THE IMPACT OF GROUP TECHNOLOGY ON PRODUCTION AND INVENTORY CONTROL

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Introduction

A number of companies, large and small, are investigating and implementing a Group Technology approach in manufacturing operations. This proven strategy is able to provide significant benefits by reducing lead times and work-in-process investment. However, the achievement of these benefits greatly depends upon the manufacturing systems used by production and inventory control.

Current P & IC systems typically do not provide for the use of a Group Technology approach. The objective of this presentation is to examine the apparent conflicts between modern materials planning and the Group Technology strategy. It is important to recognize that once identified, these conflicts can be resolved and that GT and MRP can be synergistic.

Gt Overview

It cannot be denied that the trend in U.S. industry is toward greater and greater use of the computer in manufacturing. Computer integrated manufacturing and CAD/CAM approaches are viewed as the means to significant improvement in production economies. However, to achieve any significant benefits, these modern systems must examine and capture the logic of the shop operations. As we have found over the past ten years in attempting to implement MRP systems, there often is no shop logic to capture. As a result, one needs to be created. For example if we were to achieve computer-aided process planning, clear process planning rules must be established where often none exist.

Upon examination, it is found that Group Technology principles can serve as the basis for the required logic in manufacturing operations. Therefore, Group Technology can be viewed as a strategy leading to CAD/CAM. Group Technology is not a system but rather it is a philosophy of operation.

One aspect of Group Technology is the recognition that regardless of the eventual end product use, many component parts that are manufactured in the factory exhibit a number of similarities. The similarities may be in the size, shape, processes, raw materials, and any number of other characteristics. Group Technology attempts to segregate the various component parts into groups of those exhibiting a number of similar characteristics. These individual groups are called "part families."

There are several methods used to identify the members of a part family. On one extreme, these families can be developed by relying on the product and shop knowledge of experienced company personnel. By reviewing current component production requirements, components having similarities can be identified. On the other extreme, sophisticated classification and coding systems have been developed and proven in use. These systems require that each component be given a code number in which the digits in the code number describe various important characteristics. Retrieval programs then allow the formation of part families by focusing on certain of these characteristics.

Once identified, a family can be examined for a common process. That is, one master process plan with appropriate and expected variations can be developed to manufacture all of the members of a particular part family. In our factories today, we find many similar parts being processed in dissimilar ways. This is true for a number of reasons, including the turnover of process planning personnel, changes in product demand, the failure to change routings when new equipment is procured, and a host of other reasons.

When a production process plan is developed for a family, it then appears logical that these parts could all be manufactured using a group of dissimilar machines in a defined geographic area. Thus, instead of travelling throughout the factory to many different departments, the parts can be manufactured from start to completion in a "production cell."

Benefits of Gt

Upon reflection, it can be seen that these principles of Group Technology do not bring anything really new to the shop floor. Astute foremen and production engineers have for many years attempted to develop common routings, combine setups, and even establish production lines for the manufacture of similar parts. What Group Technology does accomplish is to bring a systematic methodology to these informal approaches of the past. By not relying solely on the experience and judgement of key personnel, Group Technology permits a wider, and planned, application of sound, economic production.

The accomplishment of a cellular manufacturing process results in a number of benefits. For example, material handling costs and travel time are significantly reduced because the parts do not have to be transported from department to department. Further, it is apparent that lead time is reduced by minimizing queues between operations. Instead of travelling from department to department, the parts merely travel from machine to machine. It has been demonstrated that using current functional plant layouts, 95% of the time that a part is in the factory, it is either being transported or in queue. Only 5% of the time is work being performed on the part.

Another benefit that becomes apparent is that the work-in-process investment is reduced. Partially completed parts are not stored between operations but are moved onto the next operation through to completion. Finally, the confining of all operations in a geographic area provides better control. One supervisor, rather than many department foremen, would be responsible for the part from start to finish, and the parts would be produced by one clearly identified group of workers.

Another significant Group Technology benefit can be accomplished by the *proper sequencing* of the production of parts within a family. The production cell concept can take advantage of the use of common equipment set-ups, or at least minimize the set-up modifications required in changing from one part to another.

Many larger companies such as Boeing, Deere, and Bendix are using Group Technology principles along with a number of other well known and lesser known companies. It has been predicted that in ten years, 50-70% of U.S. industry will be using Group Technology. The U.S.S.R. Western Europe, and Japan all have been using Group Technology for many years.

The Role of P & IC

It can be visualized that the benefits to be derived from a Group Technology approach are very much dependent upon the release of manufacturing orders for individual members of the part families at the same time. It is also important that proper consideration be

given to the sequencing on the shop floor for minimal set-up. These are obviously determined by the P & IC system in use. However, materials management systems have often been ignored in the planning and application of Group Technology cells.

These cells have been typically established by manufacturing engineering groups focusing on optimizing equipment utilization. Therefore, the major benefits expected may not be achieved if the materials management consequences have not been considered in cell design and in cell operations.

On the other hand, modern MRP systems have ignored the principles of Group Technology. These materials management systems are designed to be used in a functional layout mode. They have not been prepared for a Group Technology approach.

Thus, both the manufacturing engineering and the production and inventory personnel must become familiar with objectives of the other, if a Group Technology implementation is to be successful.

