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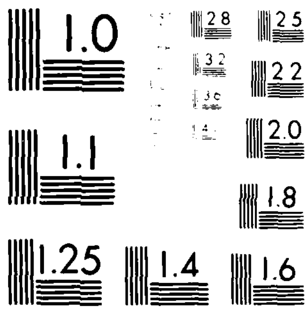

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AFWAL-TR-82-4063

AD-A144 732

INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM) ARCHITECTURE PART III

VOLUME VIII - TECHNOLOGY TRANSFER

SofTech, Inc.
460 Totten Pond Road
Waltham, MA 02154

September 1983

Final Report for September 1980 - October 1982

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

MATERIALS LABORATORY
AIR FORCE WRIGHT AERONAUTICAL LABORATORIES
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

84 08 14 151

FTR110410000U
8 September 1983

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This report has been reviewed by the Office of Public Affairs (ASD/PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

Richard R. Preston
RICHARD R. PRESTON, Captain, USAF
Project Manager
Computer Integrated Manufacturing Branch
Manufacturing Technology Division

13 July 1984
Approval Date

FOR THE COMMANDER

Nathan G. Tupper
NATHAN G. TUPPER
Chief
Computer Integrated Manufacturing Branch
Manufacturing Technology Division

13 July 84
Approval Date

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Manufacturing Architecture	ICAM	MFG1
Model of Manufacturing	IDEF	MFG01 Glossary
Integrated Computer-Aided Manufacturing	MFG0	
Subsystem Integration	DESIGN0	
Technology Transfer	DESIGN1	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Integrated Computer Aided Manufacturing (ICAM) Architecture Part III was initiated to maintain and update the existing manufacturing architecture as well as develop training courses to assist in the transition of IDEF applications, concepts and procedures to other Air Force programs. This volume presents the three courses designed to transfer IDEF concepts and techniques to other ICAM Programs. → 1-1

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This report is presented in the following eight volumes:

1. Volume I - Architecture Part III Accomplishments
2. Volume II - Procedures
3. Volume III - Composite Function Model of "Design Product" (DES0)
4. Volume IV - Composite Information Model of "Design Product" (DES1)
5. Volume V - Composite Function Model of "Manufacture Product" (MFG0)
6. Volume VI - Composite Information Model of "Manufacture Product" (MFG1)
7. Volume VII - MFG01 Glossary
8. Volume VIII - Technology Transfer

FOREWORD

This technical report provides the results of the Technology Transfer Task associated with the IDEF Function Modeling. This work was performed under U.S. Air Force Contract #F33615-80-C-5109, "ICAM ARCHITECTURE, PART III," covering the period of September 1980 through October 1982. The contract was sponsored by the Computer Integrated Manufacturing Branch, Materials Laboratory, Air Force Wright Aeronautical Laboratories, Air Force Systems Command, Wright Patterson Air Force Base, Ohio, 45433. The Air Force Technical Manager for ICAM ARCHITECTURE PART III was Capt Steve R. LeClair for the basic contract and Capt Richard R. Preston for the option phase.

Ms Bette R. Davis was the SofTech Program Manager. The other contributor to this document was A.W. Snodgrass, DACOM.

TABLE OF CONTENTS

Section 1
SCOPE

1.1 Identification

This volume documents the material developed to facilitate the dissemination of the concepts developed under the ICAM program.

This technology transfer material provides an executive overview of ICAM and Technology Modernization (TechMod) techniques and benefits and, separately, course material for teaching the IDEF methodology. For each of these two subjects, a presentation manual and a "train the trainers" manual is provided.

The presentation manuals include guidance for: setup, pre-presentation activities, presentation, and post-presentation activities. These manuals also include hard copies of the actual slides used in the presentation. The "train the trainers" manuals repeat the material of the presentation manuals, but add an instructional objective and a suggested narration for each slide.

This volume documents work performed under ICAM Project Priority 1104 - ICAM Architecture of Manufacturing Part III.

1.2 Background

The Integrated Computer Aided Manufacturing (ICAM) program has as its objective the mprovement of productivity in the aerospace manufacturing sectors of American industry. It is directed toward improving productivity through the systematic application of computer technology in the design and manufacturing environment. This approach is not only ambitious, but is also realistic in that it stresses the development of computer aided design and manufacturing capabilities. The integration of these computer aids into the design and manufacturing environment and among themselves will ultimately signal the success of the ICAM program.

