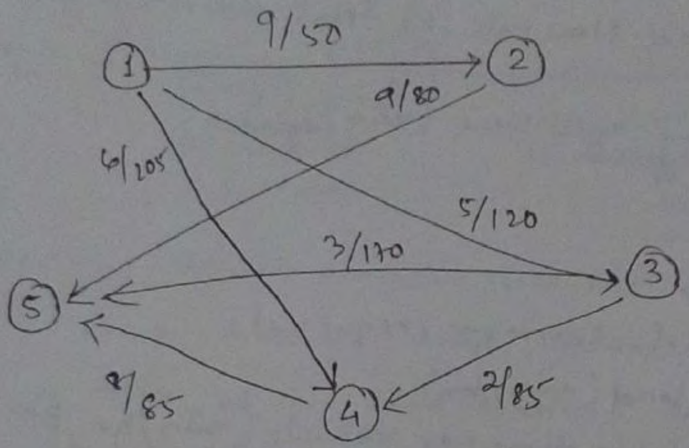
Network diagram

(d)

	To	1	2	3	4	5
from	1	0	9/50	5/120	6/205	0
	2	0	0	0	0	9/80
	3	0	0	0	2/85	3/170
	4	0	0	0	0	8/85
	5	0	0	0	0	0



Nodes represent the load/unload stations and arrows are labeled with flow rates and distances.

* $T_c = T_L + \frac{L_d}{v_c} + T_U + \frac{L_e}{v_e}$

T_c = delivery cycle time (min/del).

T_L = time to load at Load station (min).

L_d = distance the vehicle travels between load & unload station (m)

v_c = carrier velocity (m/min)

T_U = time to unload at unload station (min).

L_e = distance the vehicle travels empty until the start of the next delivery cycle (m).

* $AT = 60 A F_t E_w$

AT = Available time (min/hr per vehicle).

A = availability.

F_t = traffic factor.

E_w = worker efficiency.

* $R_{dv} = \frac{AT}{T_c}$

R_{dv} = hourly delivery rate per vehicle (del/hr per vehicle).
T_c = delivery cycle (min/del).
AT = available time in 1 hr with adjustments for time losses (min/hr).

* $WL = R_f T_c$

WL = workload (min/hr).
R_f = specified flow rate of total deliveries per hour for the system (del/hr).
T_c = delivery cycle time (min/del.)

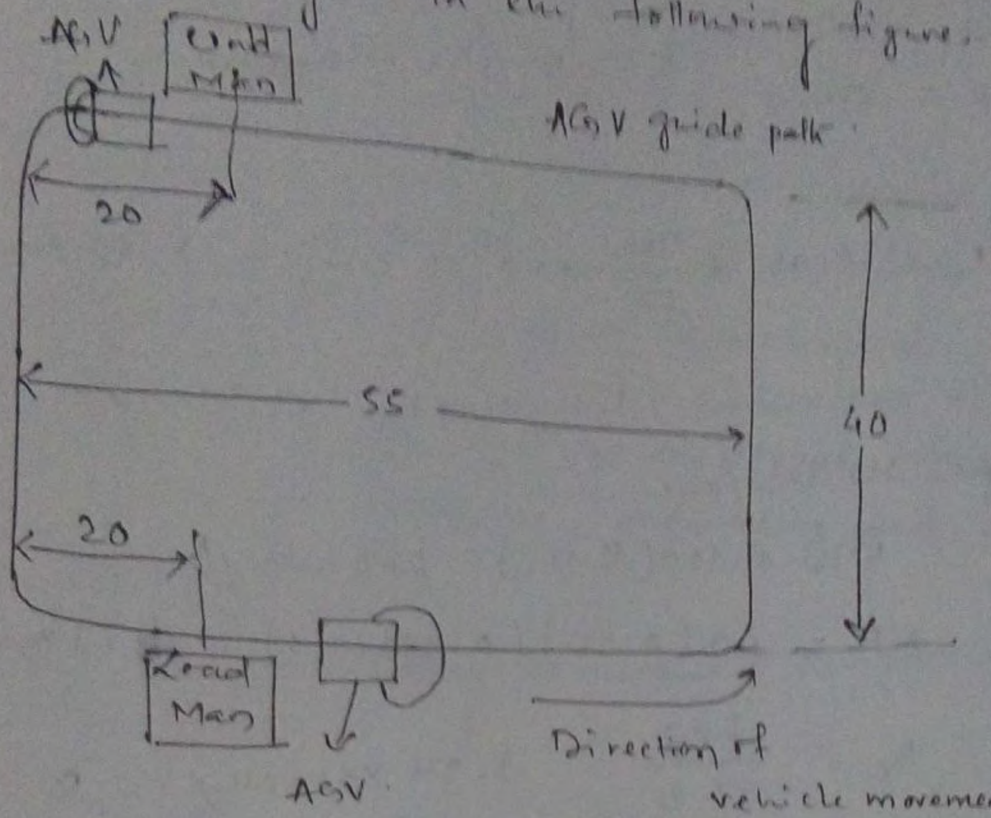
* $n_c = \frac{WL}{AT}$

n_c = NO. of carriers required.
WL = workload (min/hr).
AT = available time per vehicle (min/hr per vehicle).

