INDUSTRIAL DATA PROCESSING APPLICATIONS REPORT

Applications	Automated Manufacturing Planning
Type of Industry	Bearing Manufacturer
Name of User	Rollway Bearing Co., Inc. Syracuse, N.Y.
Equipment Used	IBM 1440 Data Processing System

Synopsis

The Rollway Bearing Co. is using a new computer technique to create manufacturing instructions from design data. The system, presently utilizing an IBM 1440 computer, is called Automated Manufacturing Planning. It converts engineering designs into precise manufacturing instructions in a matter of minutes, a process which formerly took days.

The technique specifies the raw material form to be used, the methods and time standards involved, and, by extending these, provides detailed estimates of total production costs. A routing sheet is produced giving detailed manufacturing instructions for machine operators. A copy of the routing sheet follows the bearing through every phase of production.

Under Automated Manufacturing Planning a complete set of manufacturing instructions is originated for each order, whether it is for a new or stock item. Changes in procedure are easily inserted into the program, so that the routing sheet reflects the latest manufacturing techniques, and the cost estimates and time standards are highly accurate.

Manufacturing planning, or the conversion of design specifications to manufacturing instructions, has traditionally been responsible for a big slice of engineering time. Generation of manufacturing instructions for new items, and incorporation of equipment or process changes into the instructions for stock items, can be a full time job for a staff of engineers. The Rollway Bearing Co., Inc., of Syracuse, N. Y., has enlisted the aid of a computer to do this job.

The technique, called Automated Manufacturing Planning, is based on the principle that the manufacture of any device is the product of logical, step-by-step procedures that can be stated as a series of simple alternative decisions. For example, if a roller in a bearing must perform within a certain load range, a simple decision can indicate the type of steel that must be used. Also, since the roller must have certain tolerance requirements, another decision can dictate the type of machine to be used in the finishing operation. These decisions, which are documented either as decision tables or as standard flow charts, can be translated into a computer program which accepts design specifications and -- by proceeding through a sequence of logical decisions -- produces detailed manufacturing routings. Some of the logical decisions made by the computer include:

- The operations to be performed, such as turning, grinding, heat treating, etc.
- The sequence in which the operations must be performed.
- Work methods.
- Time standards.
- Raw materials to be used.
- Tool and fixture specifications.
- In-process dimensions and temperatures, where applicable.
- Standard costs and estimates of cost per hundred.

Rollway, a wholly-owned subsidiary of Lipe-Rollway Corp., is a leading producer of straight cylindrical roller bearings used in a great number of industries. Besides offering several thousand catalog items, the firm, which employs over 600 workers, also makes bearings to meet specialized customer requirements.

Traditonal Approaches To Manufacturing Planning

In most companies, manufacturing planning is performed by engineering personnel who rely principally on their extensive knowledge of shop process capabilities, as well as their ability to retrieve data on completed orders from files and apply it in modified form to new but similar requirements. For each new part, the manufacturing planning data is determined by specialists. Much of the decision making is routine and, frequently, calculation of such items as machine settings and time standards is a laborious process. The information is recorded on a routing sheet, filed, and distributed as required. These files are usually classified by part number and become very large. Similarly, files are established for tools, time standards, and cost data. Engineering, method, process and equipment changes frequently affect many records in these files.

Some companies have mechanized a portion of this activity by transferring these voluminous records to punched card or computer files for faster retrieval and maintenance. These systems absorb much of the clerical work involved in storing and retrieving, but do not solve the fundamental problem of incorporating changes accurately and quickly into stored data. When any new manufacturing procedure is introduced the engineer still has an unanswered question: "What information does this change affect, and how does it affect it?"

EDP At Rollway

Using an IBM 1440 computer, which also handles their payroll and sales records, the Rollway installation, while covering only 40% of their product line, is already providing considerable improvement.

Previously, manufacturing planning at Rollway was done in the traditional manner -- old manufacturing instructions stored in a file, and kept up to date by a tremendous expenditure of engineering time. Cost estimates for custom parts might take as much as two or three days, and even then there was considerable possibility of error.