A key to the achievement of this goal is the development of the ICAM Definition (IDEF) Methods and the ICAM composite models of design and manufacturing. The ICAM Definition Methods are a family of techniques through which -- analysts and laymen explore and discuss the nature of design and manufacturing systems. These techniques, developed for the ICAM program, provide a means of studying, recording, and communicating the inherent requirements and realities of the aerospace manufacturing environment. They are equally effective and valuable in many other manufacturing and non-manufacturing environments.

There are three ICAM Definition Methods: IDEFØ - Function Modeling; IDEF1 - Information Modeling; and IDEF2 - Dynamics Modeling. A manufacturing system is described and studied through the application of all three techniques.

The ICAM composite models of manufacturing, or architectures, record a "composite view" of what manufacturing is and how it operates. Composite architectures are presented in two forms: the "AS IS form -- representing the way in which design and manufacturing are currently accomplished; and the "TO BE" form -- representing the way in which design and manufacturing will be accomplished with computer aids in place.

Architecture Process

The necessary first step in increasing the productivity of design and manufacture is to understand current design and manufacturing practice precisely and to record this understanding concisely. This development of understanding has two main phases:

- Study specific company
- Evolve a composite understanding.

Factory View

Understanding of the current design and manufacturing process must be based on the detailed factual information which describes this process in those companies which successfully produce aerospace products. This has been called "Factory View" information. The Factory View of manufacturing and design is different for each company, for each division of a company, for each plant within a company, and even somewhat different for each organization and each individual within each plant.

Composite View

One objective of ICAM is to develop improvements in the design and manufacturing process which will be broadly applicable across the whole aerospace industry. In order to do this, it is necessary to have some understanding of "general or generic design and manufacturing practice." Such an understanding emphasizes the essential information necessary to all design and manufacturing processes, while de-emphasizing the differences of organization and terminology among the various factory views.

As prime contractor, SofTech contracted to DACOM the development of the technology transfer packages. Successful technology transfer is central to the stated objective of improving productivity in the aerospace manufacturing sectors of American industry. This transfer must encompass an understanding at the executive level as well as at the practitioners level. These levels are addressed by the packages documented here.

1.3 Functional Description of Document

This volume documents the technology transfer materials developed under ICAM Project Priority 1104 - ICAM Architecture of Manufacturing Part III. The remaining sections of this book are also available as individual publications follows:

Section 2.1	TM 110460001U Technology Transfer Executive Overview Presentation Manual May, 1982
Section 2.2	TM 110460002U Technology Transfer Executive Overview "Train the Trainers" Manual, May, 1982
Section 2.3	TM 110460003U Technology Transfer Practitioner's Presentation Manual, May, 1982
Section 2.4	TM 110460004U Technology Transfer Practitioner's "Train the Trainers" Manual, May, 1982

Also available, and included as an appendix to this volume, is a Technology Transfer Program Task Report Summary, which provides a detailed chronology of this development effort.

Use the following Request Order Form to request copies of Technology Transfer Documents, and submit to:

ICAM Program Library
AFWAL/MLTC
Wright-Patterson AFB, OH 45433

FTR110410000U
8 September 1983

ARCHITECTURE PART II - FINAL REPORT

DOCUMENT REQUEST ORDER FORM

VOLUME I - Architecture Part III Accomplishments

VOLUME II - Procedures

VOLUME III - Composite Function Model of "Design Product" (DES0)

VOLUME IV - Composite Information Model of "Design Product" (DES1)

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VOLUME VII - MFG01 Glossary

VOLUME VIII - Technology Transfer

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Section 2
TECHNOLOGY TRANSFER MANUALS

2.1 Technology Transfer Executive Overview Presentation Manual

FORWORD

This instructor's Presentation Manual is designed to help orient and educate executive level management relative to the need for a structured approach to implementing new manufacturing technology, thereby gaining productivity. It provides an overview of the U.S. Air Force's Manufacturing Technology Modernization (TECHMOD) Program's use of related IDEF applications, concepts, and procedures. It also covers the use of ICAM Architecture in planning and controlling these Manufacturing Technology Modernization Programs to upgrade the U.S. industrial base.

This Presentation Manual, coupled with the accompanying "Train the Trainers" Manual, is designed to give the instructor maximum efficiency in orienting executive level personnel. It employs a step-by-step an section-by-section process, dealing with "top-down" Manufacturing Technology Modernization planning and "bottom-up" project implementa n.