The MRP Approach

Whereas Group Technology focuses on the component part, MRP focuses on the end product. MRP operates on the premise that the component parts should be produced by the factory to satisfy the needs of the end product. That is, no part should be completed before it is needed. As the end product demand fluctuates, reschedules permit the shop to move ahead or move back the schedules for the components and subassemblies. MRP calculates the material requirements and recommends a release of orders which are linked to the master production schedule.

A natural conflict begins to emerge. Component parts, under a Group Technology philosophy, should be scheduled for production with their "brothers and sisters." MRP requires that they be produced to satisfy the demands of the "parent." This inherent conflict needs first to be recognized, and then resolved through logical compromises.

Lot Sizes

In a Group Technology environment, lot sizes can be influenced by the need to balance work loads and the utilization of equipment within the cells. Using MRP, lot sizes are often related to the amount needed to satisfy the end products.

When the use of economic lot sizes is considered, Group Technology provides a case for lot sizing based on the production of the total family of parts. Often, only one major set-up is required to produce a number of different parts. Therefore, the balance between set-up costs and inventory costs should take into consideration the group set-up time and related modifications rather than the individual part set-up times.

Considering this, Group Technology would tend to require the production of smaller lots but with greater part scheduling frequency.

GT and MRP

Group technology focuses on a least cost, most efficient method of manufacturing. MRP, on the other hand, is directed toward a reliable, time effective approach. There are, however, some common objectives and a compromise between the two is possible.

Both the Group Technology philosophy and MRP systems strive to reduce work-in-process inventory. Group Technology aims for a reduction in partially completed parts, while MRP strives to reduce the finished parts inventory. MRP should recognize and adjust for the lead time reductions that can be achieved by Group Technology. Similarly, a planning period that allows for the proper rules need to be examined and adjusted for the family of parts concept.

Ideally, the P & IC personnel should be involved in the initial design of a manufacturing cell. The size and content of the cell is somewhat arbitrary. A manufacturing cell can, and often times should, be designed to produce more than one family of parts. This is necessary to justify the assignment of the equipment to a cell when annual part requirements for one part family are not sufficient. Manufacturing engineers tend to overemphasize this approach so as to achieve and improve equipment utilization. However, there is a point in which too many families, assigned to one cell, can present complexities. These unfavorably affect work-in-process, lead times, and order sequencing and begin to defeat the original purpose of the cell. P & IC can assist in optimizing this cell size. This involves economic investment trade-offs that are usually overlooked in a functional layout; that is, achieving the balance between maximum machine utilization, minimum inventory investment, and shortened lead times. Many times in a Group Technology environment, machine utilization suffers so that other benefits can occur. This is a difficult concept to accept in some organizations.

In the execution of the production schedule, Group Technology offers some important simplifications to P & IC. The limiting of all operations to one geographic area means that only one shop order per part, rather than one per operation, is needed. Further, because cell design usually revolves around one or two key machines, available capacity is readily determined. Finally, the schedule for any particular part typically involves only one supervisor and minimizes the need for expediting. These advantages can help P & IC personnel appreciate the Group Technology approach and the need for compromise.

Expectations

Group Technology is coming to many, but not to all environments. The principle potential users of Group Technology are those who are in batch manufacturing and who have a wide number of product variations and a resulting large number of different pa[illegible] Also, there is typically a clearly perceived need for dramatic improvement in cost and/or delivery.

If Group Technology is found to be feasible in a particular environment, it will not affect all factory operations. At best only 60-70% of the operations in any manufacturing facility will have potential for a Group Technology application. Further, the change to Group Technology will probably be quite gradual and will start with a pilot cell to demonstrate its effectiveness. The total implementation may be scheduled over many months, or even years.

Even if it is found that the rearrangement of the factory is not economically feasible, there is a case for the installation of some Group Technology principles. Often, these can be executed by using only the family of parts concept but not changing to cellular production. While all the key benefits of Group Technology, such as the reduction of material movement, will not be obtained without factory rearrangement, other benefits, such as the reduction of set-up time, can be achieved.

None of the commercial MRP systems, and a few in-house systems, consider a Group Technology plant layout. With Group Technology, a number of revisions are needed in the software. These include the logic for order release and order sequencing, lot sizing techniques, and lead time considerations. A search of the literature reveals that few "canned" solutions are available. The problems have been recognized, and a number of theories have been presented but few if any have been developed in the factory environment.

Conclusion

It is important that P & IC personnel understand the principles of Group Technology. They are sound, and have been proven. While Group Technology may not be for all, it is getting a great deal of attention in the search for productivity improvement. Some major installations are in place and many more are planned.

There is no one way to implement Group Technology. While the principles involved are clear and relatively simple, the installation of a Group Technology approach varies with the needs of the environment. The degree and method of application must be related to the expected savings from the change. Initial efforts should include a thorough examination of feasibility and a plan for implementation. It should be recognized that using the cellular method of plan layout considerably reduces the job shop flexibility associated with a functional layout.

In any event, if a Group Technology approach is justified to any degree, it will affect, and be affected by, the material management system. This will require modifications to the systems that are not necessary in a functionally laid out plant.

Group Technology provides an opportunity for significant improvement but its execution usually requires a substantial cost investment and a major disruption of the status quo. Like MRP, GT, for ultimate success, requires a great deal of knowledge and education in its concepts and execution.

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