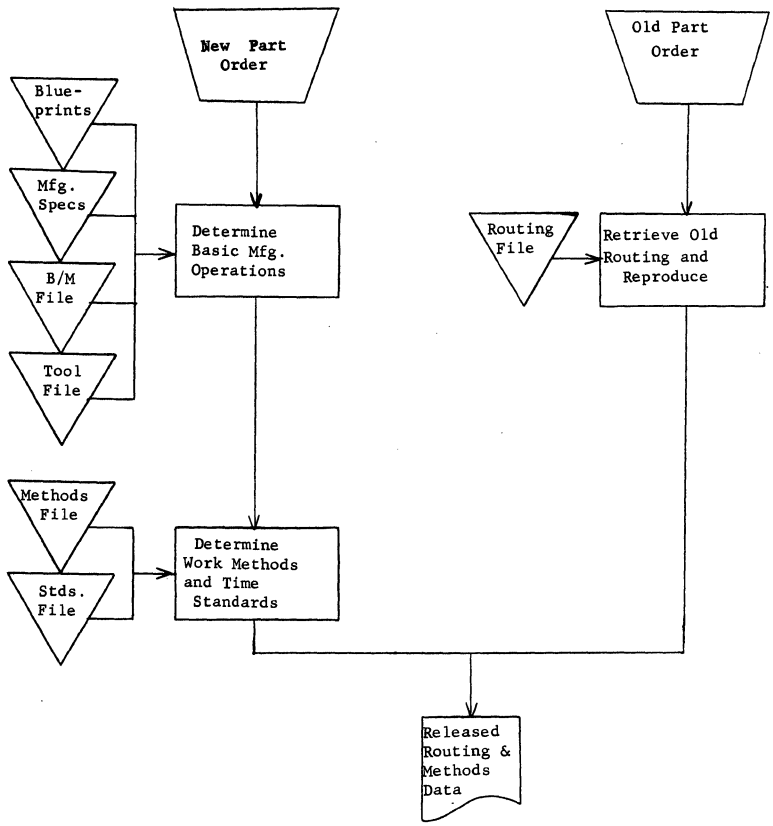
Now, the generation of manufacturing instructions, cost estimates, time standards, etc., takes only a few minutes. In discussing the new system, H. Follett Hodgkins, Jr., Rollway's vice president and general manager, said: "We receive three major benefits from Automated Manufacturing Planning -- a drastic reduction in the time needed to get a design into production; the virtual elimination of a mountain of paperwork; and an increase in the speed with which we can give detailed and accurate price quotations."

Under Automated Manufacturing Planning, manufacturing routings for stock items are no longer maintained. When an order or a request for a price quotation come in, the design specifications are fed into the computer and in minutes detailed manufacturing instructions, complete with cost estimates and time standards, are typed out.

The manufacturing instructions are automatically typed on a standard routing sheet which is then sent through the shop. The operations to be performed are numbered sequentially, and give detailed instructions to machine operators.

Each of the other components of the Rollway company uses the output of Automated Manufacturing Planning to conduct its individual activities. The new system plays a vital role in such functions as scheduling, labor control, and cost accounting. Production Control schedules parts for manufacture, coordinates material, machine, and manpower resources and monitors shop perform-

TRADITIONAL APPROACH TO MANUFACTURING PLANNING.



ance. Wage Administration extends and accumulates operator time for payroll purposes from manufacturing planning data. Quality Control determines what procedures are needed to maintain quality standards for each part and when these procedures are to be initiated; Tool Engineering designs special tools and fixtures.

Automated Manufacturing Planning

Automated Manufacturing Planning is based on the premise that recomputing an answer each time it is required may be more advantageous than storing answers for selective recall, assuming the speed and accuracy of a computer can be utilized in the process. Under Automated Manufacturing Planning, manufacturing instructions and data that have been generated in the past need not be stored or maintained. Instead, the specifications for each customer order -- whether for a new design or a standard catalog item -- are fed into the system to generate, in minutes, a completely new set of instructions. These instructions specify the best and most economical method of production. Since engineering, method, process and equipment changes can easily be incorporated into the program, each set of instructions produced accurately reflects the current change level of both the product and the manufacturing process.

