CONCEPT OF GROUP TECHNOLOGY ACCOMPLISHMENT IN THE FIELD OF CELLULAR MANUFACTURING SYSTEMS

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Abstract - *In this paper we have planned to give the detailed examination of group technology (GT) and its principle of implementation in the field of cellular manufacturing to achieve the drastic change in output of production. Cellular manufacturing system has been proved a vital approach for batch, job shop production and some extend to process industries and group technology has been an essential tool for developing a cellular manufacturing system. With the principle implementation of group technology act as a traditional concept and still plays significant role in new manufacturing concepts like just in time, total quality management and technologies such as optimized production technology, computer integrated manufacturing in manufacturing system concept of group technology helps to achieve reduction in setup time, inventory levels and logistics of goods and also gives effective control of production and also we narrate some examples to easily understand the group technology concept by produce the basic ideas about GT in the field of cellular manufacturing also decision-making and accountability are more locally focused, often resulting in quality and productivity improvements.*

Key Words: Cellular manufacturing 1,Traditonal concept 2, Groupm Technology 3, Vital approach 4

1. INTRODUCTION

Group Technology or GT is a manufacturing technique in which the parts having similarities in geometry, manufacturing process and/or functions are assembled together. GT is based on a general principle that many problems are similar and by grouping similar problems, a single solution can be found to a set of problems, thus saving time and effort. The group of similar parts is known as part family and the group of machineries used to process an individual part family is known as machine cell [1].This type of manufacturing in which a part family is produced by a machine cell is known as cellular manufacturing. In this type of manufacturing efficiencies were generally increased by employing GT because the required operations may be confined to only a small cell and thus avoiding the need for transportation of in-process parts. Cellular Manufacturing is a model for workplace design, and has become an integral part of lean manufacturing systems and it is based upon the principles of Group Technology, which seeks to take full advantage of the similarity between parts, through standardization and common processing[2].In Cellular manufacturing, sometimes they called cellular or cell production, arranges factory floor labor into semi-autonomous and multi-skilled teams, or work cells, who manufacture complete products or complex components. Properly trained and implemented cells are more flexible and responsive than the traditional mass-production line, and can manage processes, defects, scheduling, equipment maintenance, and other manufacturing issues more efficiently and this paper gives some concept that relevant to concepts of GT with cellular manufacturing systems in various production industries.

2. Rise of Group Technology To Examines Products, Parts and Assemblies:

Unlike Henry Ford, today's manufacturers cannot just make "any color as long as it's black." Fragmented markets, competition and sophisticated customers have created dizzying product variety often with lower volume. Numerous firms have choked on this diversity.Increasing inventory, slower product introductions, confusion and declining quality indicate an inability to deal with increasing variety. Group Technology (GT) tames this variety beast. Group Technology examines products, parts and assemblies. It then groups similar items to simplify design, manufacturing, purchasing and other business processes. The figures below illustrate how an apparently random collection of items has surprising similarity [3].

From this more ever all of the manufacturing and production industries were follow and implement the concept of group technology and they discovered several advantages of GT in their production units.

Fig -1: Arrangement of Ungrouped Parts

3.GT DESIGN IN ENGINEERING :

