Information Systems at Inland Steel

By: John R. Lanahan

Editor's note:
The following is adapted from a speech presented to the Brazilian Iron and Steel Institute in Rio de Janeiro on 15 September 1977 by John R. Lanahan, Assistant Comptroller — Systems for the Inland Steel Company. The purpose in publishing this article is to exemplify the philosophy underlying information systems development at Inland Steel Company. Hopefully, this example will motivate MIS people to make systems activity insights available to their users as well as to share practices among interested parties.

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Inland Steel Company is the fifth largest steel company in North America and is the largest producer of steel at one plant. More than 6,000,000 tons/year can be shipped, of which about 60% are flat rolled products. Inland has a series of subsidiaries in warehousing, metal building, and containers which are also steel users. Total corporate sales are in excess of $2 billion per year, of which about 70% come from the steel plant.

The Systems Function

Information systems for Sales and Manufacturing within the Steel Division at Inland Steel support the heart of the business. The Systems function is located, for administrative purposes, in the Finance Department. The function reports to the Corporate Comptroller, who reports to the Vice President of Finance.

The organization of the Systems Department is designed to implement the theory of how such a department should work. This is shown in Figure 1. Each of the functions will be discussed separately. There are 256 people in the Systems function — 14 in a management group, 30 analysts, 70 programmers, and 142 in machine operations and controls.

Current equipment includes two IBM 168-3’s with nine Megabytes of memory and appropriate supporting hardware. We support a large teleprocessing network over a geographical area of about 1200 kilometers with eight high speed, over 200 medium speed which are mostly CRT’s, and 20 low speed terminals. Our area is not particularly large, but our local concentration is fairly intense, most being within eight square miles of the steel plant.

Management

The Assistant Comptroller—Systems and his immediate staff have the usual managerial functions for their organization. In addition, there are some specific functions:

- integrate the externally requested and internally initiated projects into short and long-range plans for Steel Division systems that will be submitted to the Systems
Figure 1. Organization of the Systems Department
Review Committee for appraisal and decision;

- recommend plans for corporate systems and computer operations that will avoid costly duplication, but which will also allow the separate corporate units the freedom to effectively deal with the problems of their businesses; and

- anticipate future problems, the trend of systems, and new opportunities in hardware and software, so as to avoid dead-end developments in information handling or crash emergencies.

**Systems**

Systems has the responsibility of identifying problems and developing solutions to them in any area of information handling. This activity requires an orientation to the skills of problem-solving, with an emphasis on the problems of the steel industry, in general, and particularly of Inland Steel with no orientation to any specific technology. This person is also responsible for initiating projects of value to the company. Other functions reporting to the Director of Systems are:

- Systems Development — serves the corporate staff, sales and non-operating departments in manufacturing;

- Systems implementation — serves the operating departments of manufacturing; and

- Systems Maintenance — serves accounting and performs the maintenance function for all systems.

**Operations**

Operations is assigned the function of efficiently operating a jobshop concerned with carrying out reliable daily operation of computer applications and developing and maintaining effective quality control of the product and maintenance of the equipment. This entails recruiting, training, and supervising an efficient work force. Theory is not the major element of this section; it is essentially a difficult line operation. Two subdivisions of operations, General Offices and the Indiana Harbor Works, are traditional production shops.

Operations Support is a quality control and production scheduling function for applications processed by the line operations. It develops and monitors schedules to assure that commitments made to users are honored, and to assure that new commitments are realistic. It maintains control over timing and quality of data input, output, and production files.

Operations Analysis is a support function for the software and operating systems of the computer hardware. It develops and monitors job control language and job streams and maintains systems data files. It develops and monitors performance standards for the efficient operation of hardware, software, monitors, and hardware probes. It analyzes malfunctions of hardware and software and maintains and develops improved recovery procedures.

**Programming**

Programming is assigned the function of efficiently using computer technology — both hardware and software. It has two major divisions, Systems-Programming and Applications-Programming.

Systems-Programming is the heart of the technical side of systems activity. It has the responsibility to select hardware, operating systems, file structures, and programming languages that will give Inland an expandable computer complex which will effectively support Steel Division efforts to solve problems in information handling at the best overall cost. The function requires an orientation to the technology, not to the company, the industry, or business in general. It is responsible for providing the Application Programming Division with instructions on how to enter and retrieve information from the files, generate reports, and use the capabilities of the operating system. Systems-Programming is a function similar to a design or research operation, with a small staff of highly talented professionals.

