance of lenses in production. The scanner and display console are interfaced with the 924.

THE SYSTEM

Itek's business is basically project oriented. Once the company receives a contract, it's up to the firm's engineers to develop the optic system. The art of lens design and production is complicated. Engineers are required to work in close tolerances of up to 0.000025 of an inch with a large number of variables and parameters to account for. There is little margin for error.

The 3300/924 tandem has approximately 100 OPUS programs available from which the engineer can draw in the design of his lens. In order to come up with a basic design, it is necessary for the engineer to keypunch his parameters, and decide which program is applicable to his individual project. Normally he punches four basic parameters into a deck of cards:

-- number of pieces of glass needed in an optic system
-- curvature of the lens
-- components (what kinds of glass will be needed)
-- surfaces (cards must be punched for both the front and the back of each lens element in an optic system)

Once the job is punched, the engineer fills out a job request, a three-part color coded form which contains the user's name and the requestor's name, the project charge number, requestor's telephone number, estimated time of the run, name of the program to be used, the priority and the date the information will be needed, as well as other program information needed by the computer operations staff.

In all, only five basic forms are used by the EDP department to handle nearly all jobs. They are:

-- A tab key punch job request
-- A 3300 Computer Job Request
-- A Card Replacement Request (used to make corrections or change parameters)
-- A Request for Scheduled Attended Time (Used on late work and deferred runs)

The forms are punched card size and serve as header documents for each individual run. The original and number two copies go with the card deck, and the third copy is kept in the computation center for its files.

After the deck of cards and the header document has been logged in by the computation center, it is scheduled, and run through a card reader which provides input to the computer. The 3300 produces a set of analysis graphs drawn on the CalComp printer which show what effect the lens will have on incoming rays of light. Additionally, the specifics of the optic system design are interpreted in mathematical form and printed out on the 1,000 line-per-minute printer.

If the engineer is unsatisfied with the results of the first run, he manipulates his input data -- changing the parameters -- until an optimum optic system is designed.

In addition to the printed and plotted data produced, the computer also outputs a card deck representing the exact configuration of the lens. The card deck is used in quality control during the manufacturing process. When the engineer is finally satisfied with the system design, he sends his specification -- the printed output and the plotted lens drawings -- to the drafting department where blueprints are drawn. The final blueprint is then sent to the production department.

In the final stages of fabrication, a laser beam is shot through the lens and photographed. The photo is sent to the computation center where it is scanned by the Itek scanning device which is on-line to the 924. Previously, the deck of cards containing the specifications of the lens were entered. Essentially, the computer compares the capabilities of the lens with the design criteria, producing a contour plot of the lens surface. The plot is returned to the optical shop where it is used by the optician to determine how much more polishing is needed and on what areas of the lens.

In addition to design and lens quality control, the OPUS system is also used to determine whether or not the optic system is in tolerance, and how far out of tolerance a system can be, while staying within the specifications.

RESULTS AND FUTURE PLANS

Itek's management has built design and flexibility into its systems. The Central Data Processing Dept. has an IBM 360/50 on order for delivery sometime in 1970. Future plans also call for the implementation of a Bill of Materials Processing System. The system will enable Itek to control and track material from the time an engineering drawing is made until the equipment is built and shipped. Continued attention will be paid to the building of the data base and improvement of reporting to all levels of management.

Use of the computer in the Scientific Computation Center has eliminated the hundreds of millions of calculations necessary to design one optical system. It has enabled Itek to produce improved optical systems that push the state of optic technology. Improvements in computer techniques currently being used will, in management's view, enable Itek to design even more sophisticated lens systems. The techniques being used in the Scientific Computation Center can be applied to machine tool design and electrical and mechanical engineering.