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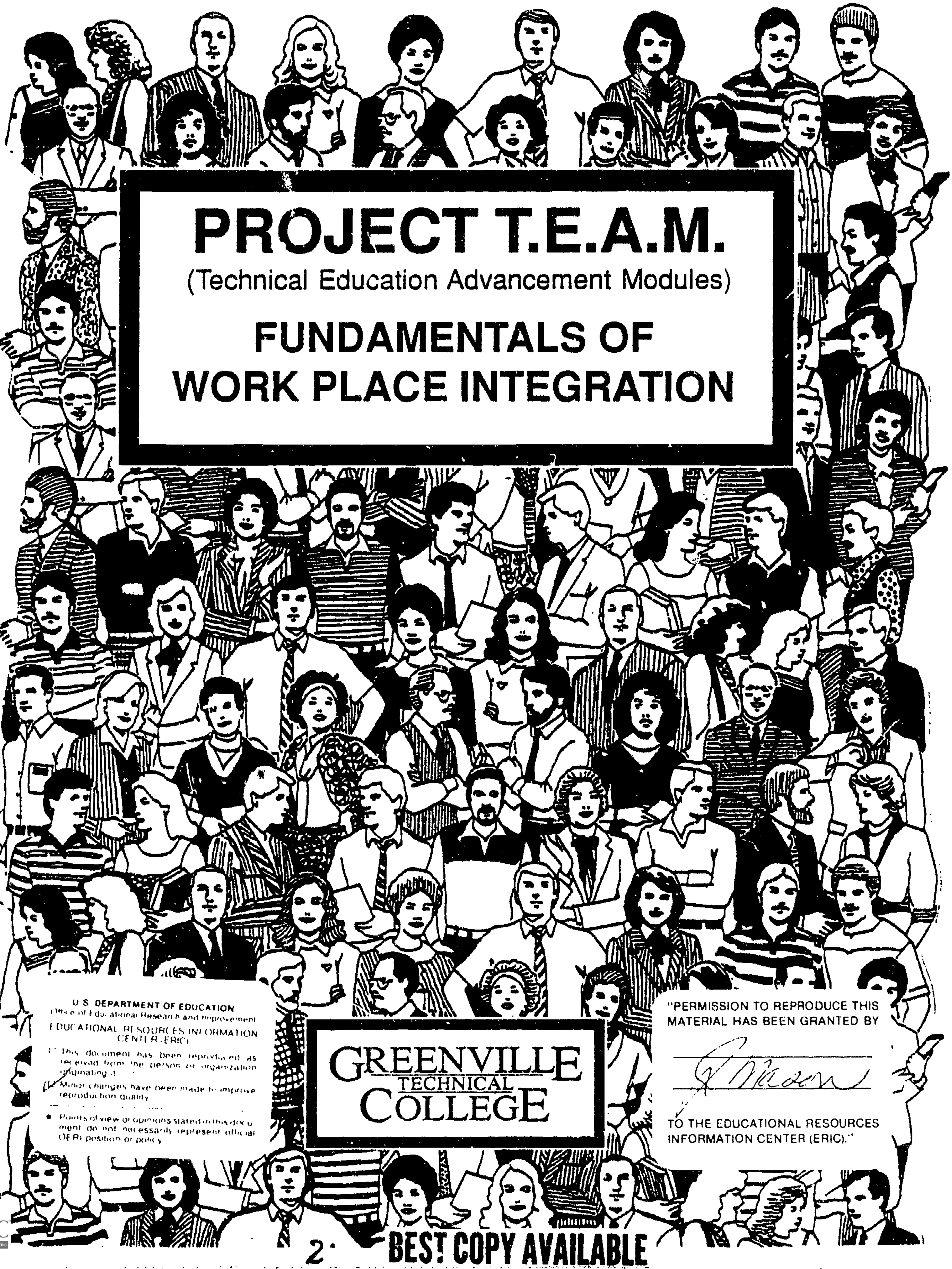
ABSTRACT

This module is one of a series of instructional guides developed by Project TEAM (Technical Education Advancement Modules), a cooperative demonstration program for high technology training for unemployed, underemployed, and existing industrial employees whose basic technical skills are in need of upgrading. The module is a 27-hour overview course on workplace integration intended to develop competencies in the following skill areas: identifying the basic elements that make up an integrated environment; understanding the hardware/software solutions currently in use; understanding the importance of the human resource in an integrated environment; and analyzing the role of integration in today's workplace. The six units cover the following topics: introduction to a changing world in manufacturing; the business enterprise in four areas--marketing, engineering and research, production management, and production; and strategy, planning, and implementation of integration. The manual serves as a student outline and as an instructor guide. It includes information sheets, role-playing exercises, fill-in forms, and other learning activities. (KC)



PROJECT T.E.A.M.

(Technical Education Advancement Modules)

FUNDAMENTALS OF WORK PLACE INTEGRATION

GREENVILLE TECHNICAL COLLEGE

PROJECT TEAM
TECHNICAL EDUCATION ADVANCEMENT MODULES

INSTRUCTIONAL MODULE:

FUNDAMENTALS OF WORK PLACE INTEGRATION

Developed by:

Vicki Kraeling

Funded by:

Cooperative Demonstration Program CFDA No. 84.199A
U.S. Department of Education
1989-1990
(Federal share $280,345 [75%]; College share $133,650 [25%])

Introduction:

The purpose of this manual is to serve as an instructional guide for the TEAM Grant module Fundamentals of Work Place Integration.

Fundamentals of Work Place Integration is a twenty-seven hour overview course intended to develop competencies in the following skill areas:

- Identifying the Basic Elements that make up an Integrated Environment
- Understanding the Hardware/Software Solutions Currently in Use
- Understanding the Importance of the Human Resource in an Integrated Environment
- Analyzing the Role of Integration in Today's Work Place

Overview of Project TEAM:

Project TEAM (Technical Education Advancement Modules) is a program targeted toward the unemployed, underemployed, and existing industrial employees who are in need of upgrading basic technical competencies. The program seeks to give adequate preparatory educational opportunities in generic technical skill areas and to create a public awareness of the need for these basic skills. Curriculum content was determined by an assessment team of local industrial employers. Their evaluation resulted in the development of 15 instructional modules; some of which may be industry specific, but most of which are applicable in and necessary to a majority of industrial settings. The modules may be used collectively or as a separate curriculum for a specific course or courses. The material contained in each manual will serve as a student outline and as an instructor guide which may be used selectively or in its entirety.

COURSE OUTLINE

I. INTRODUCTION TO A CHANGING WORLD IN MANUFACTURING

II. THE BUSINESS ENTERPRISE- MARKETING

III. THE BUSINESS ENTERPRISE-ENGINEERING AND RESEARCH

IV. THE BUSINESS ENTERPRISE-PRODUCTION MANAGEMENT

V. THE BUSINESS ENTERPRISE-PRODUCTION

VI. STRATEGY, PLANNING AND IMPLEMENTATION FOR INTEGRATION.

FUNDAMENTALS OF INTEGRATION IN THE WORKPLACE

MODULE I

INTRODUCTION TO A CHANGING WORLD IN MANUFACTURING

TIME REQUIRED: 6 HOURS

TEXT REFERENCE: INTEGRATED MANUFACTURING, ERIC GERELLE AND JOHN STARK, PP. 1-26.
A CIM MODEL, ROBERT M. THACKER, PP. 1-7/

OBJECTIVES: UPON COMPLETION OF THIS UNIT, THE STUDENT WILL BE ABLE TO:

IDENTIFY A MODERN MANUFACTURING ENVIRONMENT.

DESCRIBE THE DIFFERENCES BETWEEN A TRADITIONAL MANUFACTURING ENVIRONMENT AND AN INTEGRATED ENVIRONMENT.

EXPLAIN HOW CHANGE IS AFFECTING THE PRESENT MANUFACTURING ENVIRONMENT.

RELATE THE CONCEPT OF CHANGE TO PRACTICAL SITUATIONS IN THE WORKPLACE.

LEARNING ACTIVITIES: VIEW VIDEO PART II -CIM IMPERATIVE, A STUDY OF THE IBM PLANTS 20:20 MIN.

GROUP DISCUSSION TOPIC: HOW IS CHANGE AFFECTING YOU IN YOUR WORKPLACE?

READ CHAPTER I
INTEGRATED MANUFACTURING

MODULE I OUTLINE

INTRODUCTION TO A CHANGING WORLD IN MANUFACTURING

I. OUR CHANGING WORLD

A. CAUSES OF CHANGE

B. EFFECTS OF CHANGE

C. RESPONSES TO CHANGE

II. TRADITIONAL MANUFACTURING ENVIRONMENTS

A. PAST PRACTICES (1950-1960)

B. PRESENT MANAGEMENT PRACTICES

C. IMPLICATIONS FOR TODAY

III. THE INTEGRATED ENTERPRISE

A. ORGANIZATION CONCEPTS

B. LEADERSHIP

C. IMPLICATIONS

STUDENT NOTES:

TODAY'S MANUFACTURERS FACE MANY CHALLENGES. . . . .

INCREASED COMPETITION BOTH DOMESTIC AND INTERNATIONAL..........

SHORTER PRODUCT LIFE CYCLES........................

RISING LABOR AND RAW MATERIAL COST.......................

NEW TECHNOLOGIES ....

ORGANIZATIONAL CHANGES....................

and many other challenges in the

manufacturing sector.

In order to meet these challenges, companies must seek new ways to respond more quickly to the market place with quality products. Industry needs new ways to reduce product costs, to shorten lead time, and to reduce inventories. In the past, the traditional way to achieve this was AUTOMATION. Today many companies use automation on the plant floor through CAD/CAM, CNC and other computer aided tools. However, companies now realize that the total operation needs to communicate and share information. Integrating the workplace includes not only the functional areas of a company, but the areas that support these functions. Sharing information requires systems that enable the different elements of enterprise to work as if they "were in the same room".

CIM A Very Old Concept

Earliest Approach To Manufacturing:

- Wholly Integrated Approach
- Craftsman Performed all Task
- Tool Used to Accomplish Intergration was Craftsman's Mind

↓

Late 1700's – 1800's Technological Advances

- Led to Specialization
- Led to Demise of Integration
- Led To Quality Control
- Led to Production Control
- Remains the Norm in Manufacturing

↓

Mid 1980's Computer Integrated Manufacturing

- New Version of Total Integration
- Computer Allows Total Integration Rather than Craftsman's Mind

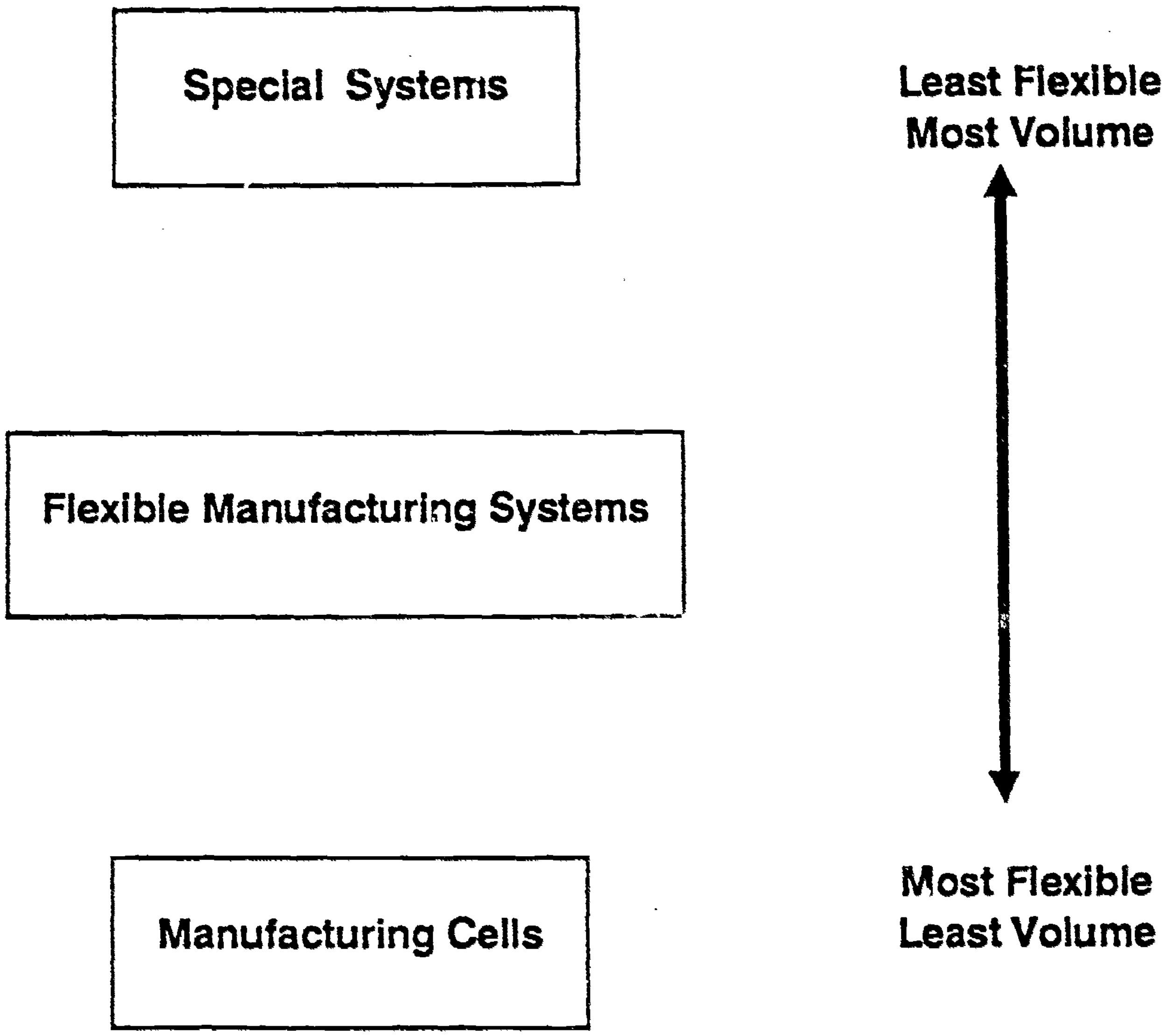
General definition of CIM is:

Any computerized manufacturing system in which numerically controlled machines are joined together and connected by some form of automated material handling system

- Human involvement with CIM system
    - Loading
    - Unloading
    - Changing tools
    - Setting tools
    - Continuous maintenance
    - Occasional repair

Types of CIM Systems

Types of CIM Systems



WHAT IS CIM?

"IT'S ·KE WE'RE ALL WORKING IN THE SAME ROOM"...........

Computer Integrated Manufacturing simply means manufacturing is based on a common database. In a computer integrated system, the database used for designing or machining is also used for planning the process and creating the bill of materials, materials requirement plannning (MRP), scheduling, and many other functions necessary to get the product out the door. The database is shared throughout the organization and is easily exchanged. All the functions are interdependent and their interaction is continuous. Any change or revision to one of the functions automatically affects every other element within the organization.

All areas have up- to- the- minute information on every aspect of the manufacturing process.

CIM

IDEAS

CONTROLS

ACTIONS

INTEGRATI..G

FUNCTIONS

THE KEY PROBLEMS IN MANUFACTURING TODAY.

SHORT TERM THINKING/NO FORWARD VISABILITY
(merger mentality)

ALWAYS BEHIND
(sales promises/behind schedule purchases and mfg. orders)

CRISIS MANAGEMENT
(Too little planning/reaction is a way of life)

TOO MANY BUFFERS
(just-in-case vrs. just-in-time)

BAD DATA
(No interaction between functions)

NO REWARDS FOR THE TEAM PLAYER
(climbing up and over someone mentality)

STUDENT NOTES:

THE SOLUTIONS

CIM = COMPUTER INTEGRATED MANUFACTURING

The integrated use of computers in all phases of the business enterprise.

JIT = JUST IN TIME

A philosophy of eliminating all waste (inventories) etc. in the manufacturing operation.

TQC = TOTAL QUALITY CONTROL

Continuous improvement from idea to action in the enterprise. Quality is inherent in the process-not inspected in at the final step.

MRP II MANUFACTURING RESOURCE PLANNING

The total MRP system (material requirements planning), includes strategic and financial planning.

STUDENT NOTES:

INTEGRATING THE WORKPLACE: MAJOR OBJECTIVES

- FLEXIBILITY--REDUCED LEAD TIME OR CYCLE TIME
- IMPROVED USE OF RESOURCES ....FROM DESIGN TO CUSTOMER

SUPPORTING INTEGRATION OBJECTIVES

- SHORTEN DESIGN CHANGE TIME
- SHORTEN PROCUREMENT/MANUFACTURING TIME
- LOWER PRODUCTION COSTS

  MACHINES

  PEOPLE

  OVERHEAD/SUPPORT
- IMPROVE ASSET PERFORMANCE

  PEOPLE

  INVENTORIES

  WORK IN PROCESS

  EQUIPMENT/PLANT
- TOTAL QUALITY IMPROVEMENT
- CUSTOMER SERVICE IMPROVEMENT/MARKETING RESEARCH
- LONG TERM COST/PROFIT EMPHASIS
- ORGANIZATIONAL CHANGES ENABLE CREATIVITY

WHY INVEST IN INTEGRATION?