A typical mechanical designer produces about two discrete new parts per week. Thus, even a small department designs hundreds of parts each year. Without formal methods, designers cannot track the drawings. They duplicate or near duplicate many existing parts. Like the Hydra of Greek Mythology, the problem feeds on itself. As more new designs enter the system they become harder to track and encourage even more duplication. GT using Coding and Classification (C&C) addresses this.
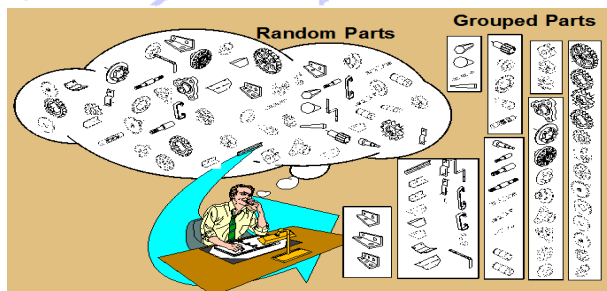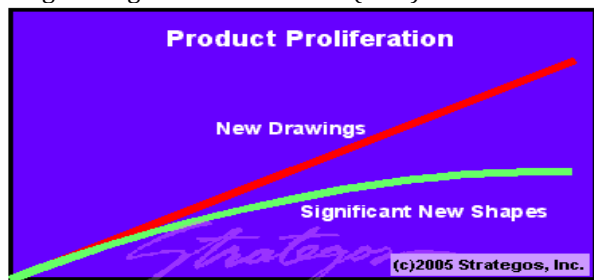

Fig-2: Pictorial representation of GT in Engineering Design

4. GT AND OTHER DEPARTMENTS:

GT produces savings and benefits in almost every area of the business. It combines tasks, equipment, gages, tooling and schedules into larger groups of similar elements for similar solutions. Purchasing can group similar parts and achieve quantity discounts. For non-standard purchased parts, grouping helps suppliers achieve savings and reduce price. Accounting is simpler in a GT environment[4]. Here costs are collected by cell and family rather than individual part. A simple allocation procedure assigns costs accurately within families.

5. GT AND MANUFACTURING:

Group Technology benefits manufacturing in many ways. It reduces the number and variety of parts. Process planning for the remaining parts is easier and more consistent. Computer Aided Process Planning (CAPP) is an important tool for this[5]. It uses the coded similarities to plan consistently, standardize and accurately estimate costs. It then assigns the part to a GT manufacturing cell.Group Technology cells reduce throughput time and Work-In-Process. They simplify schedules, reduce transportation and ease supervision. Some of the more dramatic and tangible savings come from improved setups and tooling cost. Setup time reductions bring smaller lot sizes and smaller queues which mean faster throughput, shorter lead times and decreased inventory.GT sometimes eliminates the need for expensive NC equipment. Combined with NC, GT simplifies programming, fixturing and tooling.
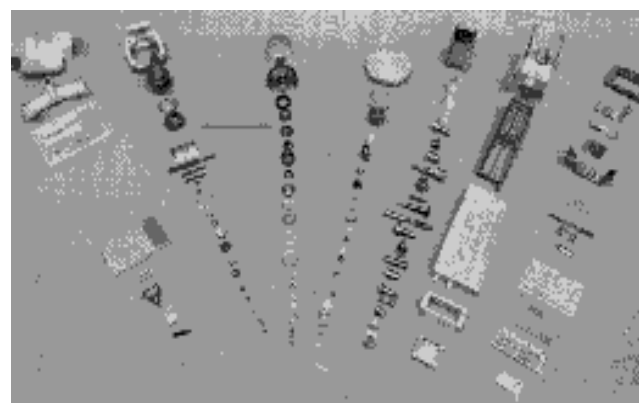

Fig-3 Example of Group of Parts in Manufacturing system

5.CLASSIFICATION METHODS OF GROUP TECHNOLOGY

Classification may be done by several methods. 'Eyeball' and experience suffice when parts are few. Production Flow Analysis considers current processes and sequences. It groups parts accordingly[6]. Graphics classification is

useful for design standardization and design retrieval. Coding systems are highly versatile in manufacturing, design and purchasing but they are very expensive because of the labor involved in the original coding. An approach to manufacturing in which similar parts are identified and grouped together in order to take advantage of their similarities in design and production Similarities among parts permit them to be classified into part families In each part family, processing steps are similar The improvement is typically achieved by organizing the production facilities into manufacturing cells that specialize in production of certain part families.

6.PART FAMILY CLASSIFICATION IN GT SYSTEM:

A group of parts that possess similarities in geometric shape and size, or in the processing step used in their manufacture Part families are a central feature of group technology.There are always differences among parts in a family but the similarities are close enough that the parts can be grouped into the same family.