2.1.1 Introduction

This is an instructor's Presentation Manual intended to aid those teaching an executive overview of the Air Force Manufacturing Technology Modernization (TECH MOD) Program's use of ICAM IDEF Modeling Methodologies.

This Instructor's Presentation Manual consists of a guide for conducting an Executive Level briefing. The instructor's Executive Overview "Train the Trainers" Manual provides a step-by-step text, containing the objectives and procedures to be covered, concepts, and a suggested narration (with which to start).

The course materials are presented in a standardized format. Each page is composed of a copy of the presentation material, the instructional objective that must be covered with that material, and a suggested narration that may be followed until individual styles can be developed.

Overall planning for and conducting of actual executive training sessions is almost as critical to accomplishing participant learning objectives as the course presentation material. Attention must be given to planning for presentation set-up, pre-presentation, presentation, and post-presentation activities.

2.1.1.1 <u>Presentation Set-Up</u>

2.1.1.1.1 Audio/Visual Equipment:

a) Overhead vue foil projector

b) 35mm projector (if slides are used)

2.1.1.1.2 <u>Audio/Visual Aids:</u>

a) Overhead transparencies

b) 35mm color transparencies (when slides are used)

c) Training materials (handouts and/or manuals)

2.1.1.1.3 <u>Room Set-up:</u>

Everyone must be in hearing and seeing distance of the presentation.

<u>REMEMBER</u>: The best instructional program is no good if you can't hear and see it!

2.1.1.2 <u>*Pre-Presentation*</u>

- Review all training materials beforehand and be familiar with them.

- Make sure room, equipment, and materials are all in order and ready to go when you are.

  REMEMBER: Prior planning prevents poor performance!

- Set up audio/visual equipment.

- Get audio/visual aids ready for presentation.

  a) Make sure all overhead transparencies are in their order of presentation.

  b) Make sure all 35mm color transparencies (when slides are used) are in their order of presentation and that they are all placed in carousel right-reading, (a slide in backwards or upside down can throw your whole presentation off kilter).

- Handout copies of presentation materials may be provided if warranted by advance coordination.

2.1.1.3 Presentation

- Give introduction

  a) Include purpose and viewpoint of presentation.

  b) Set atmosphere conducive to learning.

- Go through training materials step-by-step.

- Use peer cross-referencing method to check for understanding.

  PEER CROSS-REFERENCING METHOD

  a) Ask who understands the point you've just presented.

  b) Ask who isn't clear about it.

  c) Ask if anyone who understands the point can explain it to those who don't.

  NOTE: If you don't get any takes, you must explain it over again, if possible, in different terms.

- REMEMBER:

  Just because you've presented the material doesn't mean that everyone has understood it.

2.1.1.4 Post Presentation

- Try not to leave any question unanswered. If you don't know, find out, and write or call with the answer.

- At some time, a sheet could be filled out with the name, organization, department, phone number, etc. of those attending. Get sheet typed and make copies to give to everyone. Use for:

  - historical record

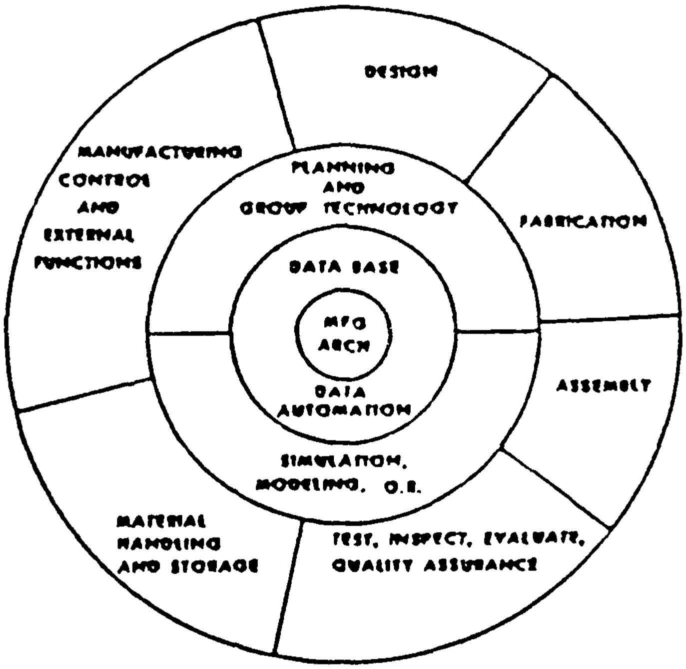
  - contact sheet.