RAW MATERIALS -----> FACTORY <----- FINISHED PRODUCT

ADDING VALUE

(MANUFACTURING)

COSTS OF ADDING VALUE

DIRECT

- STORAGE
- SCRAP LEVELS

INDIRECT

- HIGH INVENTORY
- SPACE UTILIZATION

TIME WAITING

- CONVENTIONAL JOB SHOP - 95%
  - TIME LOST TO VACATIONS ETC. - 33%
  - TIME LOST TO IMCOMPLETE USE OF SECOND AND THIRD SHIFTS - 44%
  - TIME IDLE - 2%
  - TIME LOST FOR SETUPS, LOADING GAGING - 12%
  - TIME LOST FOR CUTTING CONDITIONS - 2%

STRATEGIES FOR MANUFACTURING

1960 SAFETY STOCK

1970 MRP

1980 JIT

1990 CIM

2000 WORLD CLASS MANUFACTURING.......CIE........CIE...........

"IT'S LIKE WE'RE ALL WORKING IN THE SAME ROOM".

FUNDAMENTALS OF INTEGRATION IN THE WORKPLACE

MODULE II

THE BUSINESS ENTERPRISE-MARKETING

TIME REQUIRED: 6 HOURS

TEXT REFERENCE: INTEGRATED MANUFACTURING, ERIC GERELLE AND JOHN STARK, PP. 29-30, AND PP. 81-104.

OBJECTIVES: UPON COMPLETION OF THIS MODULE, THE STUDENT WILL BE ABLE TO:

EXPLAIN WHAT THE FUNCTIONS OF MARKETING ARE IN A BUSINESS ENTERPRISE.

DESCRIBE HOW INTEGRATION CAN LINK THE COMPANY'S MARKETING OBJECTIVES WITH THE OBJECTIVES CONCERNED WITH MAKING PRODUCTS.

LEARNING ACTIVITIES: READ THE TEAM MODULE MATERIAL

PARTICIPATE IN GROUP DISCUSSION

BEGIN THE UNIT PROJECT CHART

VIEW THE CIM DEMO/MARKETING FUNCTION.

MODULE II OUTLINE

THE BUSINESS ENTERPRISE - MARKETING

I. A BROAD DEFINITION OF MARKETING

II. MARKETING OBJECTIVE

- A. EXTERNAL CUSTOMER
- B. INTERNAL CUSTOMER

III. FUNCTIONS

- A. MARKET RESEARCH
- B. FORECASTING
- C. SALES
- D. CUSTOMER SERVICE
- E. PERFORMANCE TRACKING
- F. SALES ANALYSIS
- G. ADVERTISING AND PROMOTION
- H. SALES CHANNELS AND DISTRIBUTION

IV. DATA FLOW-MARKETING

A. INPUT FROM BUSINESS MANAGEMENT

B. INPUT FROM CUSTOMER

C. OUTPUT TO CUSTOMER

D. OUTPUT TO PRODUCT DEVELOPMENT

E. OUTPUT TO CUSTOMER SERVICE ORDERING

F. OUTPUT TO MASTER PRODUCTION PLANNING

V. CUSTOMER ORDER SERVICING

A. ENTERING, TRACKING AND SHIPPING SALES ORDERS

B. PRODUCT QUOTES

C. CREDIT CHECKING

D. PRICING

E. ALLOCATING ORDER QUANTITIES

F. DISTRIBUTION SHIPMENT GUIDELINES

VI. DATA FLOW CUSTOMER ORDER SERVICING

A. INPUT FROM ORDER AND FORECASTING

B. INPUT FROM CUSTOMER

C. INPUT FROM PRODUCTION PLANNING

D. OUTPUT TO ORDER ALLOCATIONS

E. OUTPUT TO CUSTOMER

F. OUTPUT TO SHIPPING

G. OUTPUT TO PRODUCTION ENGINEERING

VII. INFORMATION TECHNOLOGY IN MARKETING

A. TRADITIONAL APPLICATIONS

B. MEASURING COSTS AND BENEFITS

C. TECHNICAL APPROACH VRS. END-USER

MARKET RESEARCH

CORPORATE BUSINESS STRATEGY

MARKET
REQUIREMENTS

----MARKETING------

PRODUCT
REQUIREMENTS

DISTRIBUTION AND
SALES

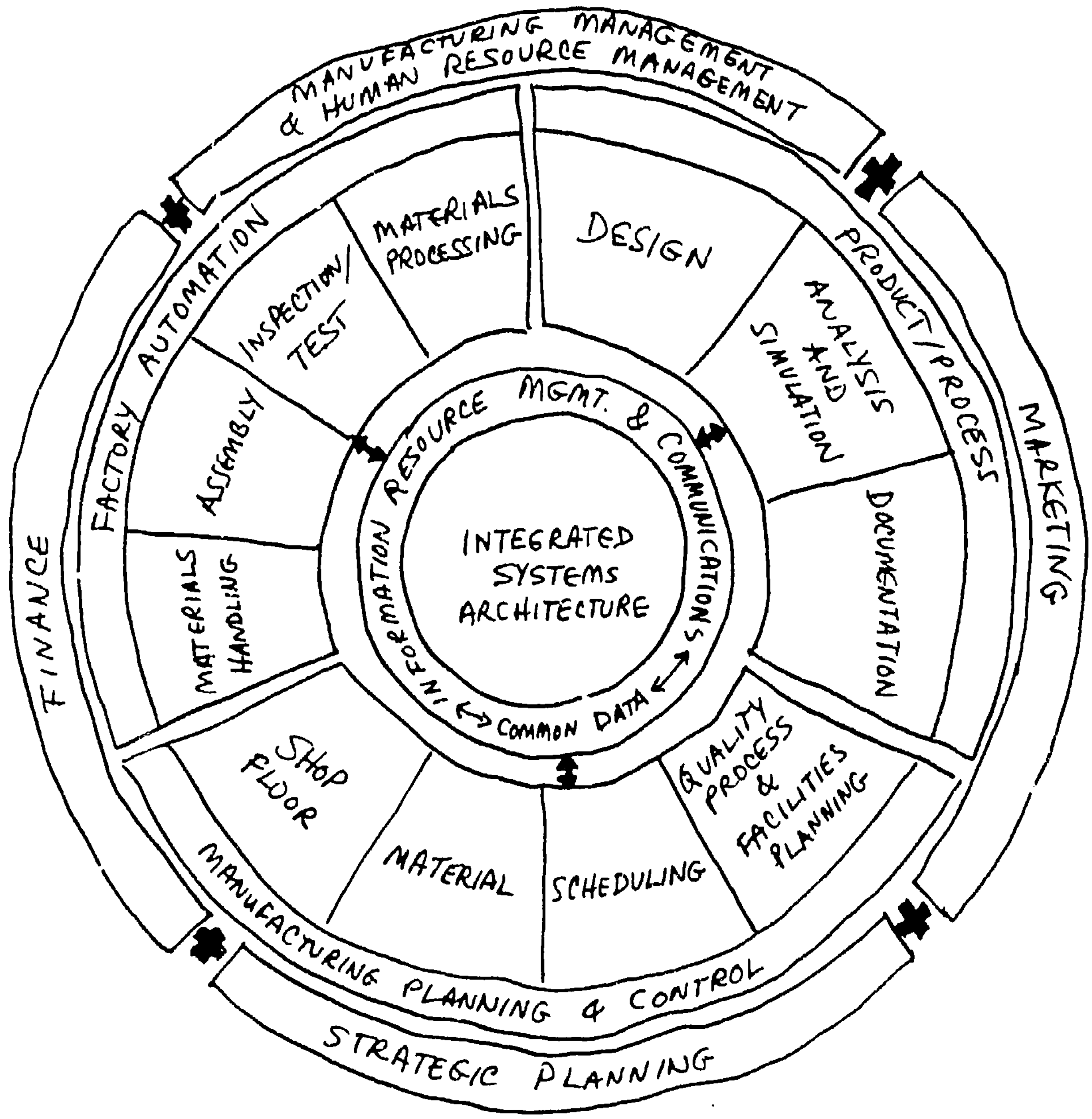
BUSINESS
PLANNING AND
CONTROL

STUDENT NOTES:

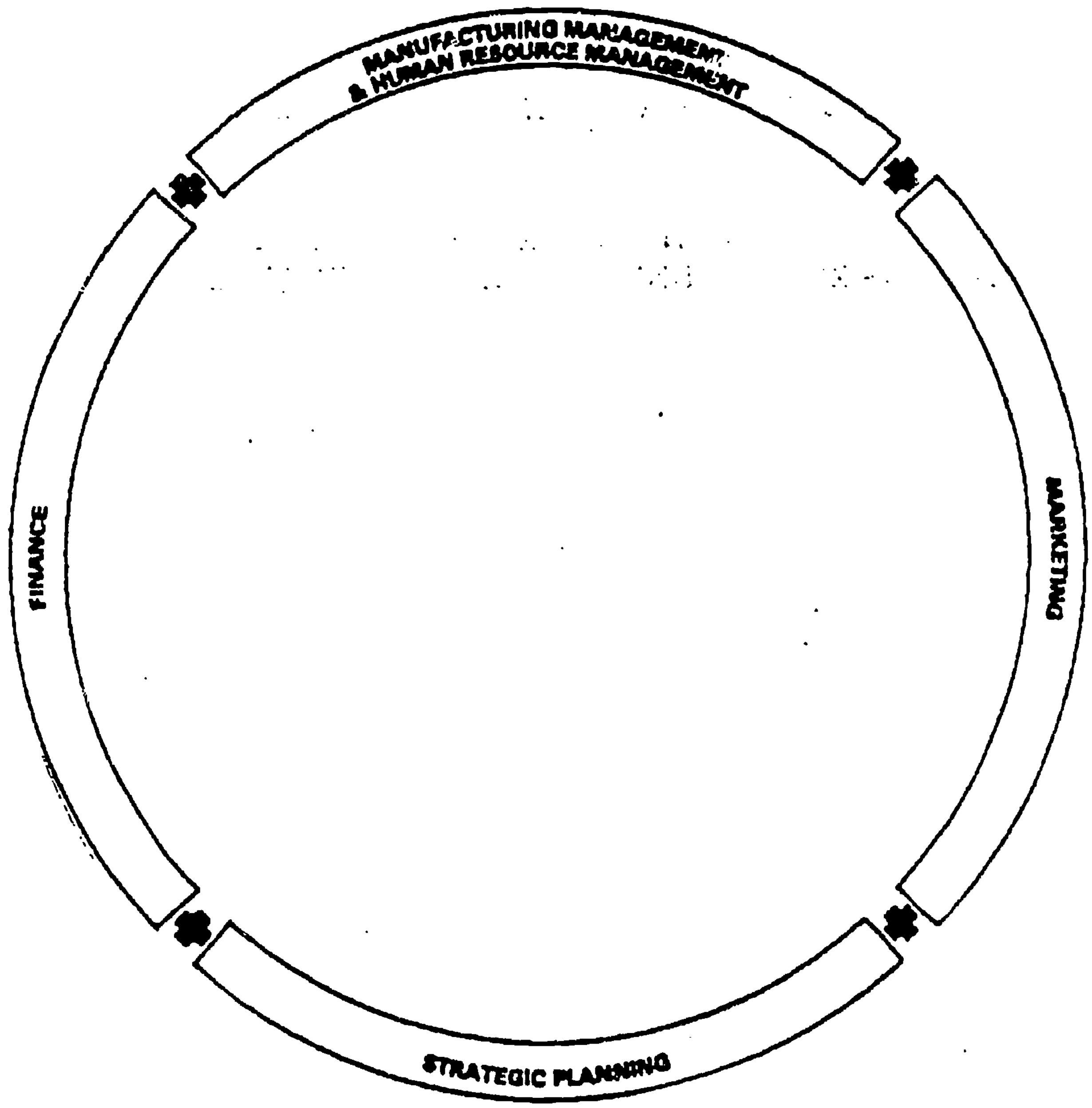
CIM ENTERPRIZE WHEEL

THIS MODEL OR WHEEL WAS DEVELOPED BY CASA/SME TECHNICAL COUNCIL AND IS MADE UP OF FIVE FUNDAMENTAL DIMENSIONS.

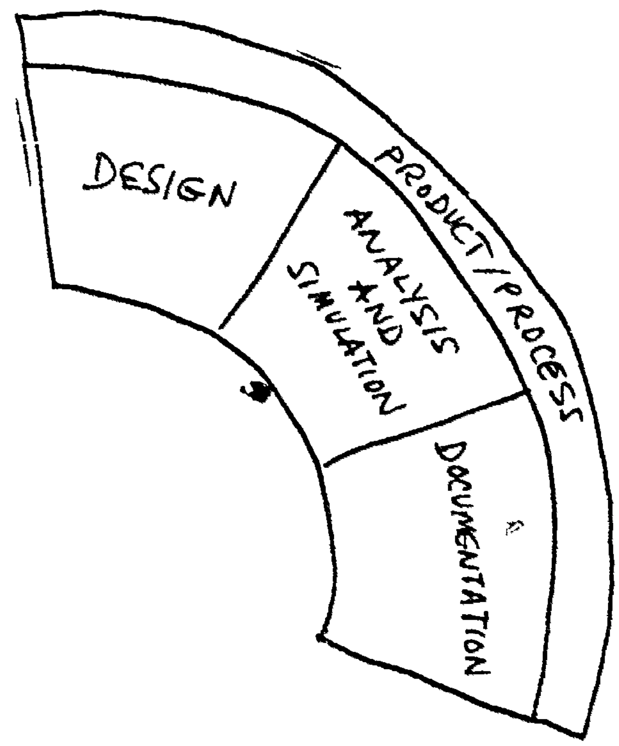
1. GENERAL BUSINESS MANAGEMENT
2. PRODOUCT AND PROCESS DEFINITION
3. MANUFACTURING PLANNING AND CONTROL
4. FACTORY AUTOMATION
5. INFORMATION RESOURCE

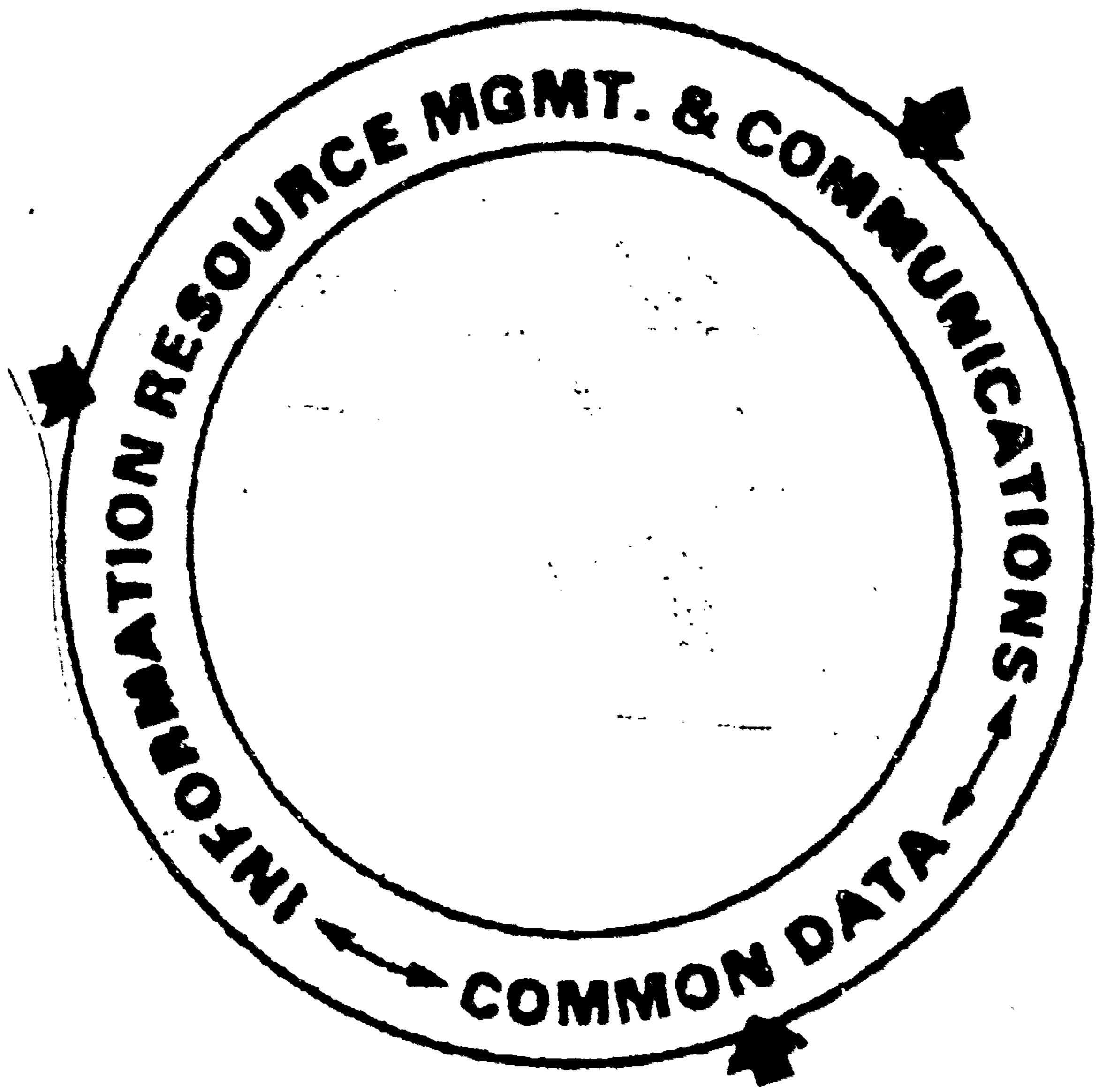


GENERAL BUSINESS SEGMENTS



PRODUCT AND PROCESS DEFINITION




INFORMATION RESOURCE MGMT. & COMMUNICATIONS
COMMON DATA

MARKETING

I.CREATE CUSTOMER

II.FUNCTIONS

-SALES
-CUSTOMER SERVICE
-ADVERTIZING
-FORECASTING
-RESEARCH & DEVELOPMENT
-PRICING & PACKAGING
-PUBLIC RELATIONS
-DISTRIBUTION

A. MARKETING FUNCTION

PUBLIC RELATIONS -
BUILD CORP. IMAGE, DEAL WITH MEDIA

RESEARCH & DEVELOPMENT -
SEEKS NEW PRODUCT IDEAS, DETERMINING CUSTOMER TASTE & NEEDS, PROTOTYPES CREATED FOR CUSTOMER TESTING.

