

Preface

An acceptable axiom declares that innovation is a driving force to improve the manufacturing performance. This axiom might be true in most cases but in others it might be destructive by shifting the research topics towards non-supporting path and thus blocking the progress of the main research objectives.

It is not that such destructive innovation methods were not extraordinary methods; on the contrary, they showed potential by swept industry and academic colleagues to follow their research lead which might result in new innovative technologies or end up with delay of the main objective or just waste of research time and cost.

This book presents a review of three remarkable innovation methods of the 50s, which had far-reaching impacts on the manufacturing methods: group technology, numerical control and integrated manufacturing system.

Group Technology. The method is followed to organize the factory in “work cells” instead of functional layout. A work cell is defined as a group of machines, located close to one another, and can manufacture a family of parts. The main slogan of GT is that “One solution may serve a family of problems”. There is no need to solve each problem as unique, first try to relate it to a family of problems and try to use one solution to all of them. In other words “don’t invent the wheel over and over again”.

A variety of enterprises that adapt this manufacturing method have confirmed that within 2–3 months of changing over to work cell sections the labor productivity rises by 12–20%, the cost per unit value of finished products falls by 2–3%, the duration of the machining cycle falls by 25–35%, and the average value of work in progress falls by 15–25%.

Group technology was the leading manufacturing technology until the mid-70s. A survey by the University of Michigan researchers predicted that by 1988 more than 50% of industry will use group technology in manufacturing, while a survey by CIRP researchers indicated that by 1990 70% of industry will use group technology in manufacturing.

The concept of “groups” or family of part was accepted with enthusiasm. Thus, the main topic of research deviated from GT to conducting research on how to create families. For over a decade, the leading research topic was to form a classification system. However, such a coding and classification that may serve several industrial users could not be formalized. As a result the topic slowly disappeared and the GT faded away with it.

Numerical Control. The numerical control **technical stage** is still one of the leading innovative technologies in our days. It intruded the computerized machines which dominates today’s manufacturing resources, i.e. CNC, DNC, industrial robots, automatic storage and retrieval, AGV, machining center, FMC, etc.

Note that these incredible manufacturing resources are a single defined objective that should and could be organized as a remarkable manufacturing **system** such as flexible manufacturing, or even automatic factory. At this point a reasonable research focus should have been system organization, but it deviated to how to increase their individual capabilities. This digression contradicted with manufacturing performance objectives and delayed the dream of forming flexible and automated factory from 1980 to 1999 and then to 2015 and even further.

IMS–Integrated Manufacturing System. The task of the manufacturing management is to plan and produce products according to management orders and policy. The objectives of the task are to plan enterprise activities in a manner that ensures the following:

- Meeting delivery date
- Minimum processing lead time
- Minimum processing cost
- Maximum resource utilization
- Minimum work in process
- Minimum capital tie-down in production.

Theoretical production planning and scheduling is actually a very simple task. The plant gets orders which define the product, the quantity and the delivery dates. The resources of the plants are known and the product bill of material is known. The task of production scheduling is to make sure that the orders will be ready on time, that’s all.

Therefore, it seems strange that in order to meet this **simple** task, over 130 innovation production planning methods were proposed such as: Agile Manufacturing; Just-in-time; Kanban system; Lean manufacturing; OPT; Outsourcing; TQM; Virtual manufacturing; and others keep coming at an ever-increasing pace. Any one of the proposed methods improves a certain aspect or several aspects of the manufacturing cycle. However, none of the proposed methods improve all disciplines’ aspects and area of activities of the manufacturing cycle.

A common shared justification is that production planning is a very complex task. Research proves that the manufacturing process is flexible by nature.

However, the structure of the proposed manufacturing system makes it rigid and complex. Analyzing the reasons for the rigidity shows that:

The complexity is a result of the rigidity which is caused by using one (or two) routine and attempting to solve disruptions by mathematics and not by technology.

Moreover by being a system in which decisions are being made too early in the manufacturing process. Some decisions (routine) were made several years before the execution time. Therefore, they cannot comply with the dynamic situation of the manufacturing process.

IMS approach was misleading and adverse to the objectives. The planning and execution regards the routing as static and unalterable; therefore the capacity planning is simple, but it robs the shop of production flexibility and efficiency. The basic notions of the hierarchical approach techniques are:

- Use the “best” routing for the job
- Using the “best” routing for maximum production optimization will result in the shortest throughput.
- The larger the batch quantity, the better the productivity.
- Job release to shop floor based on MRP (or ERP) will assure maximum efficiency and meeting delivery dates.

These notions (that none of them meets cost and profit objection) appear to be logical and were accepted without justification. However, research leads to the conclusion that these notions are in many cases incorrect.

The term “best” routing is obscure; routing can generate over 20 routing for each job, each one to serve a different objective (maximum production, minimum cost, maximum profit, etc.).

Using maximum production criterion of optimization for scheduling a random product mix showed that this criterion usually resulted in the longest throughput as compared to others criteria.

CAD—Computer-Aided Design. The extraordinary impact of electronic computers on enterprise management has been everywhere, extending into product-process technology; information systems and decision making; control technology and resource member. Lately, in addition to CAD—computer-aided design, with its remarkable simulation capabilities and impressive display—new incredible Additive Technologies and 3D picture have materialized. They are completely new processing technologies and open up new horizons in manufacturing methods. However, these useful new technologies caused fading away of the incredible innovations that dominated manufacturing from 1940s to mid-1970s.

Using present-day capabilities CAD can be a tool to redirect research in order to restore the remarkable potential of the above-mentioned three manufacturing methods.

The book chapters are as follows:

- Chapter 1 presents introduction to group technology, numerical control and industrial management system.
- Chapter 2 presents in detail the history of group technology, its objectives, expectations and technology. This chapter also details the great efforts that were made for over 30 years by the industries and academia in order to make it work, till it was abandoned.
- Chapter 3 presents in detail the history of numerical control systems, its objectives, expectations and technology. Numerical control actually revolutionized the hardware (facilities) used by industry. An attempt to keep on this innovation technology to create an automated factory failed.
- Chapter 4 presents the history of industrial management system (IMS) its great efforts to establish a method that will be flexible and efficient, but unfortunately such a system was not discovered yet.
- Chapter 5 is devoted to analyze the reasons for the decline of the remarkable technology after dominating the market for several decades. It concluded that the dominating research topic; the run for “routine” was a slip-up and climbing on a wrong tree. Routine is **not** the missing link between design and production planning (manufacturing). The missing link is process planning, and setting objectives to CAD—computer-aided design.

This chapter describes a restoration method which may revive the incredible group technology, numerical control integrate manufacturing system, and may assist in making the dream of automated factory come true.

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