2.1.2 A Structured Approach to Manufacturing Technology and Productivity

FTR110410000
8 September 1983

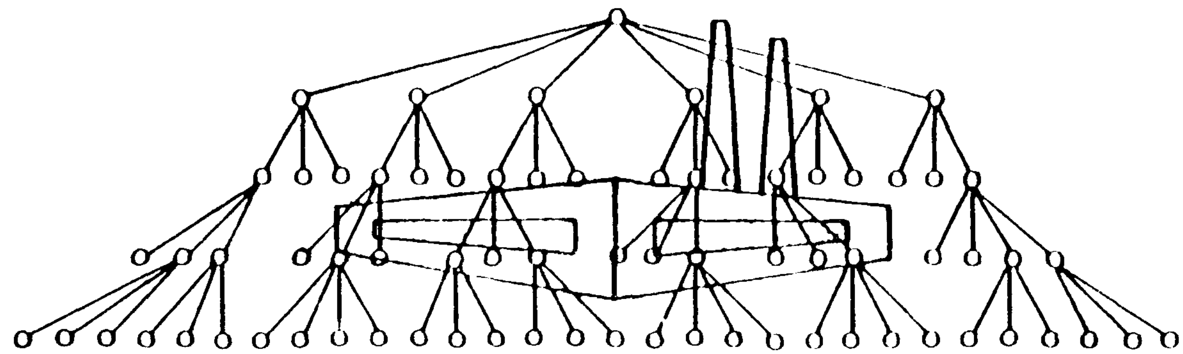
USAF MANUFACTURING TECHNOLOGY PROGRAM

A MANUFACTURING TECHNOLOGY MODERNIZATION PROGRAM CONCEPT FOR INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM) IDEF/ARCHITECTURE METHODOLOGY