DISTRIBUTION -
DETERMINES THE MOST EFFECTIVE CHANNEL A PRODUCT TAKES TO REACH A CUSTOMER - CONSIDER THE PRODUCT, COST, MARKET & CUSTOMER

BRAND MANAGEMENT -
DEVELOPS A NAME, DESIGN, AND SYMBOL WHICH IDENTIFIES A PARTICULAR PRODUCT TO A COMPANY & DIFFERENTIATES IT FROM THOSE OF COMPETITION.

FORECASTING -
ESTIMATES FUTURE DEMAND OF PRODUCTS BY ANTICIPATING MARKET TRENDS, CONSUMER SPENDING, INTEREST RATES, ETC.

ADVERTISING -
PROMOTES PRODUCTS THROUGH VARIOUS MEDIA & PROVIDES CUSTOMER INFORMATION

CUSTOMER ORDER SERVICING -
TRACKS CUSTOMER ORDERS, MONITORS CHANGES AND DISTRIBUTES INFORMATION TO APPROPRIATE DEPARTMENTS - HANDLES CUSTOMER QUESTIONS & COMPLAINTS

PACKAGING -
DESIGNS THE CONTAINER OR WRAPPING OF THE PRODUCT.

PRICING -
SETS PRICE FOR THE PRODUCT BY ESTIMATING PRODUCT COST, DETERMINING CUSTOMER DEMAND AND PERCEIVED VALUE AND ANALYZING COMPETITIVE PRICES.

SALES -
SHORT TERM ORIENTED - MARKETING IS LONG TERM STRATEGY

FORECASTING -
PROVIDES INPUT FOR
PLANNING PRODUCTION RESOURCES
-LABOR
-MATERIALS
-MACHINE

PREPARING OPERATING BUDGETS

III. CUSTOMER ORDER SERVICING FUNCTIONS

ORDER RECEIPT & ENTRY
ORDER CHANGES
ORDER SHIPPING & BILLING
DISTRIBUTION OF ORDER INFORMATION

A. ORDER ENTRY & RECEIPT

ORDERS RECEIVED BY
- DIRECTLY
  - CUSTOMER, MAIL, PHONE
- INDIRECTLY
  - SALES REPRESENTATIVE, DISTRIBUTOR, OTHER PLANTS

B. ORDER CHANGES

INVOLVE PRODUCT SPECIFICATIONS, QUANTITY & SHIPMENT DATA
WHO SHOULD BE CONTACTED:
- BILLING
- SHIPPING
- CUSTOMER-SALES REP
- INVENTORY
- PROD. CONT.
- ENGINEERING - IF DESIGN CHANGES

C. SHIPPING & BILLING

ONCE ORDERS RECEIVED, DOCUMENTED AND PROCESSED THE FINAL STEPS ARE:
- SHIP THE GOODS
- BILL THE CUSTOMER
- UPDATE INVENTORY
- INFORM SALES REP. THAT ORDER IS SHIPPED

D.DISTRIBUTION -

SHOWING CUSTOMER ORDER INFORMATION ENSURES THAT RIGHT ITEM IS SHIPPED AT RIGHT TIME - BILLED PROPERLY AND INVENTORY IS RESTOCKED AS REQUIRED

CUSTOMER -
TO ACKNOWLEDGE ORDER RECEIPT & SHIPMENT

ACCOUNTING -
BILL CUSTOMER, ETC., & SALES TAXES, COMMISSIONS, SHIPPING COST

MATL. MGMT. -
UPDATE INVENTORY & PURCHASE RECORDS

FINANCE -
SUMMARIZE SALES TO ESTIMATE CASH FLOW, FUTURE SALES STRATEGIES.

INVENTORY -
UPDATE INVENTORY NEED

PRODUCTION -
TO PLAN EFFECTIVE WORK SCHEDULES

SALES REP. -
MONITOR & UPDATE ORDER STATUS

SHIPPING -
DISTRIBUTION INFORMATION AND SPECIAL HANDLING INSTRUCTIONS

IV. RELATIONSHIPS TO MARKETING

ENGINEERING
- LONG DESIGN TIME
- FEW MODELS
- STANDARD COMPONENTS

MARKETING
- SHORT DESIGN TIME
- MANY MODELS
- CUSTOM COMPONENTS

FINANCE
- STRICT BUDGET
- PRICED TO COVER COST

MARKETING
- FLEXIBLE BUDGETS TO MEET CHANGING NEEDS
- PRICING TO INCREASE MARKET DEVELOPMENT

ACCOUNTING
- STANDARD TRANSACTION
- FEW REPORTS
- LOW CREDIT RISK
- TOUGH CREDIT TERMS

MARKETING
- SPECIAL TERMS & DISCOUNTS
- MANY INQUIRIES
- MEDIUM CREDIT RISK
- EASY CREDIT TERMS

MATERIALS MANAGEMENT
- NARROW PROD. LINE
- STANDARD PARTS
- LOW COST MATERIAL
- ECONOMICAL LOT SIZES
- PURCHASING AT IN FREQUENT INTERVALS

MARKETING

- BROAD PROD. LINE
- NON-STANDARD PARTS
- HIGH QUALITY OF MATERIALS
- LARGE LOT SIZES TO AVOID STOCK OUTAGES
- IMMEDIATE PURCHASING FOR BUYER NEEDS

PRODUCTION CONTROL

- LONG PRODUCTION LEAD TIME
- LONG RUNS WITH FEW MODELS
- NO MODEL CHANGE
- STANDARD ORDERS

MARKETING

- SHORT PRODUCTION LEAD TIME
- SHORT RUNS WITH MANY MODELS
- FREQUENT MODEL CHANGES
- CUSTOM ORDERS

FUNDAMENTALS OF INTEGRATION IN THE WORKPLACE

MODULE III

THE BUSINESS ENTERPRISE-ENGINEERING

TIME REQUIRED: 6 HOURS

TE :T REFERENCE: COMPUTER AUTOMATED MANUFACTURING, JOHN H. POWERS JR., PP. 112-162.

TEAM MANUAL

OBJECTIVES: UPON COMPLETION OF THIS MODULE, THE STUDENT WILL BE ABLE TO:

DEFINE ENGINEERING

DESCRIBE THE STEPS IN PRODUCT DESIGN AND RELEASE

DEFINE CAD, CAM AND CAE.

EXPLAIN THE ADVANTAGES OF COMPUTER APPLICATIONS FOR THE ENGINEERING FUNCTION WITHIN THE ORGANIZATION.

LEARNING ACTIVITIES: READ THE TEAM MODULE MATERIAL.

PARTICIPATE IN GROUP DISCUSSION

VIEW THE CIM DEMO/PART TO MACHINE

DISCUSS THE REVIEW QUESTIONS.

REVIEW QUESTIONS FOR DISCUSSION:

1. WHAT IS COMPUTER GRAPHICS AND HOW IS IT USED IN MANUFACTURING?

2. DISCUSS SOME OF THE MAJOR APPLICATIONS FOR CAD IN INDUSTRY.

3. HOW DOES THE ENGINEERING FUNCTION INTERACT WITH PURCHASING?

MODULE III OUTLINE

THE BUSINESS ENTERPRISE-ENGINEERING

I. DEFINITION OF ENGINEERING

II. FUNCTIONS OF ENGINEERING

A. RESEARCH

B. PRODUCT DEVELOPMENT

C. MANUFACTURING PROCESS DEVELOPMENT

D. FACILITIES ENGINEERING AND MANAGEMENT

E. ENGINEERING RELEASE

III. RESEARCH

A. INVESTIGATING AND DEVELOPING NEW MATERIALS, PRODUCTS AND PROCESSES.

B. INPUT FROM RESEARCH SOURCES

C. OUTPUT TO PRODUCT DEVELOPMENT

D. OUTPUT TO PROCESS DEVELOPMENT

E. OUTPUT TO FACILITIES ENGINEERING

IV. PRODUCT DEVELOPMENT

A. PRODUCT DESIGN

B. PRODUCT ANALYSIS

C. PRODUCT MODELING

E. PRODUCT SPECIFICATION AND PROCESSING REQUIREMENTS

(DRAWINGS, MATERIALS, PARTS LISTS AND BILL OF MATERIAL)

F. ENGINEERING CHANGES

G. DATA INPUT FROM MARKETING

H. DATA INPUT FROM RESEARCH

I. DATA INPUT FROM PLANT OPERATIONS

J. DATA OUTPUT TO PROCESS DEVELOPMENT

(SPECS, MANUFACTURING CONTROL REQUIREMENT, DRAWING, TEXTS AND MAIL)

V. PROCESS DEVELOPMENT

A. DEVELOPMENT OF METHODS AND TOOLS FOR MANUFACTURING

B. PROCESS CONTROL SPECIFICATIONS

C. ROUTINGS

D. QUALITY TESTS AND SPC CONTROLS

E. NC PROGRAMMING REQUIREMENTS

F. EXPERT SYSTEM DEVELOPMENT AS A TOOL

G. DATA INPUT FROM RESEARCH AND PRODUCT DEVELOPMENT

H. DATA INPUT (SPC) FROM PLANT OPERATIONS

I. DATA OUTPUT TO PLANT OPERATIONS (ROUTINGS, PROCESS CONTROL, MACHINE PROGRAMMING VIA ENGINEERING RELEASE)

VI. FACILITIES ENGINEERING

A. PLANT LAYOUT AND FACILITIES

B. AUTOMATION PLANNING

C. PLANT MAINTENANCE

D. MATERIALS HANDLING

E. DATA INPUT FROM RESEARCH

F. DATA INPUT FROM PROCESS DEVELOPMENT

G. DATA OUTPUT TO PLANT OPERATIONS

VII. ENGINEERING RELEASE CONTROL

A. COORDINATION OF RELEASE OF NEW PRODUCTS, PROCESSES, TOOLS AND ENGINEERING CHANGES TO MANUFACTURING.

B. DATA INPUT FROM PRODUCT AND PROCESS DEVELOPMENT

C. DATA OUTPUT TO PRODUCTION PLANNING

D. DATA OUTPUR TO PLANT OPERATIONS

VIII. ENGINEERING MANAGEMENT

VIV. COMPUTER AIDED DESIGN DEFINITION

X. COMPUTER AIDED MANUFACTURING DEFINITION

XI. COMPUTER AIDED ENGINEERING DEFINITION

XII. INFORMATION FLOW BETWEEN THE ENGINEERING FUNCTIONS

A. THE TRADITIONAL APPROACH

B. AN INTEGRATED APPROACH

ENGINEERING

PRODUCT DESIGN AND ANALYSIS

CORPORATE BUSINESS STRATEGY

PRODUCT REQUIREMENTS

---ENGINEERING----

PRODUCTION SPECIFICATIONS

DESIGN AND MANUFACTURING ENGINEERING

PROCESS PLANNING AND PARTS PROGRAMMING

STUDENT NOTES:

ENGINEERING

COMPUTER AIDED ENGINEERING

COMPUTER AIDED DESIGN

COMPUTER AIDED DRAFTING

WHAT IS ENGINEERING:

. WEBSTER'S

APPLICATION OF SCIENTIFIC AND MATHEMATICAL PRINCIPLES TO PRACTICAL ENDS SUCH AS THE DESIGN, CONSTRUCTION, AND OPERATION OF EFFICIENT AND ECONOMICAL STRUCTURES, EQUIPMENT, AND SYSTEMS.

. AN ENGINEER'S

TAKING AN IDEA AND MAKING IT A REALITY

. A MARKETING MAJOR

SOME OF MY BEST FRIEND'S ARE ENGINEERS. . ."

IN TODAY'S ENGINEERING SCHOOLS, MORE EMPHASIS IS BEING PLACED ON THE ABILITY TO COMMUNICATE. NO LONGER IS ENGINEERING REMOVED FROM THE REALITY OF THE SHOP FLOOR. INTEGRATION IS ENABLING THE ENGINEER TO DESIGN IN REALITY.

QUESTION: DO YOU AGREE THAT ENGINEERING IS CHANGING AND WHY?

PRODUCT DEVELOPMENT

PHASE I. RESEARCH

PHASE II. DESIGN ENGINEERING/PRODUCT DEVELOPMENT

PHASE III. MANUFACTURING PROCESS DEVELOPMENT

PHASE IV. FACILITIES ENGINEERING AND MANAGEMENT

PHASE V. RELEASE CONTROL

TERMS TO KNOW:

CONCURRENT ENGINEERING

CAD

CAM

CAE

2-D

3-D

SOLID MODELING

FINITE ELEMENT ANALYSIS

SIMULATIONS

KINEMATICS

TYPES OF COMPUTERS

SUPERCOMPUTERS

APLICATIONS FOR IRS, RESEARCH LABS, THE NATIONAL WEATHER BUREAU, LARGE AIRLINES GOVERNMENT DEFENSE, AND OTHER APPLICATIONS NEEDING EXCEPTIONAL MEMORY, SPEED, AND WORD SIZE.

MAINFRAME COMPUTERS

LARGEST COMPUTER MOST COMMONLY USED. THESE ARE OFTEN REFERRED TO AS THE "HOST" COMPUTER. THE LEADING VENDORS OF MAINFRAME COMPUTERS ARE IBM, DIGITAL, AND HEWLETT-PACKARD.

MINICOMPUTERS

NO CLEAR-CUT DEFINITION, BUT USED TO DESCRIBE A SCALED-DOWN VERSION OF A MAINFRAME COMPUTER. THESE ARE USUALLY A MACHINE THAT CONTAIN ALL THE PROCESSING AND STORAGE FUNCTIONS IN ONE PACKAGE. THEY CAN PROVIDE COMPUTER POWER TO INDIVIDUALS OR CONTROL OTHER MACHINES.

MICROCOMPUTERS

EVOLVED FROM THE DEVELOPMENT OF THE MICROPROCESSOR AND IS RESPONSIBLE FOR THE GROWTH IN PORTABLE, PERSONAL, COMPACT COMPUTERS AND CONTROLLERS USED TODAY.

BASIC ELEMENTS OF A DIGITAL COMPUTER

```
CENTRAL PROCESSING                        INPUTS AND
                      <--------->             OUTPUTS
     UNIT

-------------------

CONTROL   ARITHMETIC  <--------->             MEMORY
   UNIT   LOGIC UNIT
```

ELEMENTS OF A COMPUTER SYSTEM

```
STORAGE DEVICES       <--- MAIN COMPUTER ---->      OUTPUT DEVICES
E.G. TAPES, DISKS                                   E.G. PRINTERS.
```

SATELLITE COMPUTERS AND TERMINALS

DEFINITIONS:

HARDWARE-ELECTRONIC EQUIPMENT THAT CAN BE SEEN

SOFTWARE-COMPUTER "PROGRAMS" OR A SET OF CODED INSTRUCTIONS THAT TELLS THE COMPUTER TO DO A SPECIFIC TASK.