* $n_c = \frac{R_f}{R_{dv}}$

n_c = NO. of carrier required.
R_f = total delivery requirements (del/hr).
R_{dv} = delivery rate per vehicle (del/hr per vehicle)

Prob:
consider the AGVS layout in the following figure.



The vehicle travel counter clockwise around the loops to deliver loads from the load stations to the unload station. Loading time at the load station = 0.75 min and unloading time at the unload station = 0.50 min. How many vehicles are required to satisfy demand for this layout if a total of 40 del/hr. must be complited by the AGVS.

The following performance parameters are given:-

vehicle velocity = 50 m/min. availability = 0.95.

traffic factor = 0.90. $E_W = 1.0$.

Determine (a) travel distances ~~required~~ loaded and empty.

(b) ideal delivery cycle time.

(c) No. of vehicles required to satisfy the delivery demand.

Q.1: (a)

$L_d = 110\,m$

$L_e = 80\,m$ } from the diagram.

(b)

$$T_c = 0.75 + \frac{110}{50} + 0.50 + \frac{80}{50} = 5.05 \text{ min}$$

(c) To determine the number of vehicles required to make 40 del/hr

$$WL = 40(5.05) = 202 \text{ min/hr}$$

$$AT = 60(0.95)(0.90)(1.0) = 51.3 \text{ min/hr. per Vehicle}$$

$$n_c = \frac{202}{51.3} = 3.94 \text{ vehicles} \approx 4 \text{ vehicles}$$

Module-III

Introduction to the Manufacturing systems :-

→ A manufacturing system is a collection of integrated equipment and human resources, whose function is to perform one or more processing or assembly operations on a starting raw material, part or set of parts.

→ The integrated equipment includes production machines and tools, material handling and work positioning devices and computer system.

→ eg * Single station cell (one worker, one production machine).
* Machine cluster (one worker, group of machines)
* Manual assembly line (Series of work stations)
* Automated transfer line (Series of automated work stations that perform processing operations/machining)
* Automated assembly line (system)
* Machine cell (Manually operated production machines and work stations).
* flexible manufacturing system.

Components of Manufacturing system :-

(1) Production machines plus tools, fixtures and other related hardwares.
→ Manually operated
→ Semi-automated.
→ fully-automated.

(2) Material handling system.
→ loading
→ Positioning
→ Unloading
→ transportation.

(3) computer system to co-ordinated / control the preceding components.

(4) Human workers to operate & manage the system.

Group technology:-

→ Group technology is a manufacturing philosophy in which similar parts are identified and grouped together to take advantage of their similarities in design and Production. Similar parts are arranged into part families, where each part family possesses similar design and manufacturing characteristics.

→ eg:- A plant producing 10,000 different part numbers may be able to group the vast majority of these parts into 30 to 40 distinct families.

* The processing of each member of a given family is similar, and this should result in manufacturing efficiency.

→ The greater efficiency is achieved by arranging the production equipment into machine group or cells to facilitate work flow.

→ Organizing the production equipment into machine cells, where each cell specializes in the production of a part family, is called cellular manufacturing.

→ Group technology is most appropriate under the following conditions:-

* The plant currently uses traditional batch production and a process type layout.

* The parts can be grouped into part families.

→ Major task to implement the GT:-

* Identifying the part family.
* Rearranging production machines into machine cells.

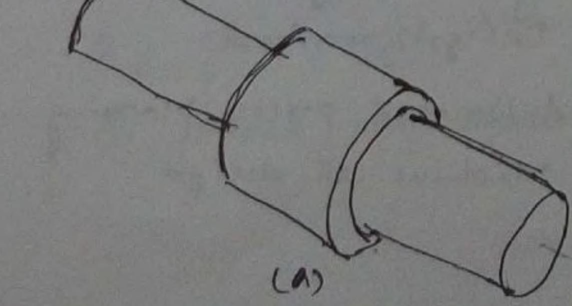
Benefits of Group technology:-

* GT promotes standardization of tooling, fixturing & setups.
* Material handling is reduced because the distances within a machine cell are much shorter than within the entire factory.
* Process planning and production scheduling are simplified.
* Setup times are reduced, resulting in lower manufacturing lead time.
* Work-in-process are reduced.
* worker satisfaction usually improves.
* Higher quality work is accomplished using group technology.