Applications-Programming has the responsibility to apply our technology to the solution of specific problems, both in new systems and in maintenance or improvement of old. This function blends line and technical aspects, as any group applying a technology to specific problems.
The Systems Review Committee

Guiding the Inland systems function is a steering committee which plays a key role in our activity. This committee is called the Systems Review Committee. The senior managers on the committee and their positions in our organization are shown in Figure 2. By title, the members are:

- V.P. of Finance — Chairman
- V.P. Steel Manufacturing
- Comptroller
- V.P. Corporate Strategy
- Senior V.P.
- Pres. of J. T. Ryerson (A Warehouse Subsidiary)
- V.P. Sales

It is our belief that the workings of this committee, representing the heads of all our users or "internal customers," has been the cornerstone of the development and installation of systems which effectively support the major operations of the business. The committee meets three times a year at a minimum.

The first meeting is set up to discuss current problems facing systems and data processing operations. Sample subjects have been the conflict between inter-active terminals and security, the need for an EDP audit function, and alternatives in CPU expansion.

In the first case it was explained to the Review Committee how the introduction of inter-active terminals posed a potential threat to the security of data and the integrity of fiduciary systems at the same time as they offered cost advantages and more effective systems applications. The issue was referred to the Board of Directors, which concluded the cost and applications advantages were worth the risk. Subsequently, an EDP Audit Function was established to assure that fiduciary systems had proper controls built into them and that they were properly implemented.

The second meeting allows for an annual reiteration of the five-year plan, covering applications, manpower, and hardware. The third meeting is to finalize the annual plan and budget for next year.

It should not be assumed that the functions of the committee are nominal, stereotyped, or perfunctory. Three of the seven members are engineers who have had direct experience with computers, and all seven have had in-house and outside formal training in computers and their applications. They make real decisions about problems and engage in vigorous debate about the projects to be done and the resources required to do them. Since they represent the consortium of department heads, their approval sets a very favorable stage for development and implementation.

Systems philosophy

The purpose of our systems function is to serve the user. Our philosophy of systems reflects this objective.

The orientation and theory of our operation is well understood in the company. We firmly believe in Pareto's law: 20% of the effort will get 80% of the results. Consistent with this belief, we rarely carry a system to cover everything, preferring to leave manual systems where possible for the 20% of the subject operation that will need 80% of the effort. This is a type of a marginal utility concept.

We are opportunists. In our major production system, logic dictates that we start at the Coke Plant Blast Furnace and proceed in an orderly fashion to finished product shipment. We, in fact, started further in the process, at Pickling and Cold Reducing, because there was a clearcut problem and the superintendent of the department was desperate for help. We then moved in erratic leaps both up and down the product flow, where departmental management was motivated and where clearcut problems existed.

Another precept is that we exist to furnish effective support to the steel business, and that the efficient operation of the data processing operation must always be secondary to that primary purpose. The leverage of timely, accurate information systems is so great to the steel business, that apparent "inefficient" machine room practices are justified if needed for the greater goal.

Our theories are wrapped up in what may be called the Analogy Concept. Consider all the office work in the steel company as a conceptual unit, including those who record new orders, production, sales, shipments; those who plan and issue work instructions and mill schedules;
Figure 2. Systems Review Committee — Positions in Total Organization
those who control costs; etc. In this view, we may say that the total activity so encompassed is an attempt to maintain an analogue of the real world. This analogue is maintained in the hope that by examining and manipulating the analogue, we can make plans and issue instructions that will cause the configuration of reality to be more suited to our purposes. The phrase was "in the hope that," because unless the analogue is of high quality, the results will be quite unpredictable. Only an analogue of high quality will give the desired results.

High quality analogues require accurate, timely input for updating, some manipulative capacity to test out alternative plans or reactions, and the ability to deliver accurate, timely output to the actors in the real world. We believe that, under proper discipline and control, computer information systems using teleprocessing input and output meet these specifications better than any alternatives we know. Remote events can be recorded using machine assisted techniques to minimize inaccuracy. They can be transmitted rapidly and with little internal error. Models of any desired complexity, from simple simulation to various complex OR techniques, can be used to test out alternatives. Instructions can be rapidly and accurately transmitted to work stations.

System relationships

To implement these theories, we started at the production recording function and so far have erected the network of interrelated files and systems which are shown in Figure 3. This figure is divided into four vertical sections. The outside columns are systems, and the inside columns are files.

The second column from the left represents the prescriptive files, which tell us what to do with a customer's orders. The Master File of Repeat Customer Orders permits a translation to Inland language of a customer's purchase order. This produces simultaneously all the work instructions that are necessary to process and ship that order. The File of Active Mill Orders is the set of such work instructions.

The next column represents the descriptive files which tell what has been done to the slabs, coils, or lifts of steel, and is the In-Process Inventory. The righthand column is the Major Systems which update the files as a result of processing. The extreme left-hand column represents Derived Systems which use the files for a set of purposes which will be described later.