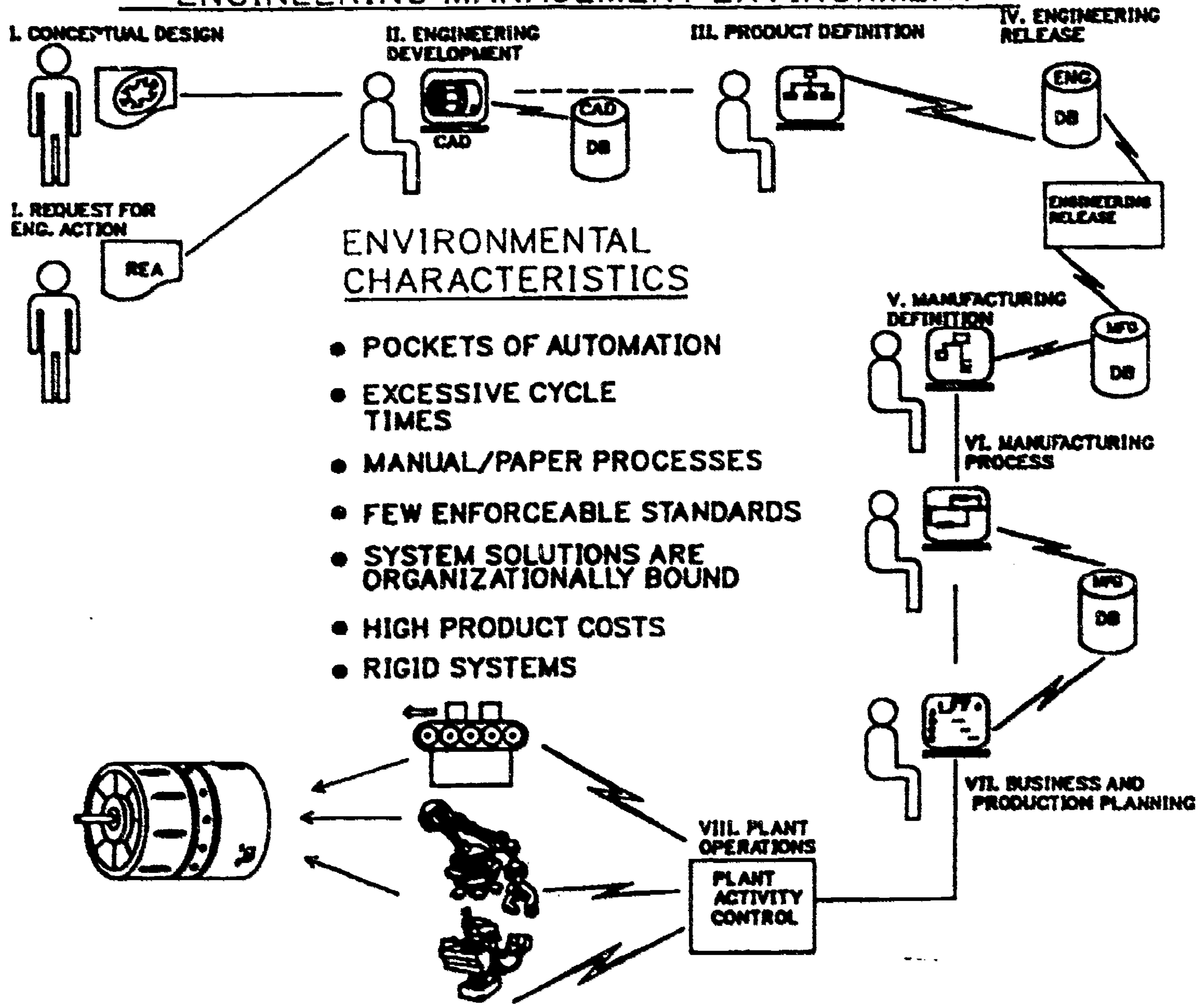
LANGUAGES-COMPUTER PROGRAMS ARE WRITTEN IN LANGAUGES THAT COMMUNICATE WITH THE COMPUTER LOGIC THROUGH THE USE OF A SYMBOLIC CODE. THE MOST ELEMENTARY CODE IS "ASSEMBLY" LANGUAGE OR "MACHINE" LANGUAGE. HIGH LEVEL LANGUAGES USE SIMPLER CODES SIMILAR TO NORMAL SPEECH TO COMMUNICATE COMPLEX INSTRUCTIONS.

COBOLT IS AN ASSEMBLY LANGUAGE.

"C" IS A HIGHER LEVEL LANGUAGE.

STUDENT NOTES:

ENGINEERING MANAGEMENT ENVIRONMENT



STEPS IN PRODUCT DEVELOPMENT AND RELEASE

1 -> 2 -> 3 -> 4 -> 5 -> PRODUCTION

1. RESEARCH
2. DESIGN ENGINEERING/PRODUCT DEVELOPING
3. MANUFACTURING PROCESS DEVELOPMENT
4. FACILITIES ENGINEEERING AND MANAGEMENT
5. RELEASE CONTROL

THESE ARE THE "FUNCTIONAL AREAS" OF ENGINEERING.

DEFINITION

CAD - COMPUTER ASSISTED DESIGN AND /OR DRAFTING. USUALLY ASSOCIATED WITH FUNCTIONS PREVIOUSLY DONE ON THE DRAWING BOARD. THE REAL ADVANTAGE OF CAD OVER THE DRAWING BOARD IS WHEN CHANGES ARE MADE IN THE DESIGN.

CAM - COMPUTER ASSISTED MANUFACTURING.
PROGRAMMING THE AUTOMATION EQUIPMENT ON THE PLANT FLOOR. TECHNOLOGY THAT ALLOWS DESIGN FILES TO BE DOWNLOADED DIRECT TO MACHINES.

CAE - COMPUTER ASSISTED ENGINEERING.
ENABLES THE ENGINEER TO CREATE PROTOTYPES AND DO COMPLEX ANALYSIS MORE EASILY.

2D - 2 DIMENSIONAL DRAWING IS THE TRADITIONAL WAY OF CREATING AN ENGINEERING DRAWING. IT SHOWS THREE SIDES OF AN OBJECT. THESE ARE THE TOP VIEW, FRONT VIEW, AND ONE SIDE VIEW.

3D - 3 DIMENSIONAL REPRESENTATION HAS DEPTH TO IT. IT CANNOT BE DONE ON A SHEET OF PAPER. A 3 D MODEL ON A CAD SYSTEM CAN BE ROTATED TO VIEW A T ANY ANGLE.

SOLID MODELING - A DESIGN TECHNIGUE WHICH ALLOWS VISUALIZATION OF A PRODUCT AS IT WILL LOOK AND ALLOWS FOR ANALYSIS OF THE PRODUCT BEFORE IT IS ACTUALLY BUILD. VOLUME CALCULATIONS AND INTEFRENCE CHECKING IS POSSIBLE, BUT THIS REQUIRES COMPUTER POWER MUCH MORE INTENSIVE THAT 2D. THIS IS WHY WORKSTATIONS ARE BEING DEVELOPED TO PROVIDE MORE COMPUTING POWER AT THE ENGINEER'S DESK.

FINITE ELEMENT MODELING - THE MATHEMATICAL MODEL OF AN OBJECT DIVIDED FOR STRUCTURAL ANALYSISI INTO A GROUP OF DISCRETE ELEMENTS.

FINITE ELEMENT ANALYSIS - THIS USES THE FINITE ELEMENT MODEL AND IS USED TO CHECK THE DESIGN PERFORMANCE. EG. MOLD FLOW. THIS IS VERY COMPUTER INTENSIVE.

COMPUTER SIMULATIONS - THESE ARE PROGRAMS WRITTEN BY ENGINEERS TO SIMULATE PRODUCT TESTING AND/OR FUNCTION. AN EXAMPLE WOULD BE A MOLD DESIGN AND HOW THE MATERIALS FLOW.

KINEMATICS - THIS REFERS TO THE ABILITY TO SIMULATE THE MOTION OF A MECHANICAL ASSEMBLY. THIS ALLOWS FOR PRODUCT DESIGN TO BE TESTED FOR CLEARANCES ETC.

MODULE IV OUTLINE

THE BUSINESS ENTERPRISE -
PRODUCTION MANAGEMENT

I. A BROAD DEFINITION OF PRODUCTION MANAGEMENT

II. PRODUCTION MANAGEMENT OBJECTIVE

III. FUNCTIONS

A. MASTER PRODUCTION PLANNING

B. MATERIAL PLANNING AND RESOURCE PLANNING

C. PROCUREMENT

D. PLAN RELEASE

IV. MASTER PRODUCTION PLANNING

A. DATA INPUT FROM CUSTOMER ORDER FORECAST

B. DATA INPUT FROM DISTRIBUTION CENTERS

C. DATA INPUT FROM OUTSIDE PLANTS

D. DATA OUTPUT TO MATERIAL PLANNING

E. DATA OUTPUT TO ASSEMBLY PLANT OPERATIONS

V. MATERIAL PLANNING AND RESOURCE PLANNING

A. DEFINITION OF MRP

B. INPUT FROM ENGINEERING

C. OUTPUT TO PLANT OPERATIONS

D. OUTPUT TO PROCUREMENT

VI. PROCUREMENT

A. DEFINITION OF PROCUREMENT

B. DEFINITION OF JUST IN TIME

C. DATA INPUT FROM MATERIAL PLANNING

D. DATA INPUT FROM PLANT OPERATIONS

E. DATA INPUT FROM DISTRIBUTION

F. DATA OUTPUT TO SUPPLIERS

G. EDI RELATIONSHIP WITH VENDORS

VII. PLAN RELEASE

A. DEFINITION OF PLAN RELEASE

B. TYPE OF MANUFACTURING

C. DATA INPUT FROM MATERIAL PLANNING

D. DATA OUTPUT TO PLANT OPERATIONS FOR SCHEDULING

STUDENT NOTES:

PRODUCTION

MATERIALS AND RESOURCE PLANNING

CUSTOMER ORDERS

PRODUCT REQUIREMENTS

---PRODUCTION MANAGEMENT---

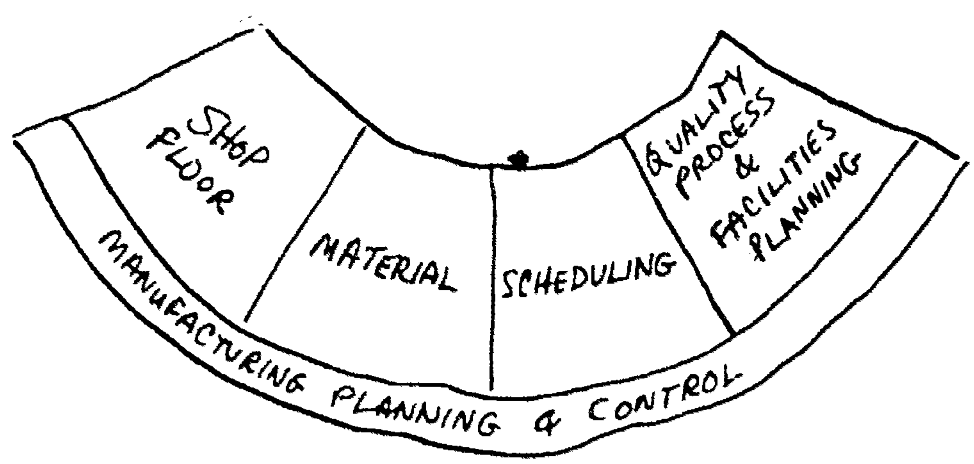
PRODUCTION SCHEDULE

PLANNERS AND DISPATCHERS

INVENTORY AND PRODUCTION CONTROL

STUDENT NOTES:

MANUFACTURING PLANNING AND CONTROL



JUST IN TIME

JUST IN TIME STRATEGY

1. MAKE TO ORDER OR PRODUCE TO EXACT DEMAND
2. ELIMINATE WASTE
3. PRODUCE ONE-AT-A TIME
4. MAKE TOTAL QUALITY IMPROVEMENT YOUR GOAL
5. VALUE PEOPLE AS YOUR MOST IMPORTANT ASSET
6. ALLOW FOR NO BUFFERS (ELIMINATE THE JUST-IN-CASE MENTALITY)
7. ALWAYS THINK LONG-TERM

JUST IN TIME PHILOSPHY

PROBLEMS ARE HIDDEN BY INVENTORY BUFFERS.

BUFFERS EG.

- POOR QUALITY (KEEP MORE INVENTORY TO COVER REJECTS)
- VENDOR UNRELIABILITY (SCHEDULE ORDERS EARLIER THAN NEEDED COVER VENDOR "MISTAKES".)
- LACK OF FORECAST (SAFETY STOCK BUFFER)
- SET UP COSTS (PRODUCE LARGE LOT SIZE BECAUSE OF HIGH SET UP COSTS)
- DELIVERY COSTS (BUY TRUCKLOAD LOTS TO SAVE COST)
- LONG LEAD TIMES AND HIGH WORK IN PROGRESS INVENTORY (LACK OF FLEXIBILITY AND NEED TO BE RESPONSIVE TO CUSTOMER)

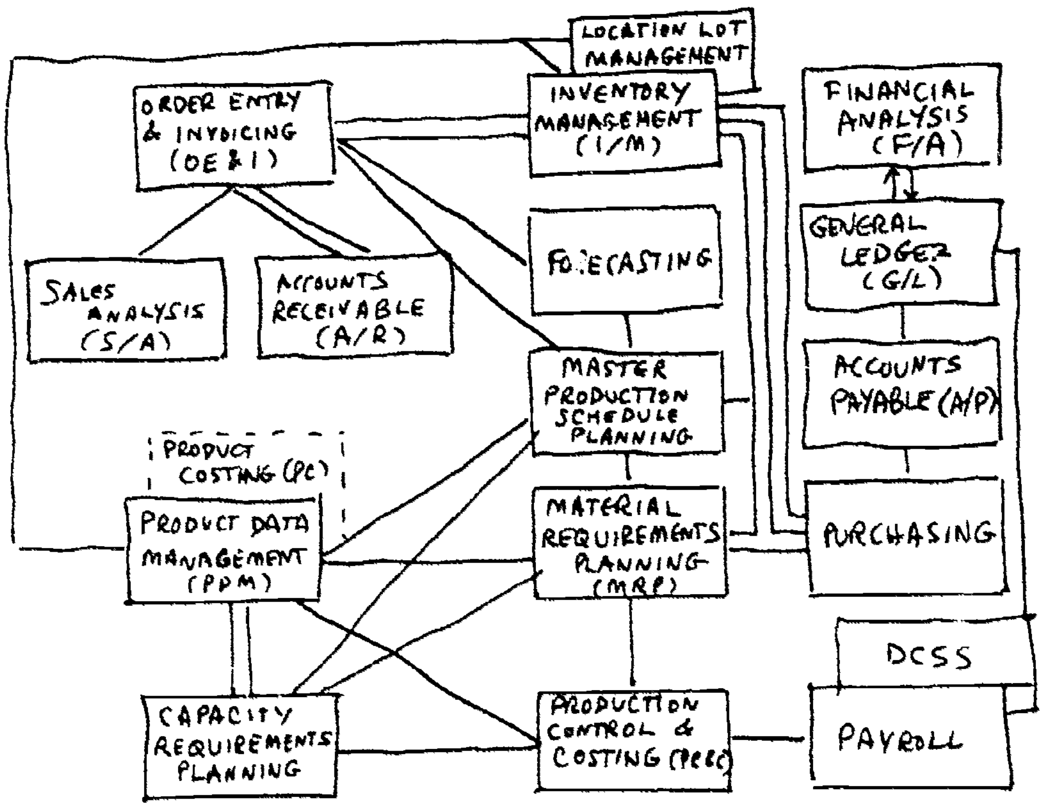
STUDENT NOTES:

REMEMBER..................................

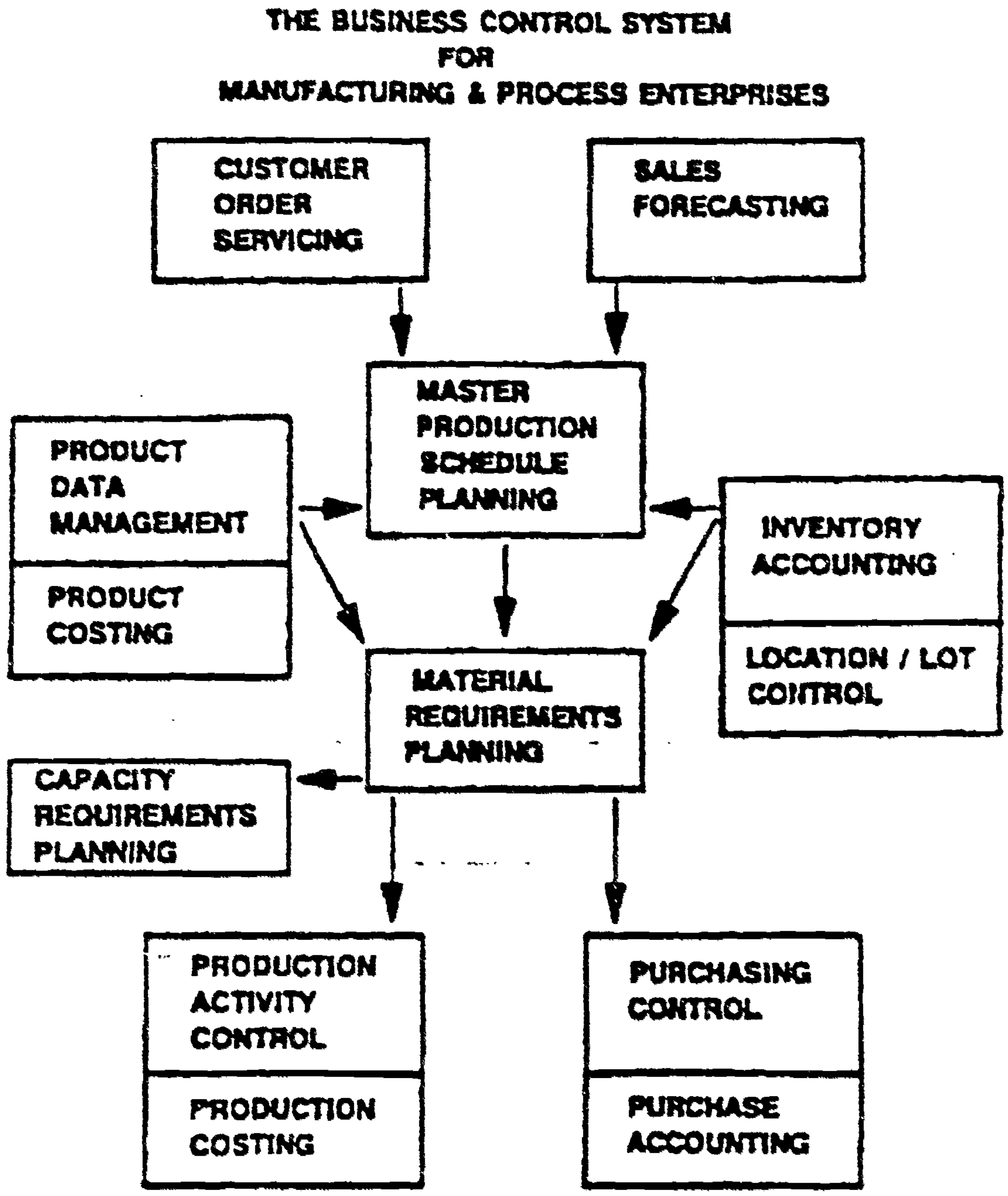
JIT, MRP, CIM, TQC ARE NOT COMPETITORS IN THE WORKPLACE,

BUT SHOULD BE IMPLEMENTED AS PART OF A FULLY INTEGRATED MANUFACTURING STRATEGY THAT COMBINES EACH PHILOSPHY IN A LOGICAL WAY.