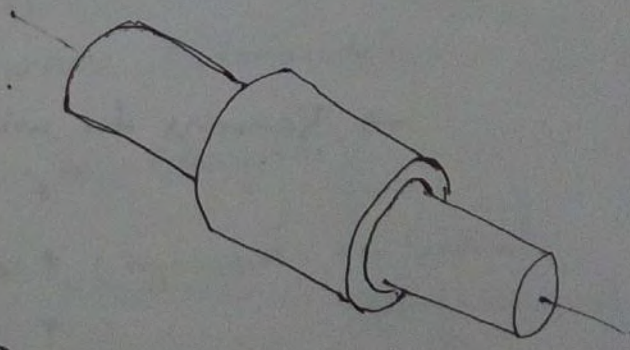
Part families:-

→ A part family is a collection of part that are similar either in geometric shape and size or in the processing steps required in their manufacturing.

→ The parts with in the family are different, but their similarities are close enough to merit their inclusion as members of part family.



(A)



(b)

Two parts of identical shape and size but different manufacturing requirement. (A) 1,000,000 Pc/yr, tolerance = ± 0.010mm, material = 1015 CR steel, (b) 100 Pc/yr, tolerance = ± 0.001 mm, material = 18-8 stainless steel.

→ There are generally 3 methods to prepare the part fa...

(1) visual inspection.

(2) Parts classification and coding.

(3) Production flow analysis.

(1) Visual inspection:-

→ This method is least sophisticated and least expensive method.

→ It involves the classification of parts into families by looking at either the physical parts or their photographs and arranging them into groups having similar features.

→ This method is less accurate

(2) Part Classification & Coding:-

→ In parts classification & coding, similarities among parts are identified and these similarities are related in a coding system.

→ There are two catagories to distinguish similarity -

(1) Design attributes.

(2) Manufacturing attributes.

→ Reasons for using a coding scheme.

* Design retrieval.

* Automated process planning.

* Machine cell design.

Features of part classification and coding system:

1. Systems based on part design attributes.
2. Systems based on part manufacturing attributes.
3. Systems based on both design and manufacturing attributes.

Part design attributes

Basic external shape
Basic internal shape
Rotational or Rectangular shape
Length to diameter ratio.
Aspect ratio (Rectangular part).
Material types
Major Diameter.
Minor Diameter.
Tolerances.
Surface finish.

Part Manufacturing attributes

Major processes
Minor processes.
operation sequence.
Surface finish.
Machine tool
Production cycle time.
Batch size.
Annual production.
fixtures required.
cutting tool used.

→ In terms of the meaning of the symbols in the code, there are three structures used in classification and coding schemes:

1. Hierarchical structure (monocode).
2. Chain-type structure. (polycode).
3. Mixed-mode structure (Hybrid of two previous coding schemes).