7.WAYS TO IDENTIFY PART FAMILIES:

Visual inspection - using best judgment to group parts into appropriate families, based on the parts or photos of the parts.

Production flow analysis - using information contained on route sheets to classify parts.

Parts classification and coding - identifying similarities and differences among parts and relating them by means of a coding scheme[7].

8.THREE STRUCTURES USED IN CLASSIFICATION AND CODING SCHEMES:

Hierarchical structure, known as a mono-code, in which the interpretation of each successive symbol depends on the value of the preceding symbols Chain-type structure, known as a polycode, in which the interpretation of each symbol in the sequence is always the same; it does not depend on the value of preceding symbols Mixed-mode structure, which is a hybrid of the two previous codes.

9. SOME OF THE IMPORTANT SYSTEMS:

Opitz classification system –the University of Aachen in Germany, nonproprietary, Chain type. Brisch System – (Brisch-Birn Inc.),CODE (Manufacturing Data System, Inc.),CUTPLAN (Metcut Associates) DCLASS (Brigham

Young University),MultiClass (OIR: Organization for Industrial Research), hierarchical or decision-tree codingstructure,Part Analog System (Lovelace, Lawrence & Co., Inc.)

10. PRODUCTION FLOW ANALYSIS (PFA) IN CELLULAR MANUFACTURING SYSTEM

In Production Flow Analysis the uses of matrix in selection of part numbers and machine numbers to group families. In the matrices below, columns represent the machines whose numbers and names are at the top. Rows represent parts whose numbers and names are on the left. When a particular part requires a particular machine, the operation sequence number is in the intersecting spreadsheet cell. Sometimes, merely an "X" signifies that a particular part needs a particular machine. Most part families have a "natural sequence." For example "Lathe" normally precedes "Deburr". This natural sequence dominates and becomes the basis for the workcell layout. You can usually ignore sequence issues when developing the PFA matrix. It is difficult to see order or similarity in the first matrix. Rearranging the rows and columns, as in the second matrix, clearly shows families of similar parts and the machines required to build them. These machines form a work cell[8].

Pump Machining Production Flow Analysis		Lathe-Manu	Lathe-Vert	HMC	Lathe-Chuck	Broach	Hob	Lathe-Bar
50547-D	Gland, MU, 6"	X						
71928	Head, Pump	X	X		Turn-Mill Cell			
71972-8	Adapter, Intake, 8"	X	X	X				
81176	Body Volute		X	X				
72298	Elbow, Relief Valve			X				
81357-T	Impellor				X	X		
62966	Generator, Tach Pulse				X		X	
70852	Gear Driven 8P,56T, RH				X	X	X	
70935	Gear, Driven,8P,26T,LH	Chucking Lathe Cell			X	X	X	
61354	Cover Bearing				X			
52594	Spacer,cplg Shaft							X
62575	Shaft Shift							X
63160	Seat, Spring				Barfeed Lathe Cell			X
51171	Retainer Bushing							X
50763	Spacer, Bearing							X

Fig-4 Example for Production Flow Analysis for Pump Machining

11.Implementation of Production Flow Analysis (PFA) in Cellular Manufacturing System

Computer programs are available for manipulating large matrices but they cannot solve the problem of inconsistent routings that is often encountered in a PFA analysis. Inconsistent routing means that similar parts use different machines[9]. This occurs for a variety of reasons such as:

Parts have usually entered the product mix over a period of many years. Different conditions and different planners over this time have arrived at different routing decisions.

Capacity issues may influence routing decisions. For example, machine A would normally be used for a particular operation but it is heavily loaded so the process planner uses machine B.

Different process planners have different backgrounds and a different bias. This may lead to different routings for the same part.

Analysts encounter inconsistent routings in most PFA analyses. If the product mix is not too complex, they can make intuitive manual adjustments. When the product mix becomes larger than 100 or so items, PFA becomes too cumbersome and a Coding & Classification analysis is indicated.