MANUFACTURING BUSINESS CONTROL SYSTEMS



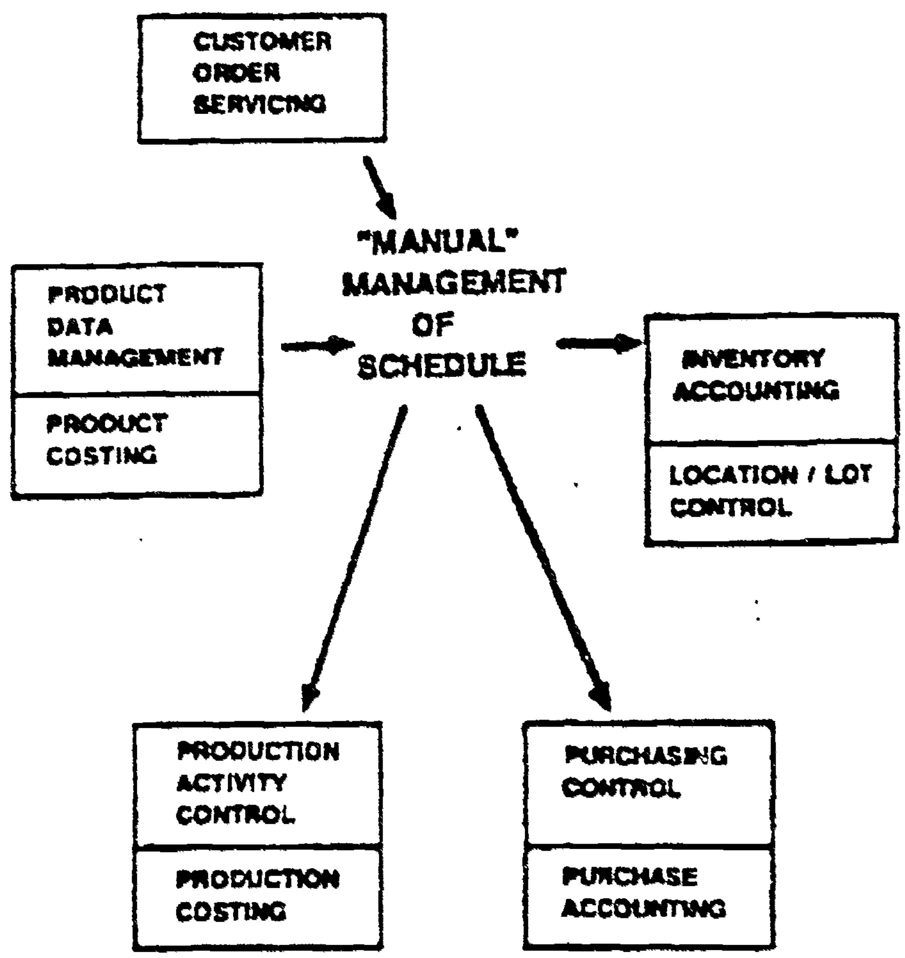
SIMPLIFIED BLOCK DIAGRAM



THE INTERIM/INITIAL CONTROL SYSTEM

1. INVENTORY MANAGEMENT, PRODUCT DATA MANAGEMENT

2. PURCHASING AND PRODUCTION CONTROL



ADVANTAGES:

- EARLIER PAYBACK AND CONTROL
- SUPPORTING SUB-SYSTEMS IN PLACE FOR EFFECTIVE MRP
- TIME TO ESTABLISH FORECASTS AND REALISTIC MASTER SCHEDULING

THE MAJOR ELEMENTS OF "ZERO INVENTORY"

HOUSEKEEPING - Physical organization and discipline

"MAKE IT RIGHT THE FIRST TIME" - Elimination of defects, quality processes

SET UP REDUCTION - Flexible changeover approaches

UNIFORM PLANT LOAD - Leveling as a control mechanism

BALANCED FLOW - Organizing flow scheduling throughout

SKILL DIVERSIFICATION - Multifunctional workers

CONTROL BY VISIBILITY - Communication media for activity

PREVENTIVE MAINTENANCE - Flawless running/no defects

FITNESS FOR USE - "Produceability" design through process

COMPACT PLANT LAYOUT - Streamlining and smoothing

SUPPLIER NETWORKS - Extension of the factory

FOCUSED WORKER INVOLVEMENT - Small group involvement activities (QC circles)

CELLULAR MANUFACTURING - Production methods for flow

PULL SYSTEM - Signal replenishment /resupply systems

PRODUCTION ACTIVITY CONTROL & COSTING

FUNCTIONS

Shop documentation
Process activity transactions
Priorities communicated to plant
Provide production status
Control WIP and lead times
Validation of bills and routings
Accumulate costs; variance reporting

INTERFACES TO

Inventory Management (order status)
Plant floor (foremen)
Product data (validation of standards)

INTERFACES FROM

Inventory Accounting & Order Release
Product data (bills, routings, w/centers)
Data collection equipment/system
Accounts Payable (costs)

BUSINESS IMPACT

Reduced WIP and lead times
Accurate/timely status for customer service
Improves basic data accuracy
Timely, accurate costing for margins/correction

IMPLEMENTATION ISSUES

Activity reporting: method and education
Error resolution
Management education: what to use and when

CAPACITY REQUIREMENTS PLANNING

FUNCTIONS

Simulate load of material plan
Help plan workcenter/resource level

INTERFACES TO

Production planning & control department

INTERFACES FROM

Production control status (open order)
Material Requirements Planning (planned orders)
Product data: routings

BUSINESS IMPACT

Less overtime/premium
Fewer bottlenecks, shorter lead times
Validation of materials plan and master schedule

IMPLEMENTATION ISSUES

None

NOTE:
CAPACITY PLANNING
- Probably lst application for assembler
- May be prior to purchasing for fabricator

MATERIAL REQUIREMENTS PLANNING

FUNCTIONS

Calculate net requirements for components
Plan and release of new orders
Suggest schedule changes to existing orders

INTERFACES TO

Purchasing
Production Control

INTERFACES FROM

MPSP - Finished goods plan
Inventory: Accurate availability (on-hand and order)
Purchasing & PC - Reasonable lead time estimates

BUSINESS IMPACT

Reduced component inventory
Improved delivery schedule (20-40%)
Increased direct employee productivity (5-15%)
Reduced expediting
Improved quality: Less rushed production

IMPLEMENTATION ISSUES

Train planners
Feedback on problems (Purchasing & Plant)

PURCHASING CONTROL & ACCOUNTING

FUNCTIONS

Provide requisition control
Assist in vendor selection/control
Print purchase order and revisions
Track receipt, dock-to-stock
Compare Invoice to "contract" and results
Analyze vendor performance
Accommodate Indirect purchases

INTERFACES TO

Accounts payable - (validate amount due)
IM - (New orders and receipts)

INTERFACES FROM

MRP - (Requisitions)
Departmental Indirect requisitions
PDM - (Dock-to-Stock routings)
IM - (Open order status)

BUSINESS IMPACT

Lower cost of purchased material
Fewer late, over/under shipments
Less clerical effort
Fewer errors in material acquisition cycle

IMPLEMENTATION ISSUES

Education
Which facilities (at start and "growing")
Purchase routings

SALES FORECASTING

FUNCTIONS

Project demand (future requirements)
Calculate safety stock(and order point)
Input to master scheduling

INTERFACES TO

Master Schedule
Inventory Management

INTERFACES FROM

Customer Order Servicing (demand)

BUSINESS IMPACT

Reduced Inventory (safety buffers)
Planning system Improved
Improved customer service

IMPLEMENTATION ISSUES

Management understanding and commitment
Marketing: forecast error measurement
Can appear complex

NOTE:
THE MOST DIFFICULT AREA
(with master scheduling)

MASTER PRODUCTION SCHEDULE PLANNING

FUNCTIONS

Business ("production") planning
Build plan ("master schedule")
Resource requirements
Finished goods: availability to promise

INTERFACES TO

Material requirements planning
Budgets and financial planning

INTERFACES FROM

Forecasting (demand)
Customer Order Servicing (backlog)
Inventory (availability)

BUSINESS IMPACT

Control of finished goods
Service level Increase
Objective for the entire business

IMPLEMENTATION ISSUES

Expediting = normal operation
Management understanding and commitment

NOTE:
THE MOST DIFFICULT AREA WITH FORECASTING INTERFACE

PRODUCT DATA MANAGEMENT

FUNCTIONS

Establish/maintain four base files
- Descriptive data
- Product structure or bill of material ("usage")
- Routings (sequence and standard times)
- Work center (rates, capacity, performance)

INTERFACES TO

Almost all systems

INTERFACES FROM

Plant and Engineering - Labor Standards/Estimates
Purchasing - Prices
Stockroom - Bill of Material Discrepancies
Accounting - Standard Rates

BUSINESS IMPACT

One set of data for all
Control of engineering changes
Reduced maintenance and filing costs
Increased accuracy

IMPLEMENTATION ISSUES

Bill/Material structuring and accuracy
Work center structuring
Routing accuracy

*NOTE:
Third most difficult

PRODUCT COSTING

FUNCTIONS

Estimate costs of product'on

INTERFACES TO

Customer Order Servicing - margin analysis
Production Costing: Standards
Purchasing: Variances

INTERFACES FROM

Same as Product Data Management

BUSINESS IMPACT

Pricing and bidding strategies
Basis for cost control

IMPLEMENTATION ISSUES

Data accuracy
Overhead definition

INVENTORY ACCOUNTING AND LOCATION/LOT CONTROL

FUNCTIONS

Process transactions
Maintain accurate availability statement:
- on hand
- on order (purchase and manufacturing)

Physical Inventory and cycle counting
Status and valuation reporting
Lot and location control/traceability

INTERFACES TO

Customer Order Servicing: availability
Master Production Schedule
Master Requirements Planning

INTERFACES FROM

Purchasing (New orders and changes)
Production control

BUSINESS IMPACT

Clerical productivity
Easier physical Inventory
Accuracy reduces shortages and "buffers"

IMPLEMENTATION ISSUES

Limited access to stockrooms
Attitude change: 95% accuracy is key
Ongoing measurements: cycle counts

NOTE:
SECOND MOST DIFFICULT AREA

CUSTOMER ORDER SERVICING

FUNCTIONS

Entry of orders, pricing, terms, etc.
Process shipment transactions
Maintain order status
Print invoice
Margin analysis

INTERFACES TO

Receivables (by due date)
Sales analysis (shipments)
Forecasting (shipments and other demand)
Inventory: picking lists and allocations
Master production schedule (backlog)

INTERFACES FROM

Inventory: shipments
Receivables: customer status/credit

BUSINESS IMPACT

Clerical productivity
Reduced order entry "lead time"
Improved control (less "lost" orders)

LOWER LEVEL MEASUREMENTS AND GOALS

SALES

- AVERAGE FORECAST ERROR

MANUFACTURING MANAGEMENT

- % OF MPS PRODUCED ON TIME
- PRODUCTIVITY BY DEPARTMENT

PURCHASING

- % OF PURCHASE ORDERS RELEASED AND RECEIVED ON TIME
- REDUCTION IN LEAD TIMES
- REDUCTION IN COST
- INCREASED QUALITY

PRODUCTION CONTROL

- % OF MANUFACTURING ORDERS ON TIME - RELEASED AND COMPLETED
- AMOUNT OF OVERTIME USED
- LABOR/MACHINE UTILIZATION
- REDUCTION IN LEAD TIME

MATERIALS MANAGEMENT

- INVENTORY ACCURACY & $ LEVEL BY PLANNER
- # OF SHORT ITEMS/WEEK

COST ACCOUNTING

- TIMELINESS OF STANDARDS/CURRENT COSTS, CHANGES
- ACCURACY OF COSTS

ENGINEERING

- ACCURACY OF BILLS & ROUTINGS
- ENGINEERING CHANGES CO-ORDINATED PROPERLY
- RESPONSE TO CUSTOMER ESTIMATE REQUESTS

SHOP FOREMEN

- ACTIVITY REPORTING ERROR DATE
- PRIORITY SEQUENCE ACHIEVEMENT
- STANDARD VS ACTUAL HOURS

STOCK ROOM

- INVENTORY ACCURACY (BY ITEM CLASS)
- TRANSACTION ERROR RATE
- RECEIVING "LEAD TIME"

NOTE:
What are the costs for not measuring and controlling these?

WHAT MUST BE ACHIEVED FOR THE SYSTEM TO WORK

BILLS OF MATERIAL: PROPERLY STRUCTURED
- To reflect "as used in production"

COMPONENT USAGE: MUST BE 99+% ACCURATE
- Must have all components to ship product

INVENTORY ON-HAND BALANCE: MUST BE 95+% ACCURATE
- MRP is "staging" on paper and it must be trusted to be used

ON-ORDER BALANCES: ACCURATE QUANTITY AND ARRIVAL DATE
- MRP "stages" over a period of time and schedules arrival of replenishment just before stockout (just in time).

COMMUNICATION SYSTEM MUST BE IN PLACE TO ENSURE THAT THE PLAN'S PRIORITIES ARE BEING IMPLEMENTED ON THE SHOP FLOOR AND IN PURCHASING

THE MASTER PRODUCTION SCHEDULE MUST BE A REASONABLE STATEMENT OF WHAT IS EXPECTED TO BE PRODUCED

THE MOST IMPORTANT ISSUES AFFECTING THE DEGREE OF SUCCESS

CHIEF OPERATING OFFICER COMMITMENT

EDUCATION - IMPLEMENTORS AND USERS

PROJECT TEAM APPROACH

STRONG, CAPABLE PROJECT LEADER

CONDITIONING PERSONNEL TO ACCEPT CHANGE

BUSINESS CASE - TIME-PHASED BENEFITS AND COSTS

DOCUMENTED IMPLEMENTATION PLAN - WHICH IS MAINTAINED

PROGRESS REVIEWS BY TOP MANAGEMENT

80% OF THE IMPLEMENTATION PROBLEMS OCCUR IN THESE AREAS AND ARE MANAGEMENT ISSUES

Evolution of MRP

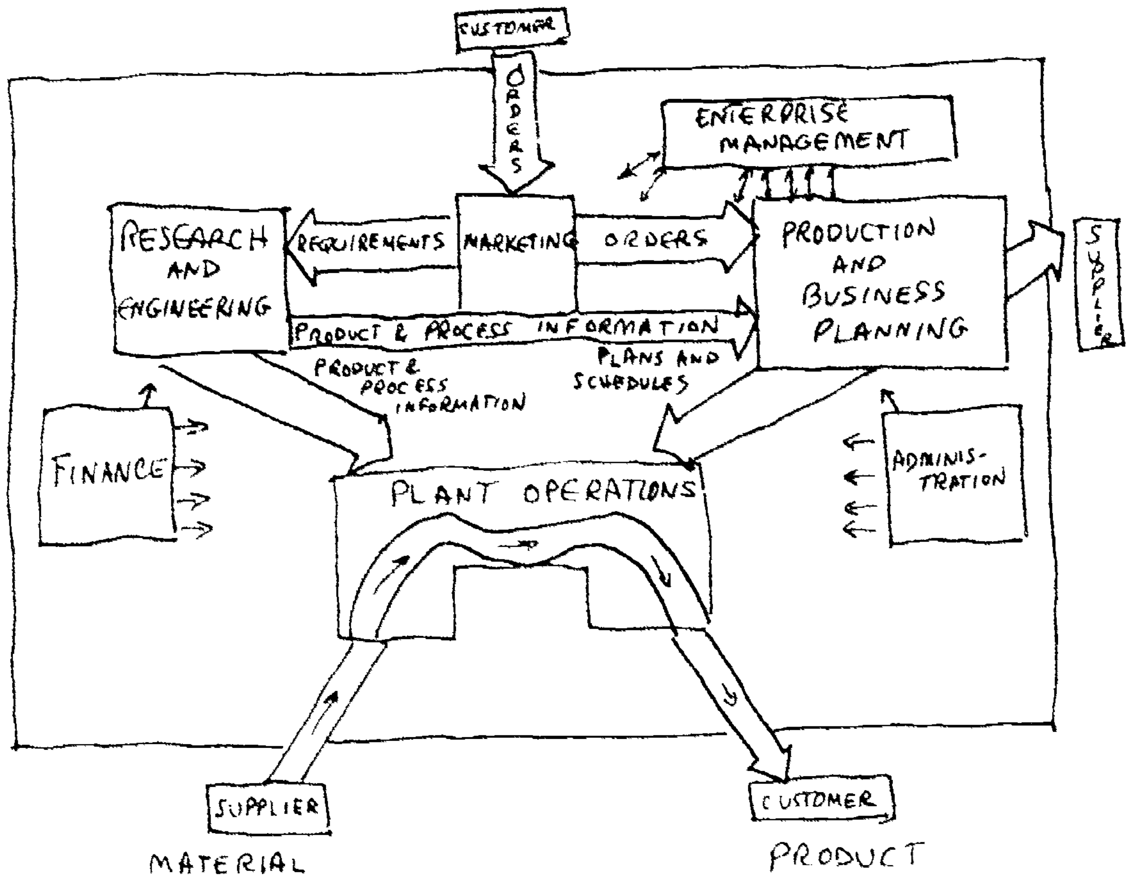
- Production planning and control systems evolved from a fundamental problem in manufacturing

    - Managing what's needed and when.