We started at the recording function because this is the most important source of input into the analogue and it was neither accurate nor timely. Recorder is the least demanding job in the production sequence and is filled by the newest or least motivated worker. The accuracy of manual recording was about 80%, and the recorders' sheets were turned in every 8 hours. This gave us inputs that were neither timely nor accurate. Compounding this error rate was the serial nature of processing in which 8 to 10 sequential steps occurred within one department, giving a serial accuracy of .8° or .8°, which of course rapidly approaches zero accuracy or utter confusion.

We installed punched card readers with key input for variable information to improve accuracy, and furnished the recorders with a punched card for each item on the work lineup. The new record was a new card punched in the central machine room and fed to the computer in mini-batches to improve timeliness.

Recording accuracy improved to 97%, and with the output of mini-batches and some internal machine verification, a staff of checkers were able to raise the accuracy to 99%. As time has gone by, more sophisticated equipment and direct computer input has further improved the timing. We are currently recording location changes the same as processing steps. In fact, our current framework for planning and control is to consider the inventories as reality, and the processing steps as merely moves between inventories.

From this point the systems will be described in logical order, rather than in chronological order. In the logical flow, the first of our systems is the Booking System. As customers' Purchase Orders are accepted, Customer, Product, Sales Offices, and Shipping Mill are entered directly into the computer along with requested shipping date. Each morning the Product Managers get a report of their cumulative shipping status as of 5 p.m. the previous day.
Figure 3. Network of Interrelated Files and Systems
Our next major effort was to speed up Order Entry. We had historically treated each new order as a unique event, and processed it serially through acceptance, credit, metallurgy, process planning, and sequential steps of steel providing. Rigorous analysis showed that 75-80% of our order items were repeats by the same customers. Capitalizing on this, we set up a computer program to perform all these steps at once after commercial acceptance was completed.

Our next important system was Providing, Combining, and Allocation. Providing is just what it purports to be: using the computer to select slab sizes and quantities for flat rolled products. It is advisory, since the exigencies of the moment to make up ingots and heats may cause variation. Combining is a program to find compatible items to make large coils for processing. Its value has been reduced by an increase in the minimum order item quantity. Allocation is a signal as to which of three hot mills should roll an item and is one of the determinants for the providing system.

Slab Inventory and Slab Application are two work-horse systems. Careful analysis determined that a few slab classes had enormous use, perhaps as much as 50:1 in terms of their percentage of all slab classes. Even more strange was the fact that some of these slab classes were unchanged over a five year period. These findings have been most helpful during low markets when we must make steel while awaiting the orders. We stock up on these high use slab classes.

Slab Application is the result of another set of analyses of flow patterns through the slab inventory. We found that under a manual system most of the inventory was tied up in slabs applied to orders that were not yet ready to roll. When an inquiry or rush order came in, we were not able to take it because there wasn't enough time to make slabs, yet ample slabs were available but committed to orders scheduled for later rolling. We developed a set of computer programs which orders, inventories, and applies steel. Steel is ordered against actual open orders, determined by striking a balance by size and grade between slabs and orders on a daily basis. When made, slabs are not earmarked to orders unless there is a metallurgical or special weight restriction.

Three times a day, or more frequently if required, a group of orders is selected for rolling, and the slab inventory is compared for rolling, and the slab inventory is compared against these. The computer applies the slabs using the logic developed by the operators and metallurgists. These programs permit us to have most of the inventory free to apply to urgent rerolls, for changed line-ups, or for rush orders or inquiries.

As may be seen from Figure 3, these systems interact with the inventory files to update these files. A valuable set of take-off systems has been developed by assessing both the inventory file and the Active Mill Order file.

A valuable adjunct to the Order Entry System is the Supplemental Instruction System. Customers frequently change orders after they are entered into our system; in North America these changes occur on a national average of one change per order. Similarly, our own technicians average about the same volume. This means that in addition to the file changes described above, there are two changes to each order after it is issued to the work force. In the past, it was nearly impossible to assure that all work stations were up to date on changes, with the consequence that there were conflicts and mistakes in processing. To solve this problem, all changes made after the order is entered are entered online to the file of Active Mill Orders. Numerous CRT inquiry devices have replaced both order paper copies and written changes to orders in many locations. When an item comes up for processing, the expeditor operator, inspector, or metallurgist can query the Active Mill Order File and be sure he has the latest revision to the prescribed processing or product.

CRT inquiry permits all expeditors and planners in flat rolled areas to select and request printouts of material available for specific lineups. This gives them the most current status of the inventory in which they are interested by contrast to the previous routinely scheduled printouts.

In addition, when a customer calls the General Sales Office in Chicago to inquire about the progress of an item, the Sales Correspondent can access these same inventory files, including shipments with car and truck numbers, to give the customer timely, accurate information.