Automated Manufacturing Planning is suitable for a broad span of fabrication and assembly industries, as well as certain process industries. The major criterion is the presence of a "theme and variations" situation for which it is practical to document the logic of a manufacturing process. This could be a product line with common characteristics: for example, gears, abrasive wheels, and fabricated specialty steel. A second possibility is the existence of "families" of parts and subassemblies. A family can be considered to be a group of parts with common geometrical or electrical characteristics, such as shafts, printed circuits, motor laminations, brackets, and bearing races. Within the family of parts there can be hundreds or thousands of individual parts that are different, as long as the uniqueness is primarily a difference of characteristics. A third possibility, where product and part characteristics vary considerably, is the presence of such common manufacturing processes as screw machine operation or punch press work. In this situation the family can be considered as all those parts which are manufactured in a similar fashion. Automated Manufacturing Planning applies primarily to products manufactured by general purpose machines and tools rather than by special purpose equipment.

All three of these groupings can be present in a single shop, and it is possible to structure one within another, for example, process within general product line.

Implementing The Technique

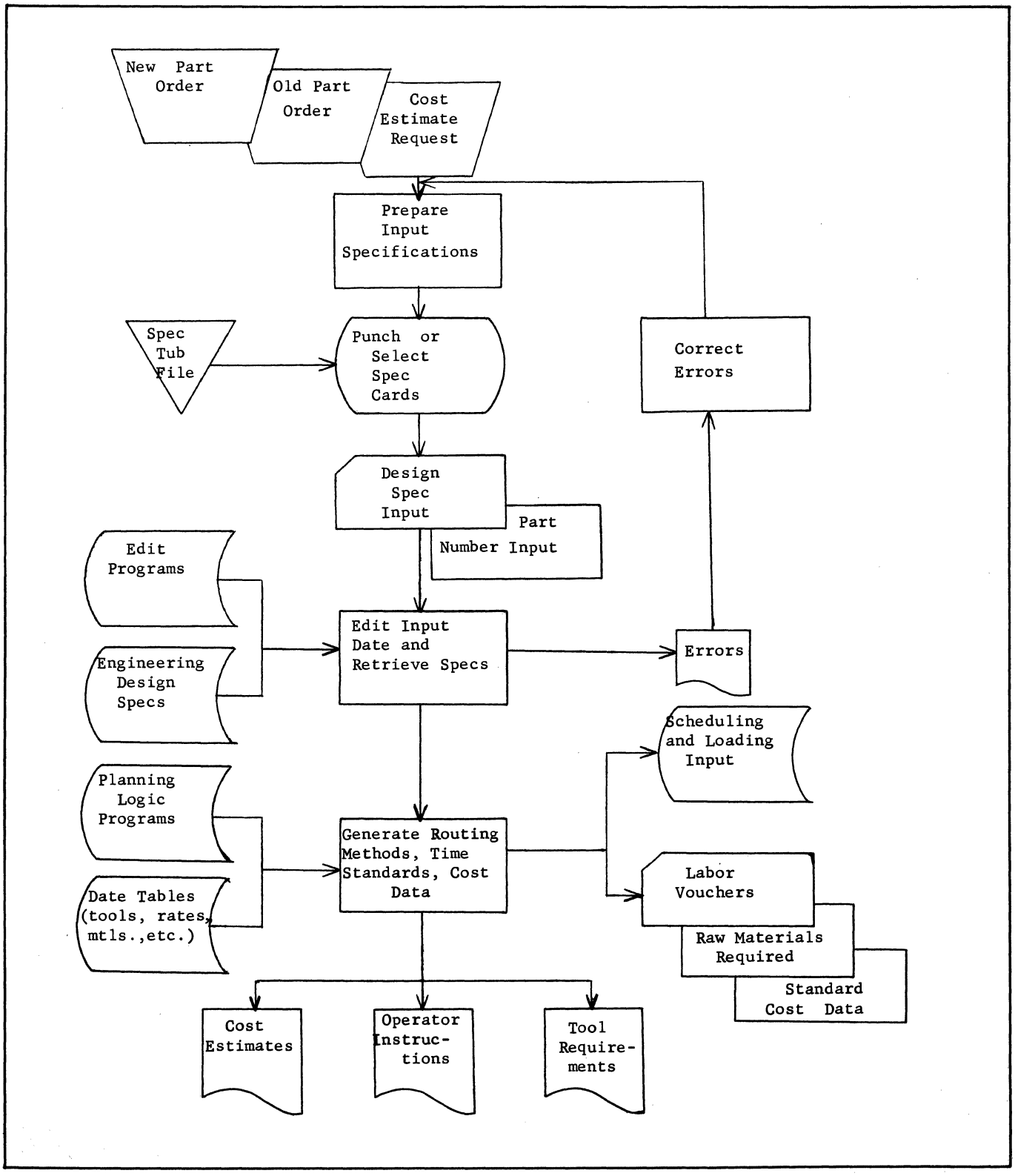
Implementation of the Automated Manufacturing Planning system takes place in three phases for each family of parts to be fabricated.