- In the past we ran our manufacturing operations by using the "informal system" of shortages lists and hot tags.

- Today we have tools to help with all aspects of the company, from production scheduling inventory, distribution, and finance, and it includes support for marketing and engineering while improving product quality and customer service.

SYSTEMS VIEW OF THE MANUFACTURING ENTERPRISE



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MRP BASED SYSTEMS

NET POSITION - IMPACT

DIRECT WORKER PRODUCTIVITY: UP 5 TO 15%

ON-TIME DELIVERY TO CUSTOMER UP 90% OR MORE

INVENTORIES REDUCED:
- Finished Goods: 5 - 10%
- Components: 20 - 40%
- Work-In-Process: 30 - 40%

EXPEDITING COSTS GREATLY REDUCED

REALISTIC MARGINS: MORE EFFECTIVE MARKETING

NO INCREASE IN PERSONNEL

Manufacturing Resource Planning (MRPII)

- The elements of MRPII include all the aspects of closed-loop MRP plus financial planning, simulation, and team-work.

- Financial planning

    - Inventory valuations and projections

    - Work in progress (WIP)

    - Cash flow projections

    - Cash receipts

    - Make or buy decisions

- Executing capacity plans

    - Input/output control is used to compare the actual hours completed against the plan.

- Finite loading Vs. infinite loading

    - CRP (Capacity Requirements Planning) often mistakenly referred to as infinite loading.

    - Infinite loading ignores capacity and loads all orders in the time period in which they are required

    - Infinite loading the computer makes decisions to prevent the capacity loads from exceeding the work center capacity.

    - CRP shows the problems to people and lets people solve them.

- Teamwork
  - Teamwork improves dramatically because the whole company operates from a single set of numbers.
  - U.S., one man, one vote
  - Japan, the educational system develops a culture in which everyone work together.
  - With MRPII, everyone has realistic goals that they're able to achieve.
  - Improved quality of work life—less finger pointing.

- Simulation
  - With MRP II we can do detailed simulations and see exactly what the impact on the business will be.
    - Capacity plans
    - Material plans
    - Cash flows
    - Inventory

EXAMPLE

- Inventory 1,000 Units
- Need to increase inventory to 2000 units

Inventory	1,000 Units
To increase inventory to 2000	1,000 Units
Sales forecast	5,000 Units
Production Plan for month	6,000 Units

Make-to- Stock Business

- Plan is determined by:
  - Looking at the current inventory.
  - Deciding if we want to increase or decrease what we have on the shelf.
  - And adding that to, or subtracting it from, the sales forecast.

- The production plan is top management's handle on the business.
- A set of numbers which drives the rest of the business.
- Becomes the input to the next level in the process, the master production schedule.

Master production schedule (MPS)

- Takes the production plan and breaks it down into more detail.
- The next stop in taking the plans made by top management and translating them into what can be accomplished in the factory.
- The anticipated build schedule.
- When there are many different final configurations such as different model 30 pumps available (30-01, 30-02, etc.) master scheduling is done at the next level (Bill of materials)
- The master schedule must be accurate, it can not be a wish list because the materials and capacity plans are driven by it.

- Executing material plans
  - Once a plan exists, there has to be a way to communicate it and monitor the planned Vs. actual completion of it.
    - Shop floor—daily dispatch list
    - Bar coding—to track the movement of shop orders through the factory
    - Micro—tab
    - Vendor schedules—purchased part delivery report
  - Monitoring of planned Vs. actual deliveries.

Capacity requirements planning. (CRP)

- Answers the question "What does it take to make it"?
- "What" is the capacity of the work centers and the people in the shop.
- Information from the material requirements planning can be used to plan capacity. (ie. items, due dates, and quantities of material)
- The system will highlight any potential problem areas and give people visibility into future capacity problems.

Production Planning

- The production plan reflects production rates for product families.
- Set by the general manager and his staff.
- Answers the question "How many"
- Make to Order Business
    - Plan is established by looking at the current backlog of orders and comparing it to the desired backlog. The forecast of what we expect to sell is then added to determine the overall production rate.

EXAMPLE:

- Model 30 Pumps
- Backlog 500 Units
- Decrease in backlog to 250 units in order to provide better customer service.

	250 Units
Marketing Forecast	<u>500 Units</u>
Production Plan Per Month	750 Units

- **The master production schedule answers the question what are we going to make.**
- **The bill of materials tell us what it takes to make it.**
- **The inventory records tell us what we already have on hand.**

- In a plant change is constant and volume is high.
- With MRP we can see months in advance by projecting our needs for every single item and reprojecting them as things change.

- Closed-Loop MRP
  - A set of functions that are needed to represent a valid simulation of reality in a manufacturing company.
  - A way to measure how well we are doing against the plan.

Priority Planning

- Priority planning is where material requirements planning (MRP) comes in.
    - What are we going to make?
    - What does it take to make it?
    - What do we have to get?

- Kan ban system
  - A variation of the two-bin system
  - Two types of cards, requisition card and a production card.
  - Suffers from all the problems of an order point system.

- Two-bin system
    - Two locations where material is stored. The primary is used first, when the second is started, it is time to re order.
- Visual review
    - A person looks at the inventory on hand and determines what to order by noting what is low.

Order Point and Variations

- Order point was the first method used to answer "when to order."
    - Average use
    - Projected lead time
    - Safety factor
- This system looked backwards.

FUNDAMENTALS OF INTEGRATION IN THE WORKPLACE

MODULE V

THE BUSINESS ENTERPRISE-
PRODUCTION

TIME REQUIRED:	6 HOURS
TEXT REFERENCE:	INTEGRATED MANUFACTURING, ERIC GERELLE AND JOHN STARK, PP. 90. TEAM MANUAL
OBJECTIVES:	UPON COMPLETION OF THIS MODULE THE STUDENT WILL BE ABLE TO: EXPLAIN THE FUNCTIONS OF PRODUCTION. DESCRIBE HOW INTEGRATION CAN LINK PRODUCTION WITH THE BUSINESS FUNCTION. DEFINE CAM, CNC, NC, AND FMS/CIM EXPLAIN WHY CIM IS MUST INCLUDE THE WHOLE ENTERPRISE.
LEARNING ACTIVITIES:	VIEW THE SHOP FLOOR CIM DEMO READ THE TEAM MODULE PARTICIPATE IN GROUP DISCUSSION TOPIC: USING ROBOTS TODAY AND WHY?

MODULE V OUTLINE

THE BUSINESS ENTERPRISE -
PRODUCTION

I. A BROAD DEFINITION OF PRODUCTION

II. PRODUCTION OBJECTIVES

III. FUNCTIONS

A. PRODUCTION MANAGEMENT

B. MATERIALS RECEIVING

C. STORAGE

D. PRODUCTION PROCESS

E. INSPECTION/QUALITY TEST

F. MATERIAL TRANSFER

G. PRODUCT SHIPPING

H. PLANT MAINTENANCE

I. PLANT SITE SERVICES

VI. PRODUCTION MANAGEMENT

A. DEFINITION

B. DATA INPUT FROM PRODUCTION PLANNING

C. DATA FLOW TO PLANT OPERATIONS

VII. MATERIAL RECEIVING

A. DEFINTITION

B. DATA INPUT FROM OUTSIDE VENDORS

C. DATA OUTPUT TO ACCOUNTING

D. DATA OUTPUT TO PROCUREMENT

E. DATA OUTPUT TO PRODUCTION MANAGEMENT

VIII. STORAGE

A. DEFINITION

B. DATA INPUT FROM PRODUCTION MANAGEMENT

C. DATA OUTPUT TO PRODUCTION MANAGEMENT AND ACCOUNTING

VIV. PRODUCTION PROCESS

A. DEFINITION

B. DATA INPUT FROM PRODUCTION MANAGEMENT

C. DATA INPUT FROM NC PRODUCTION MANAGEMENT

D. DATA OUTPUT TO PRODUCTION MANAGEMENT

E. DATA OUTPUT TO PROCESS MANAGEMENT

X. QUALITY TEST AND INSPECTION

A. DEFINITION

B. DATA OUTPUT FROM ENGINEERING

C. DATA OUTPUT TO PROCUREMENT

D. DATA OUTPUT TO PRODUCTION PROCESS

E. DATA OUTPUT TO PRODUCTION MANAGEMENT

XI. MATERIAL TRANSFER

A. DEFINITION

B. DATA INPUT FROM SYSTEM OR MANUAL

C. DATA OUTPUT TO PRODUCTION MANAGEMENT

XII. PRODUCT SHIPPING

A. DEFINITION

B. DATA INPUT FROM CUSTOMER ORDER SHIPPING

C. DATA OUTPUT TO MARKETING

XIII. PLANT MAINTENANCE

A. DEFINITION

B. DATA INPUT FROM PLANT OPERATIONS-SHOP FLOOR

C. DATA INPUT FROM SOFTWARE/PREVENTATIVE MAINT.

D. DATA INPUT FROM INSPECTION

E. DATA OUTPUT TO PROCUREMENT

F. DATA OUTPUT TO PRODUCTION MANAGEMENT

G. DATA OUTPUT TO FACILITIES ENGINEERINC

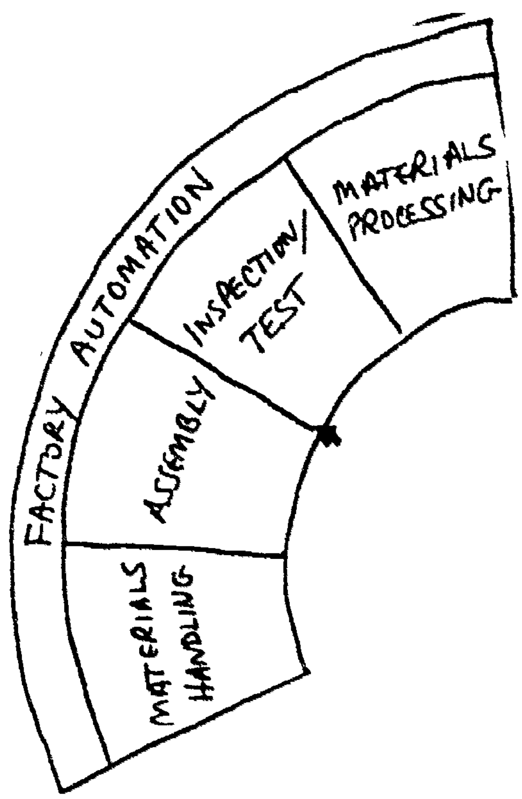
H. DATA OUTPUT TO MARKETING (COST ACCOUNTING)

XIV. PLANT SITE SERVICES

A. DEFINITION

B. DATA INPUT FROM PLANT OPERATIONS

FACTORY AUTOMATION



PRODUCTION

FABRICATION AND ASSEMBLY

PRODUCTION SCHEDULE

PRODUCT SPECIFICATION

---PRODUCTION---

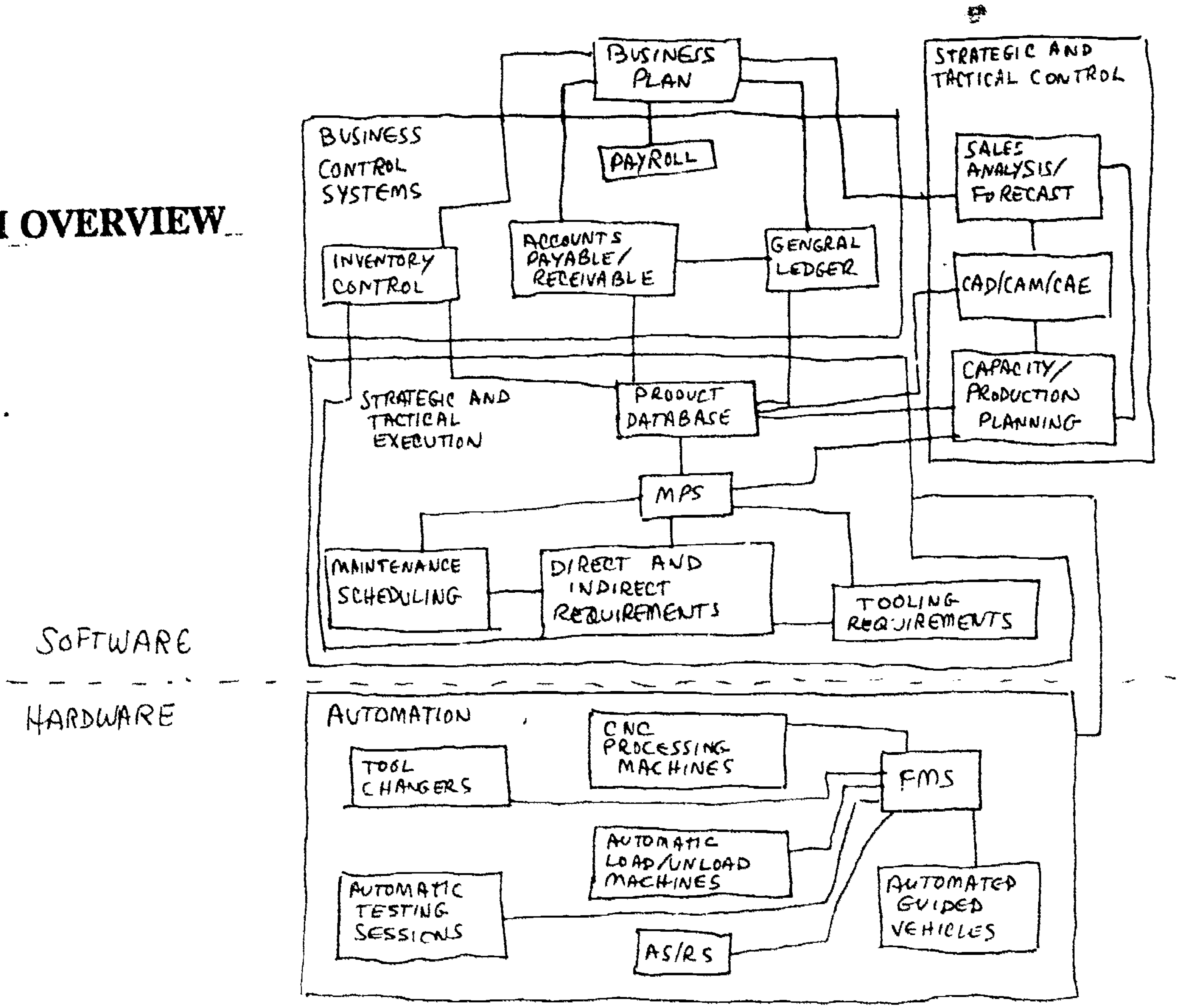
FINISHED PRODUCTS

MATERIALS AND PRODUCTION FACILITY

STORAGE AND TRANSPORTATION

STUDENT NOTES:

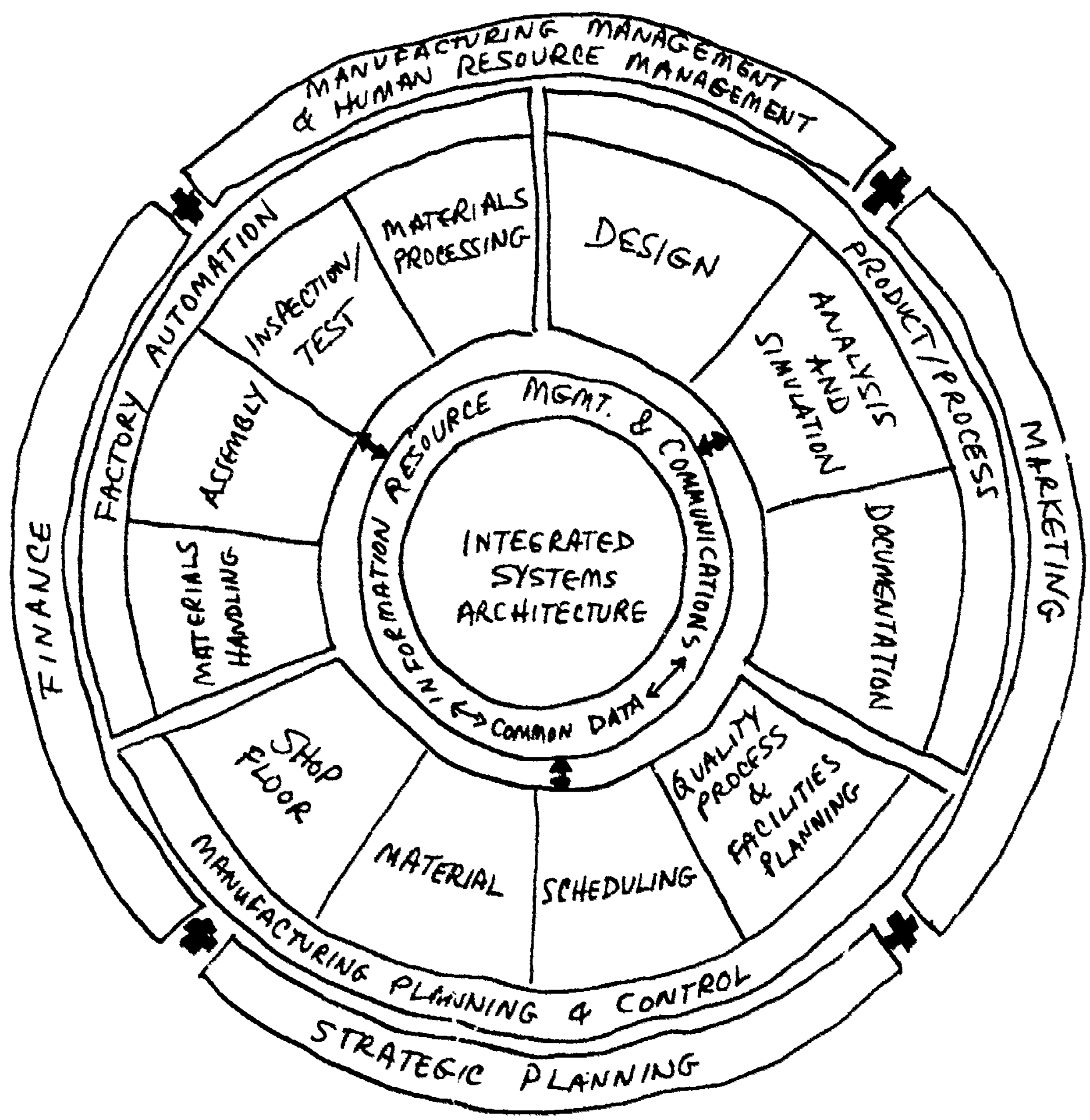
CIM OVERVIEW



CIM ENTERPRIZE WHEEL

THIS MODEL OR WHEEL WAS DEVELOPED BY CASA/SME TECHNICAL COUNCIL AND IS MADE UP OF FIVE FUNDAMENTAL DIMENSIONS.

1. GENERAL BUSINESS MANAGEMENT
2. PRODOUCT AND PROCESS DEFINITION
3. MANUFACTURING PLANNING AND CONTROL
4. FACTORY AUTOMATION
5. INFORMATION RESOURCE



Definitions

- Computer Integrated Manufacturing (CIM) is the most modern, most automated form of production.
- It involves tying different phases of production together into one wholly INTEGRATED system
- <u>F</u>lexible <u>M</u>anufacturing <u>S</u>ystem (FMS) is one type of CIM system designed for:
    - Medium range production volumes
    - Moderate flexibility

Typical Performance Benefits Experienced with Modern Flexible Manufacturing Systems

Nonquantified benefits

Improved quality

- Higher accuracy and reproducibility
- Lower rework costs, scrap rates, and quality assurance costs

Closer adherence to production schedules

- No order chasing

Improved working conditions

- Decreased accident risk and physical labor
- Increased challenge

Increased flexibility

- Increased independence of batch size, types of parts, and production quantities

The FMS, as a microcosm of the future computer integrated factory demonstrates:

- Reduced capital investment in FMS workstations (due to the much smaller number required because of greatly increased utilization when compared to stand-alone, unintegrated workstations.)

- The drastic reduction of work-in-process inventory and stock waiting to be assembled. (Virtually to zero because of the capability of these flexible systems to produce just whatever mix of parts is required for immediate assembly.)

Typical Performance Benefits Experienced with Modern Flexible Manufacturing Systems

Quantified benefits	Percent
Reduction in:	
Lead time for product	40
Lead time for parts	53-75
Required number of machine tools	53-81
Required personnel	53-92
Labor costs per part	90
Required machining hours	65
Required floor space	42
Tooling Costs	30
Total annual costs	24
Capital investment cost	10
Inventory of work in progress	90

Robot applications

- Arc welding
- MIG welding
- TIG welding
- Palletizing
- Stacking and unstacking
- Assembly
- Loading and unloading of manufacturing machines
- Grinding
- Deburring
- Painting
- Gluing
- Parts handling
- Movement of dangerous or toxic materials
- Loading and unloading
- Drilling
- Milling
- Cutting

Robot terms and phrases

Accuracy	Accuracy is a measure of how close a robot arm is able to come to the coordinates specified. There is always some difference between the actual and the desired point. The degree of difference is the accuracy of the robot.
Actuator	Any device in a robot system which converts electrical hydraulic, or pneumatic energy into mechanical energy or motion.
Continuous Path	A servo-driven robot that provides absolute control along an entire path of arm motion, but with certain restrictions with regard to the degree of difficulty in changing the program.
Controlled Path	A servo-driven robot with a control system with specifies the location and orientation of all robot axes. A control-path robot moves in a straight line between programmed points.
Degrees of Freedom	The number of degrees of freedom of a robot is the number of movable axes on the robot's arm. A robot with four movable joints has four degrees of freedom.
End Effector	An end-of-arm tool which is attached to the robot's manipulator and actually performs the robot's work.
Fixture	A special device used to hold a workpiece in the proper position as it is being tooled.

Flexible Automation	An all-encompassing term which describes the flexibility, adaptability, and reprogrammable nature of modern industrial robots.
Limited Sequence	A simple, non-servo type of robot, sometimes called a "bang-bang" robot. Movement of a limited sequence robot is controlled by a series of stop switches.
Manipulator	Another name for the arm of the robot. It encompasses basic axes which control wrist movements for robots. The three basic axes are referred to as pitch, yaw, and roll.
Payload	The maximum weight a robot is able to carry at normal speeds.
Pitch	Up-and-down motion along an axis.
Point to Point	A robot with a control system for programming a series of points without regard to coordination axes.
Repeatability	The degree to which a robot is able to return the tool center point repeatedly to the same position.
Roll	Circular motion along an axis.
Servo-Mechanism	An automatic feedback control system for mechanical motion.

Speed	The rate, in inches per second or millimeters per second, that the robot is able to move the tool center point.
Teach Pendant	A special control box which an operator uses to guide a robot through the motions required to perform a specific task.
Tool Center Point	A given point at the tool level around which the robot is programmed for performing specific tasks.
Work Envelope	The operating range, or reach capability, of a robot.
Yaw	Side-to-side motion along an axis.

FUNDAMENTALS OF INTEGRATION IN THE WORKPLACE

MODULE VI

STRATEGY, PLANNING AND IMPLEMENTATION FOR INTEGRATION

TIME REQUIRED: 6 HOURS

TEXT REFERENCE: A JUMPSTART TO WORLD CLASS PERFORMANCE, DAVE GARWOOD AND MICHAEL BANE.

INTEGRATED MANUFACTURING, ERIC GERELLE AND JOHN STARK, PP. 105-213.

TEAM MANUAL

OBJECTIVES: UPON COMPLETION OF THE MODULE, THE STUDENT WILL BE ABLE TO:

DEMONSTRATE AN AWARENESS OF HOW AN INTEGRATION STRATEGY SHOULD EVOLVE AND WHAT ARE THE ROLES OF THE PEOPLE RESPONSIBLE FOR THE PLANNING AND IMPLEMENTATION.

UNDERSTAND THE CONCEPT OF INTEGRATION.

LIST THE FUNCTIONS WITHIN AN ORGANIZATION AND EXPLAIN HOW INTEGRATION BENEFITS THE ORGANIZATION.

EXPLAIN WHY THE HUMAN FACTOR IS CRITICAL TO THE INTEGRATION PLAN.

DESCRIBE HOW A COMPANY JUSTIFIES THE COST OF INTRODUCING NEW TECHNOLOGY.

LEARNING ACTIVITIES: VIEW VIDEO PART I -CIM, A DIFFERENT PERSPECTIVE.

COMPLETE PROJECT CHART

PARTICIPATE IN GROUP DISCUSSION

VIEW SIMULATION DEMO

MODULE VI OUTLINE

STRATEGY, PLANNING AND IMPLEMENTATION OF INTEGRATION

I. COMPUTER INTEGRATION

A. DEFINITION

B. REASONS TO IMPLEMENT

C. PLANNING FOR IMPLEMENTATION

D. GOAL OF INTEGRATION

II. HISTORY OF INTEGRATION

A. 1950-1960 TRADITIONAL METHODS

B. 1970 MATERIALS RESOURCE PLANNING

C. 1980 JUST IN TIME--JAPANESE MANAGEMENT

D. 1990 COMPUTER INTEGRATED MANUFACTURING

E. 2000 INTEGRATED BUSINESS

III. OVERVIEW OF AN INTEGRATED SYSTEM

A. BUSINESS CONTROL SYSTEMS

B. ENGINEERING CONTROL SYSTEMS

C. PRODUCTION CONTROL SYSTEMS

D. HARDWARE REQUIREMENTS

E. SOFTWARE REQUIREMENTS

F. HUMAN RESOURCE REQUIREMENTS

IV. COST JUSTIFICATION

A. ADDED VALUE

B. COSTS OF ADDING VALUE

C. COSTS OF TIME WAITING

D. ADVANTAGES OF INTEGRATION

E. DISADVANTAGES OF INTEGRATION

F. COST ACCOUNTING SHORT TERM VRS. LONG TERM

G. DIFFICULTIES IN QUANTIFYING INTEGRATION

V. IMPLEMENTING INTEGRATION

A. MANAGEMENT SUPPORT

B. HUMAN ASPECT

C. HUMAN RESOURCES

D. CHANGES IN PRODUCTION

E. CHANGES IN ENGINEERING

F. CHANGES IN MARKETING

G. CHANGES IN MIS

VI. CONCLUSION

A. NON-CLOSURE

B. TRAINING CONCERNS

INTEGRATION PROVIDES US WITH AN EXCELLENT OPPORTUNITY TO LOOK AT THE PEOPLE PARTS OF AN ORGANIZATION,

. . .AND IN DOING SO, WE CAN LOOK AT CREATING AN ORGANIZATIONAL FRAMEWORK THAT CAN VALUE THE

INDIVIDUAL.

QUESTION: DO YOU AGREE WITH THIS STATEMENT. HOW DOES THIS FIT WITH THE CONCEPT OF TEAM BUILDING?

EXCERPTS FROM AN EDITORIAL:

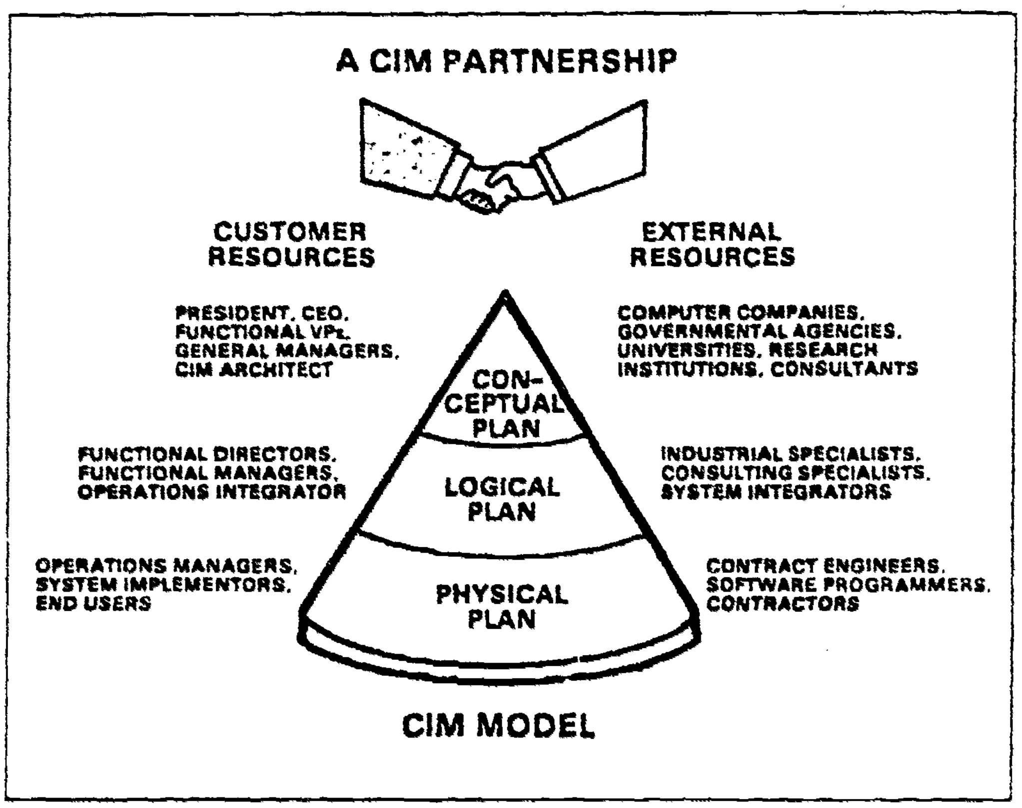
JOEL ORR., "CIP BEFORE CIM", THE BULLETIN OF THE CADD/CAM INSTITUTE, APRIL 1987.

"TECHNOLOGY FOR DOING MOST OF WHAT YOU WANT CAN BE BOUGHT 'OFF THE SHELF'TODAY."

"BUT PEOPLE ARE HOLDING UP THE PROGRESS, BECAUSE THEY DON'T SEE THEMSELVES IN THE BEAUTIFUL VISION OF CIM. SO THEY RESIST CHANGES IN LITTLE WAYS, LEADING THE COMPANY IN DIRECTIONS IN WHICH IT DIDN'T EXPECT TO GO. PEOPLE ARE AFRAID OF CHANGE. THEY HAVE DIFFICULTY SEEING WHAT THEIR NEW ROLES ARE TO BE IN THE NEW ORDER OF THINGS, AND THEY MUST BE CONVINCED THAT THEY WILL BE NO WORSE OFF, BEFORE THEY WILL TAKE AN ACTIVE ROLE IN MAKING CHANGE HAPPEN."

QUESTION? WHAT ARE SOME WAYS THAT A COMPANY CAN SPREAD THE MESSAGE OF INTEGRATION WITHIN AN ORGANIZATION?

NOTES:


A CIM PARTNERSHIP
CUSTOMER RESOURCES
EXTERNAL RESOURCES
PRESIDENT, CEO, FUNCTIONAL VPs, GENERAL MANAGERS, CIM ARCHITECT
COMPUTER COMPANIES, GOVERNMENTAL AGENCIES, UNIVERSITIES, RESEARCH INSTITUTIONS, CONSULTANTS
CON-CEPTUAL PLAN
FUNCTIONAL DIRECTORS, FUNCTIONAL MANAGERS, OPERATIONS INTEGRATOR
LOGICAL PLAN
INDUSTRIAL SPECIALISTS, CONSULTING SPECIALISTS, SYSTEM INTEGRATORS
OPERATIONS MANAGERS, SYSTEM IMPLEMENTORS, END USERS
PHYSICAL PLAN
CONTRACT ENGINEERS, SOFTWARE PROGRAMMERS, CONTRACTORS
CIM MODEL

COMPUTER INTEGRATED MANUFACTURING CIM

COMPUTER INTEGRATED MANAGEMENT CIM

COMPUTER INTEGRATED ENTERPRISE CIE

COMPUTER INTEGRATED BUSINESS CIB

...........ARE NAMES USED FOR THE PHILOSPHY OF INTEGRATING "THE WORKPLACE".

THE GOAL IS TO REDUCE MANUFACTURING INEFFICIENCIES.

STRATEGIES FOR MANUFACTURING

1960	SAFETY STOCK
1970	MRP
1980	JIT
1990	CIM
2000	WORLD CLASS MANUFACTURING.......CIE........CIE...........

"IT'S LIKE WE'RE ALL WORKING IN THE SAME ROOM".