The Opitz parts classification & coding system:-

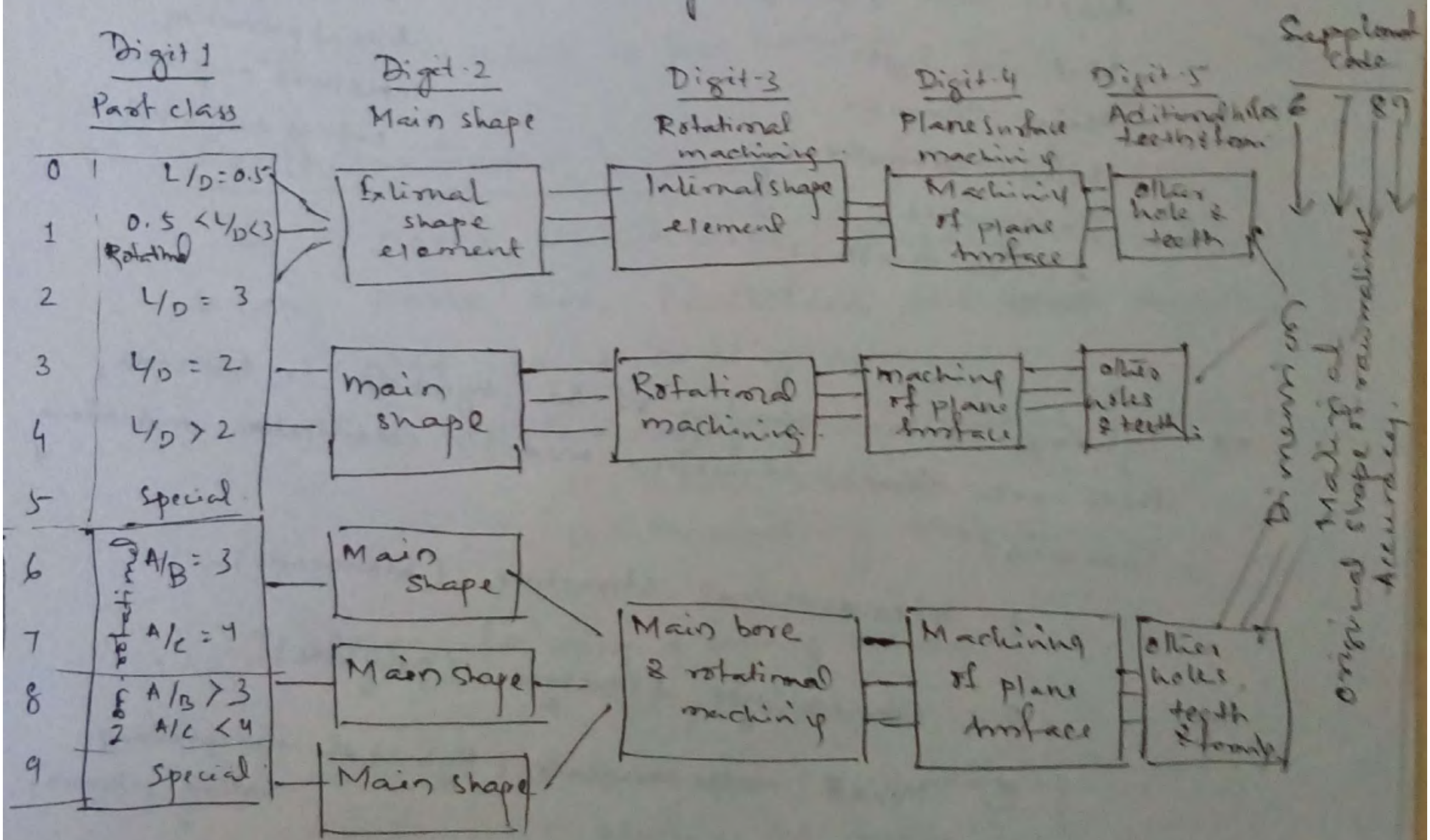
→ It was developed by H. Opitz of University of Aachen in Germany.

→ The Opitz coding scheme uses the following digit sequence:

12345 6789 ABCD.

→ The basic code consists of nine digits which can be extended by adding four more digits.

→ The first nine are intended to convey both design and manufacturing data.



→ The first five digits, 12345, are called the form code. This describes the primary design attributes of the part such as external shape and machined features.

→ The next four digits, 6789, constitute the supplementary codes, which indicates some of the attributes that are useful for manufacturing

The extra four digits, ABCD are referred to as the secondary code and are intended to identify the production operation type and sequence.

Production flow analysis:

→ Production flow analysis (PFA) is an approach to part family identification and machine cell formation.

→ It is a method of identifying part family and associated machine groupings that uses the information contained on production route sheets rather than part drawing.

→ Workparts with identical or similar routing are classified into part families. These families can be used to form logical machine cells in a group technology layout.

Procedures:

1. Data collection:

→ The minimum data needed in the analysis are the part number and operation sequence.

→ Each operation is associated with a particular machine and so determining the operation sequence also determines the machine sequence.

2. Sortation of process routings:

→ The parts are arranged into groups according to the similarity of their process routings.

→ All operations or machines included in the shops are reduced to code numbers.

Operation m/c	Code
Cut off	01
Lathe	02
Turret Lathe	03
Mill	04
Drill	05
NC drill	06
Grind	07

3. PFA chart:

→ The processes used for each part are then displayed in a PFA chart.

→ The chart is a tabulation of the process or machine code numbers for all of the part parts.

→ It is also termed as part-machine incidence matrix

Machines (j) ↓ / Parts (i) →	A	B	C	D	E	F	G	H	I
1	1	0	0	1	0	0	0	1	0
2	0	0	0	0	1	0	0	0	1
3	0	0	1	0	1	0	0	0	1
4	0	1	0	0	0	1	0	0	0
5	1	0	0	0	0	0	0	1	0
6	0	0	1	0	0	0	0	0	1
7	0	1	0	0	0	1	1	0	0

4. Cluster Analysis:

→ from the pattern of data in the PFA chart, related groupings are identified and rearranged into a new pattern that brings together parts with similar machine sequences

→ This is done by Rank order clustering analysis.

Machines	C	E	I	A	D	H	F	G	B
3	1	1	1						
2		1	1						
6	1		1						
1				1	1	1			
5				1		1			
7							1	1	1
4							1		1

Cellular Manufacturing :-

→ Cellular Manufacturing is an application of group technology in which dissimilar machines or processes have been aggregated into cells, each of which is dedicated to the production of a part, product family or limited group of families.

→ Objectives :-

- To shorten manufacturing lead time
- To reduce work-in-process inventories.
- To improve quality
- To simplify production scheduling.
- To reduce setup time.