12. CODING &CLASSIFICATION IN MANUFACTURING:

Coding systems for manufacturing usually have both product and process information. The analyst works with both If there is a great deal of inconsistency in existing processes, the analyst can revert to the more fundamental characteristics such as size, shape and material. Parts with similar physical characteristics should usually have similar processes. The coding system allows an analyst to standardize process routings and then group the parts into families. The example below shows a small part of a database for castings. Each digit position represents a particular part characteristic. For examples the third position indicates the casting's finished weight.Each character in the code carries information about the product characteristic assigned to that digit position. For example, a "1" the third character position might indicate a finished weight between 1.0 and 5.0 pounds. Through sorting, retrieval and specialized algorithms, the analyst groups similar parts as shown.

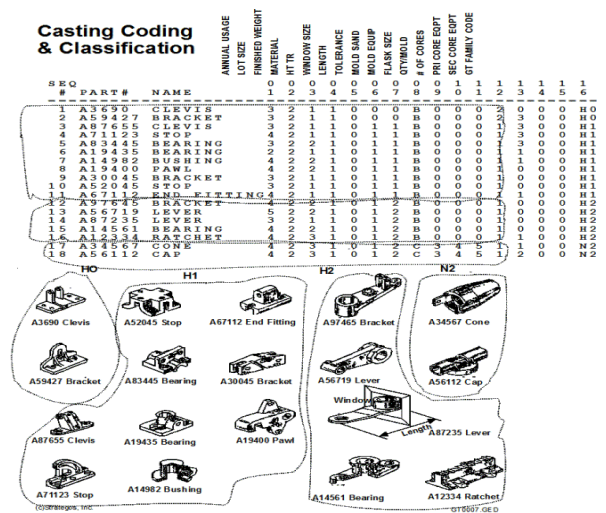## 13. IMPLEMENTING CODING & CLASSIFICATION:

Fig-5 Pictographic representation for Casting Coding Implementation

Coding and Classification presents some major challenges that are not usually evident to an inexperienced practitioner. This is especially true of large databases. But, then, large projects have correspondingly large returns[10]. A successful project requires experience and judgment in coding system design, initial coding and in family development. It is not a task for the novice.

14. Group Technology Work cell Example for Cellular Manufacturing

This cell has the classic U-shape but it does not operate like a Toyota Cell. This cell produces about 85 different turned parts. These are shafts and shafts with integral pinions and/or splines. Arrows show the sequence for three of these many parts.All parts have dedicated carts for handling and storage. They serve as material handling devices, containers and kanban. Perimeter carts are a kanban stockpoint. The internal lot size (transfer batch) is one cart (16 parts). External lot size varies from 16-48 parts in multiples of 16. Work times are highly variable and unbalanced. The hobbing machine (7-1) is extremely slow while the NC lathe is fast.The product mix was carefully selected to include some parts that require hobbing and many others that do not. Operators schedule their work from kanban signals. They must schedule non-hobbed parts immediately after a hobbed part. If they did not, the slow hobber would bring output to a crawl.

They may have 2-3 part numbers underway at the same time.Operators stay alert because the variation in cycle time means that machines finish at unforeseen moments. Operators constantly move from one machine to another, loading and unloading. Small queues highlight temporary bottlenecks which get special attention. Some drilling and milling might have been done on the NC lathe using special attachments. But, we chose to make these secondary operations to reduce machine time on the lathe. These operations occur internally to lathe turning and cell output increases as a result.

Fig-6 Importance of CMS and GT for Process Industry with Kanban

While the whole arrangement may seem like a recipe for chaos, it actually works quite well. It is not nearly as smooth as a classic Toyota cell but it is far better than the genuine chaos of a functional layout. A lot depends on the operators. Here, they were skilled and experienced machinists[9]. With kanban, we knew they could figure out what part to run and this will not give the optimum layout design and arrangement of machines but while we implement the group technology principle by separating the work process in to different cells. Then we have to achieve some improvement in productivity without any queue formation.