CIM ENTERPRIZE WHEEL

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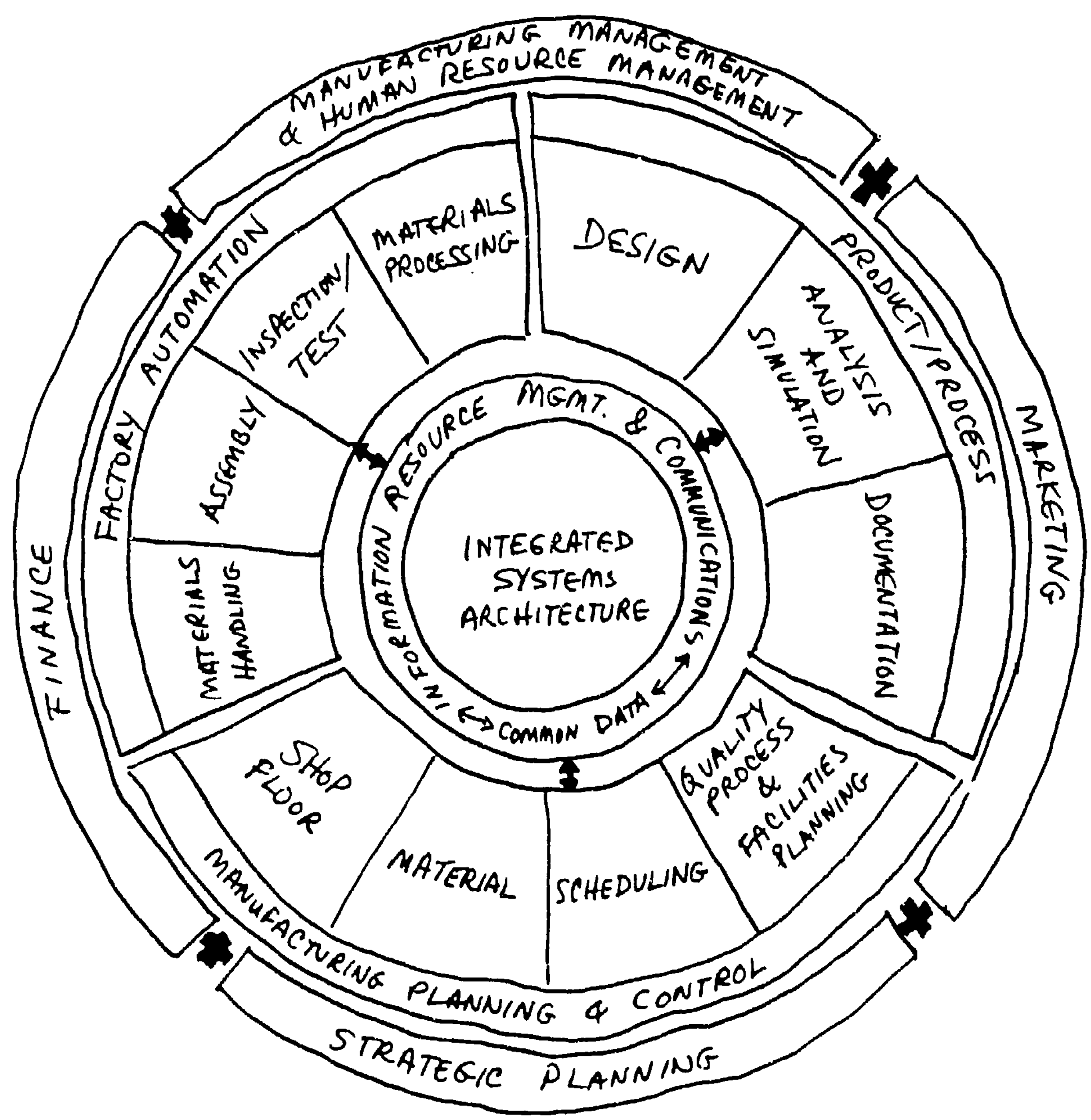
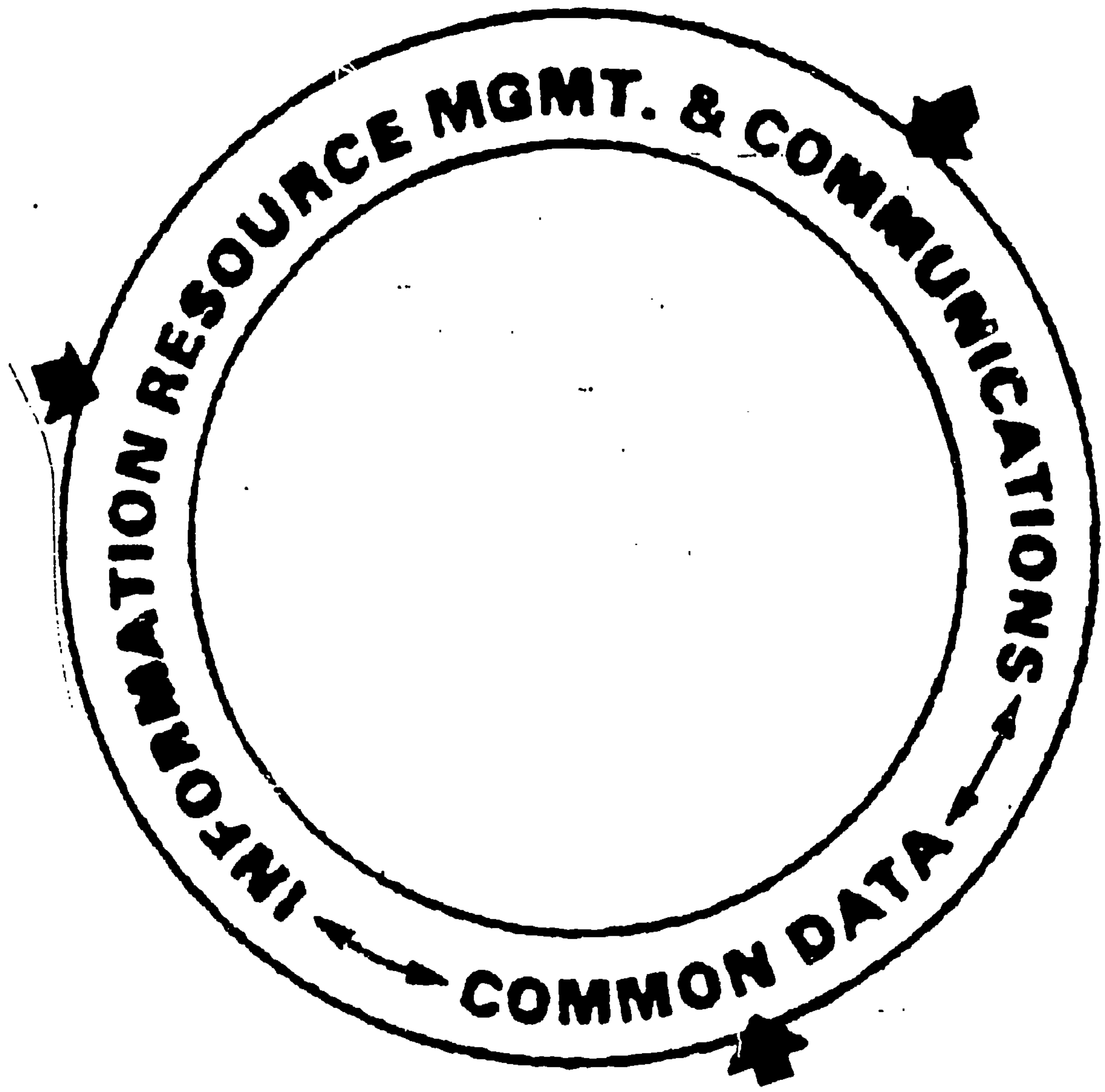



INFORMATION RESOURCE MGMT. & COMMUNICATIONS
COMMON DATA

COST ACCOUNTING JUSTIFIES COSTS ON:

- INTERNAL RATE OF RETURN IR?
- NE PRESENT VALUE NPV
- PAYBACK

THE PROBLEM TODAY IS THAT TRADITIONAL ACCOUNTING METHODS ARE BASED ON QUANTITATIVE RESULTS OVER PERIODS OF TIME. THE ROI OR RATE OF RETURN ON COMPUTER INTEGRATION SUCH AS CIM OR FMS MAY NEVER BE ACCEPTABLE WHEN COMPARED AGAINST OTHER "SHORT RANGE" PROJECTS.

THE GREATEST BENEFITS OF INTEGRATING THE WORKPLACE ARE NOT EASILY MEASURED.

MANAGERS MUST EITHER ACCOUNT FOR NON-MEASUREABLE BENEFITS OR ACCEPT THE RISK IN ORDER TO MEET COMPETITION, BUT ALL DECISIONS MUST BE BASED ON LONG TERM PLANS - THE VISION OF THE ORGANIZATION.

Savings Through Scrap Reduction Scenario

Raw Material		Value Added		Product Cost (inc FC)
$1.00	+	$9.00	=	$10.00

Let's say: Production is 100,000 units per year and the scrap rate is 25%

Scrap Cost = 25,000 x $10.00/unit = $250,000/year

WITHOUT THE VISION, SUPPORT AND CONTROL FROM THE TOP MANAGEMENT

INTEGRATION IN THE WORKPLACE, IS DOOMED TO FAIL.

WITHOUT A CLEAR STRATEGY, THE INTEGRATION PLAN ONLY CREATES MORE ....ISLANDS!

EDUCATION

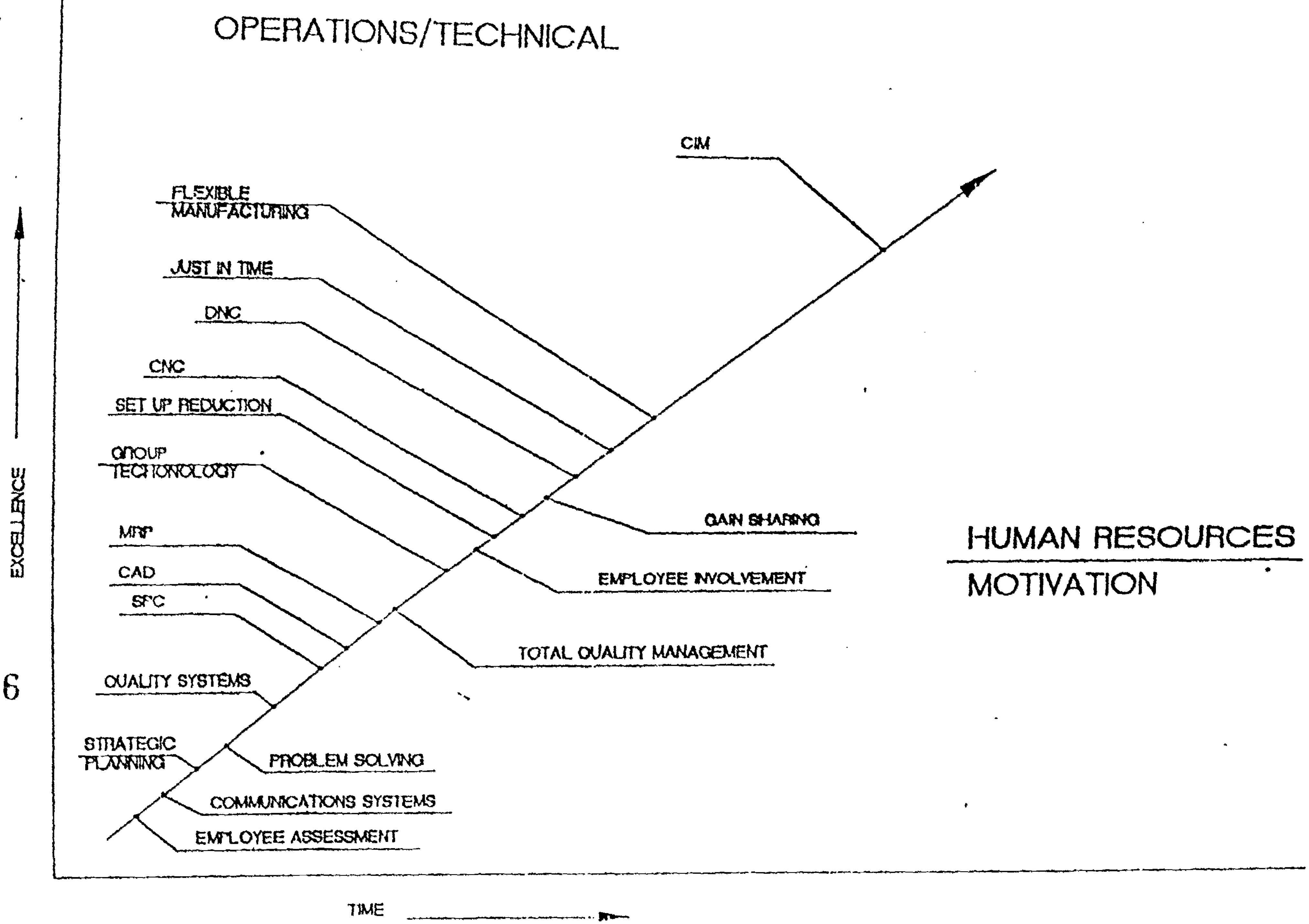
PLANNING --------> INTEGRATION <-------IMPLEMENTATION

EDUCATION

THE HUMAN ASPECT

- Automation is perceived to cause a reduction in jobs
- Generates hostility toward automation by workers
- Direct labor decreases while indirect labor increases such that the company may find itself short of skilled automation technicians.
- Union membership may drop unless they become involved in training
- Line supervisors and managers see it as a threat to their power base
- Departmental information boundaries will have to be erased

MANUFACTURING EXCELLENCE



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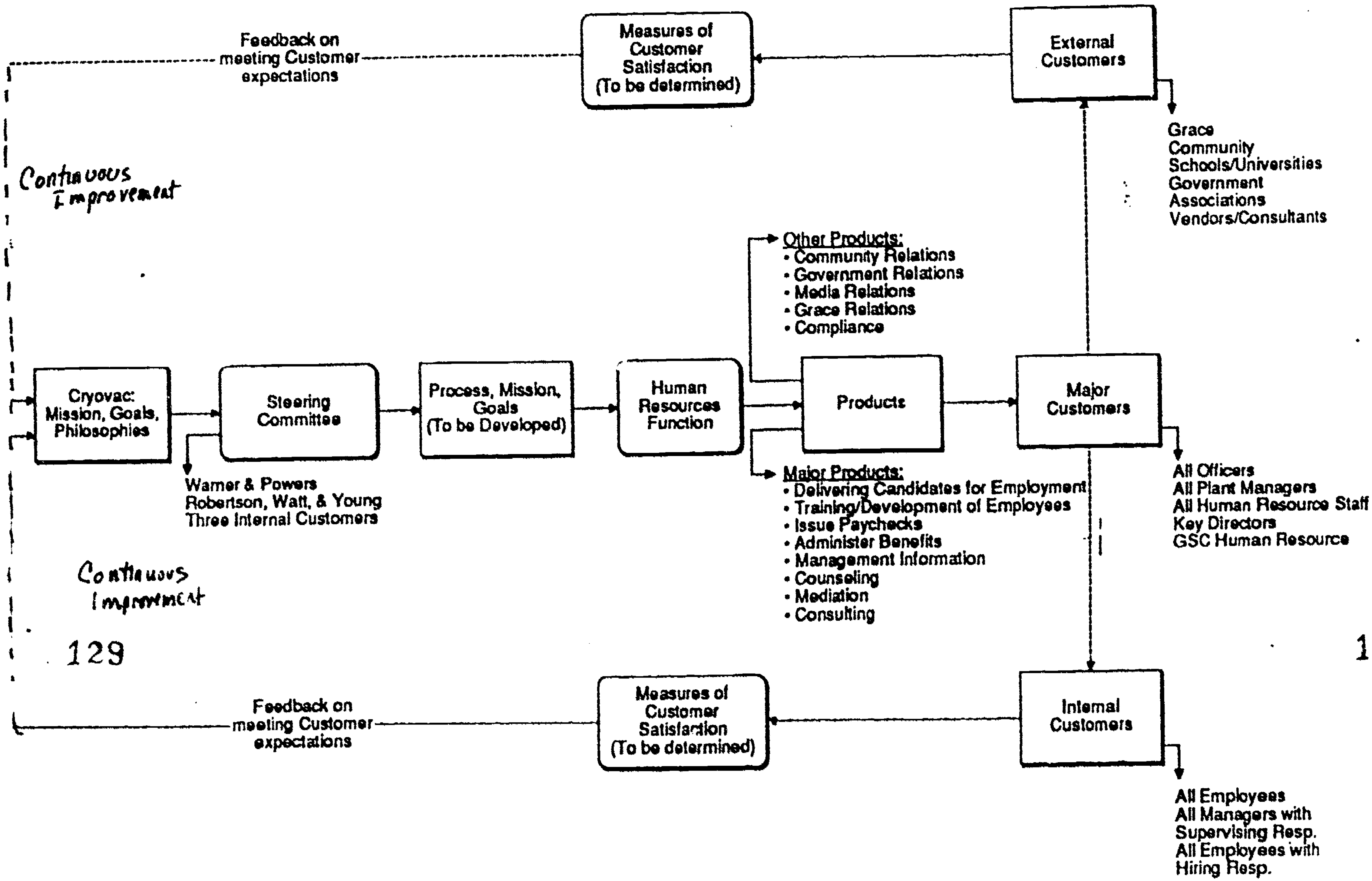
HUMAN RESOURCES

- Should lead with full support of top management
- Foster employee loyalty in the company
- Convince employees that every job is important and must be done correctly
- Should not be conducted as a "scare" tactic to coerce cooperation

Human Resources / Continuous Improvement Cycle



TOP MANAGEMENT SHOULD...........

. Implement Integration in phases beginning with inventory control and flexible manufacturing systems.

. Establish a design and INTEGRATION TEAM made up of:
  . Prodouction
  . Human Resources
  . Product Engineering
  . Marketing
  MIS
  Management

. Support the project through all phases.

. USE IT!