Performance Reporting lists shipments by time,by mill, by customer, and by product and is a part of the same database. This system serves as a
valuable control to maintain satisfactory levels of customer service.

Order Entry supports Shipping-Billing through the file of Active Mill Orders. Shipping clerks enter a minimum of specific information: coil number, weight, and customer order number on a CRT/printer at the Shipping Office. The computer prints out all the necessary details from the inventory and order file, including printing tags for the coils or lifts.

In the case of customers ordering in metric sizes, the metric nomenclature is brought to the shipping papers from the original order, and the pounds are transformed to kilograms, permitting the plant to work in the English system.

The accumulated information file containing both current and historical information is also available for analytical purposes through a special retrieval package. Such analyses are used very frequently — a total of 3000 programs a month prepared by the users themselves, half of which use these production order files. Others access personnel, accounting payroll, purchasing, and other systems.

Data processing furnishes inputs to Process Control computers, using the Active Order file to describe the task to be performed, and using the appropriate inventory file to describe the material to be processed.

**Systems Strategy**

We believe that effective systems are a tool, and that they can accomplish nothing without a user who understands how they work and is motivated to use them. We believe that the user must participate in the development of the system to achieve these conditions, and that the system must be heavily customized to fit local conditions.

Reliability of performance is of equal importance. Line users of systems are commonly performing repetitive operations daily. A system must be as available as electricity, water, and problems in order to be incorporated into the users’ work habits. This requires a machine room geared for service to the user, with someone assigned to measure the quality of the product, both for timeliness and accuracy. The technical explanations of why the program did not run, so dear to the heart of computer aficionados, makes no sense and is irrelevant to the man who did not get the information he needed to do his job. After a series of such failures, the system will no longer be used and the information produced will be filed in the wastebasket.

At Inland we try to avoid these failures of service by dual hardware and prioritizing programs. Programs that support mill operations have top priority, and will have resources made available from accounting, personnel, purchasing and payroll applications when there is a hardware failure. We test programs extensively, ad nauseum at times, before running them in a production mode. We prefer to delay implementation of a system to “starting off with a bang” and then having to interrupt service to mend some gaps in the program.

We believe that systems must be easy to use, and that it is our job to adapt the electronic tools to the users’ conventional ways of working, rather than to force them into some predetermined mold convenient to data processing. However, we make one exception: we make sure that the user puts in accurate, timely, consistent information.

Our systems tend to be simple, doing such jobs as sorting, collating, and simple simulations; we do not use elaborate mathematical models. They are aimed at extending the skills of key clerical and technical workers, not replacing them. I do not intend to demean the value of sophisticated mathematical techniques for analytical work by staff personnel; however, they are not suited for use in the type of decisions made by providers, expeditors, and foremen.

I can best illustrate this from my own experience. One of my early jobs was as a structural mill provider. Each day when I came to work, I would start out by posting production, identifying shortages, entering new orders, and checking the changes in my semi-finished inventory. This took about six hours, interspersed with inquiries from sales and other operating departments. About 3 p.m. I would start to do some planning and scheduling of the next day’s operations. About 75% of my day was routing, posting, and deleting. About 25% was the kind of work that contributed to getting good results. In other words, I spent 75% of my time updating the
analogue and 25% of my time using it, then six to twelve hours old.

The provider today receives updated order books and inventories, sorted on several different characteristics, one to four hours old. He can tap into the production database for a more current reading at any time. He spends 5% of his time updating the analogue and the remaining 95% doing significant work with access to current information.

Once the computer database is in good condition and users have accepted it as accurate, then one can start to look for the big problems. In most organizations, these occur at departmental interfaces where the jurisdiction of one manager abuts another. Commonly there is considerable conflict and argument on these boundary lines, such as between sales and manufacturing. When production does not meet shipping schedules, manufacturing comes up with analyses and numbers which show that sales over-scheduled sales reports that manufacturing produced orders out of sequence, and all the usual back and forth accusing with which all of us are familiar. A great deal of time is wasted arguing about the situation since no one accepts the same set of numbers and facts.

Once the database is accepted as accurate for basic uses, it can be used to establish a common fact situation for inter-departmental arguments, such as our performance reporting system which was mentioned previously. This will not stop the arguments, but it will turn the force of the argument from "where are we?" and "what is the fact situation?" to "what direction shall we go next?"

**Conclusion**

It is not my intent to hold up our practices as any kind of a model. Some Europeans may have had more highly sophisticated approaches twenty years ago; the Japanese have enlightened the whole world on what can be done if a complete information system is planned as an integral part of a new facility. This is an account of some of our problems, how we attempted to solve them, and why we took the action we did.