15. BENEFITS OF GT IN THE FIELD OF CELLULAR MANUFACTURING SYSTEMS:

There are many benefits of GT in cellular manufacturing for a company if applied correctly. Most immediately, processes become more balanced and productivity

increases because the manufacturing floor has been reorganized and tidied up.

There are some costs of implementing cellular manufacturing, however, in addition to the set-up costs of equipment and stoppages noted above. Sometimes different work cells can require the same machines and tools, possibly resulting in duplication causing a higher investment of equipment and lowered machine utilization. However, this is a matter of optimization and can be addressed through process design. Enable Cellular Manufacturing with the principle of GT it may gives the Reduce Engineering Cost, Accelerate Product Development Improve Costing Accuracy ,Simplify Process Planning, Reduce Tooling Cost, Simplify Purchasing, Help With Value Stream Mapping. The savings from GT come in many forms, often intangible. Here are some of the improvements that successful users have achieved:

- Setup Time..............35%-40%
- Tooling Cost............40%
- Inventory.................15%-35%
- Throughput Time....80%
- Purchased Items......15%

Group Technology is the most effective technique available for addressing the variety demanded by today's customers and allows customization of product with standardization of process [11].

16. GAP IN RESEARCH:

There has been tremendous work done by various researchers on cell formation techniques. Majority of the published works on cellular manufacturing pay very little attention towards production planning and control activities of cellular manufacturing. Many current cellular manufacturing applications are running in a non-optimal environment and their performance could be improved by optimizing the parameters. But this paper gives some of details about the advantages of group technology in the process of making a product and there is some techniques discussed above also do not investigate the effect on different performance measures if the number of cell/cell size/composition of cells varied. And our idea is too carried out some work related with cell formation problems in group technology principle of cellular manufacturing to shows some tremendous changes in production with automation in working environment.

17. CONCLUSION:

This study brings the attention towards the need for designing the cellular manufacturing system with GT for optimal performance as most of has been concentrated to the machine and parts into cell with part families.
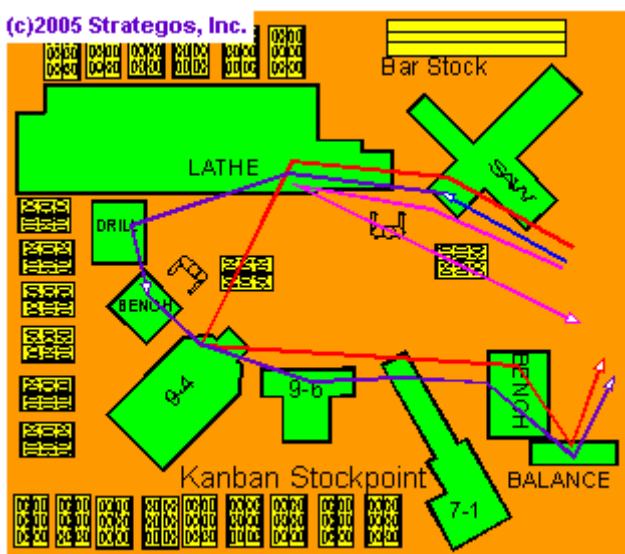
So, acute need is to develop the models to specify the optimal number of groups and optimal production mix subject to technological and logistical constraints for optimal performance of cellular manufacturing system to get success in group technology. There is a need to develop more efficient tools enabling manufacturing system designer to achieve optimal solution in reasonable processing time also with the help of group technology principle we have produce better productive system the application of GT in advanced manufacturing system enhance the design and operational efficiency of an system also lot sizing and some flexible manufacturing system also we incorporated with the production activities of an system. And our main idea to design this paper was to produce excellency of GT in cellular manufacturing to maximu reachs to small scale and large scale process industry.

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