Phase one determines the "specification range" for the family. For example, a family of bearing races might vary in outside diameter from one inch to 42 inches, and have a tolerance range of from .005 inches to .0002 inches. Different grades of steel might be used.

The range of all characteristics of a part can be identified by sampling drawings of parts produced in the past, and projecting future requirements. The result of the first phase is a summary of the specifications defining a family of parts, and, wherever feasible, a form drawing for the entire family.

The second phase determines generally how a part or assembly is manufactured. This is done in three steps:

a. Establishment of a master routing for all members of a family. The master routing covers all the operations required to make any member of the family, making each member



AUTOMATED MANUFACTURING PLANNING SYSTEM

a subset of the general pattern. The documentation -- which might take the form of a flow chart -- describes the operations and the sequence in which they are performed.

b. Determination of the methods involved in each operation. How an operation is to be performed, and on what machine, can be specified only if the capabilities of the machines and the raw materials are known.

c. Development of time standards for each operation. The objective is to generalize the relationship between time and the part or process characteristics. Where accurate standard data is available, it can be put into logical form and programed directly into the computer.

The third phase is the most significant element of Automated Manufacturing Planning. Having documented, in the first two phases, the characteristics of a family of parts and how this family is to be manufactured, the final task is to link the two with a network of basic cause-and-effect logic.

Several methods are available to record this logic: narrative, flow charts, formulas, and decision tables. The objective is to ultimately reduce the logic to a series of alternative decisions, and then translate this sequence into a computer program.

Automated Manufacturing Planning can be used with any IBM computer. It is one of several computer techniques and programs supplied by IBM for a complete manufacturing and control system. The documentation and programs required to implement Automated Manufacturing Planning are available without charge to all users of IBM computers.

Results and Future Plans

Automated Manufacturing Planning is presently operational on 40% of Rollway's product line. It has so far resulted in considerably increased efficiency in the part of the product line it serves, and in other areas, such as economical introduction of change data, the results have been dramatic.

Because the system is not yet operational for the entire line it is impossible to make a dollars-and-cents evaluation of its performance. Most of the engineering force which has been freed by the utilization of Automated Manufacturing Planning is involved with completing the installation, thus making it difficult to gauge manhour savings. As Mr. Hodgkins, Rollway's vice president and general manager, says: "The system is proven; it's working now. But we won't be able to give a detailed evaluation until our entire product line is using it. The best I can say right now is that it's a big improvement over our previous system."

Although the system is presently using the IBM 1440 computer which Rollway already had, they have ordered an IBM 360, which will give them greater capacity. Eventually, a single computer will handle all EDP operations at Rollway, including payroll, sales records, and Automated Manufacturing Planning.