EXECUTIVE OVERVIEW PRESENTATION MANUAL

EXECUTIVE OVERVIEW



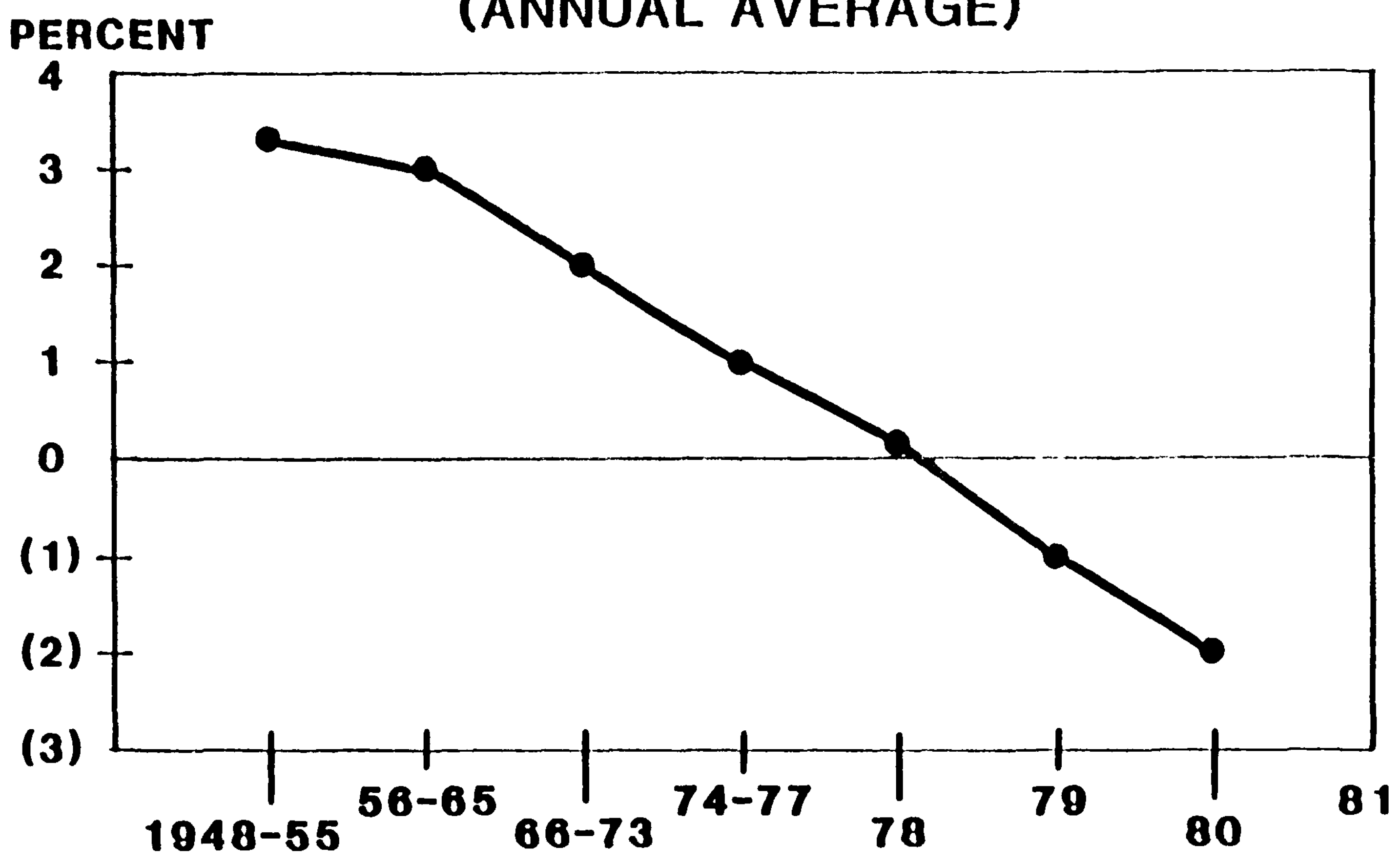
A STRUCTURED APPROACH TO MANUFACTURING TECHNOLOGY AND PRODUCTIVITY

INTRODUCTION

- THE PROBLEM
  - U.S. PRODUCTIVITY PERFORMANCE
  - U.S. INDUSTRY AUTOMATION TECHNOLOGY
- THE SOLUTION
  - INTEGRATED COMPUTER AIDED MANUFACTURING/TECH MODS
  - ICAM ANALYTICAL/PLANNING TOOLS
  - INTEGRATED STRATEGIC PLANNING & INFORMATION RESOURCE MANAGEMENT (IRM)

THE PROBLEM

PRODUCTIVITY GROWTH RATE IN U.S.
(ANNUAL AVERAGE)



SOURCE U.S. DEPARTMENT OF COMMERCE

EXTERNAL ENVIRONMENT "CAUSES"

- SOCIAL TRENDS
- HIGH INFLATION RATE
- GOVERNMENT REGULATIONS
- R&D LOW PRIORITY
- LACK OF CAPITAL IMPROVEMENT INCENTIVES

DECLINING PRODUCTIVITY "SYMPTOMS"

- OVERHEAD AND INDIRECT RESPONSIBLE FOR 60–70% OF PRODUCT COST
- AVERAGE MACHINE UTILIZATION LESS THAN 30%
- DIRECT FAB PROCESS ONLY 1 1/2% PART'S "SHOP LIFE"
- RISING LABOR COSTS BEING DIRECTLY PASSED ON TO CONSUMERS
- INCREASING SOCIAL PRESSURES

LOST PRODUCTIVITY

"AMERICAN WORKERS ACTUALLY ARE PRODUCING, ON AVERAGE, ONLY ABOUT 55% OF THE TIME THEY ARE ON THE JOB. THE RESULTING LOSS TOTALS 350 BILLION DOLLARS ANNUALLY."

T. BARRY & ASSOCIATES

INDUSTRIAL ENGRG-NOV.'80

45%
OF DIRECT LABOR TIME IS NOT PRODUCTIVE

SOURCE

- 35% POOR SCHEDULING
- 25% POOR INSTRUCTIONS
- 15% INFLEXIBILITY
- 25% POOR MATERIAL FLOW

PAYOFF

PLANNING
SCHEDULING
CONTROL

OF

PEOPLE
MATERIALS
FACILITIES

U.S. INDUSTRY
AUTOMATION TECHNOLOGY

U.S. INDUSTRY AUTOMATION TECHNOLOGY

- **AUTOMATION INVESTMENTS WILL TRIPLE TO $5+BILLION BY 1985.**

- **CAD SYSTEMS WILL CLIMB +35% ANNUALLY TO ESTIMATED $2.5 BILLION IN 1985 FROM $610 MILLION IN 1979.**

- **MINICOMPUTERS, NUMERICAL CONTROLS AND PROGRAMMABLE CONTROLLERS WILL CLIMB +35% ANNUALLY TO $2.3 BILLION IN 1985 FROM $570 MILLION IN 1980.**

- **ROBOTS WILL JUMP TO 80,000 UNITS BY 1985 FROM 2,000 UNITS IN 1981 TO TOTAL OF $+600 MILLION.**

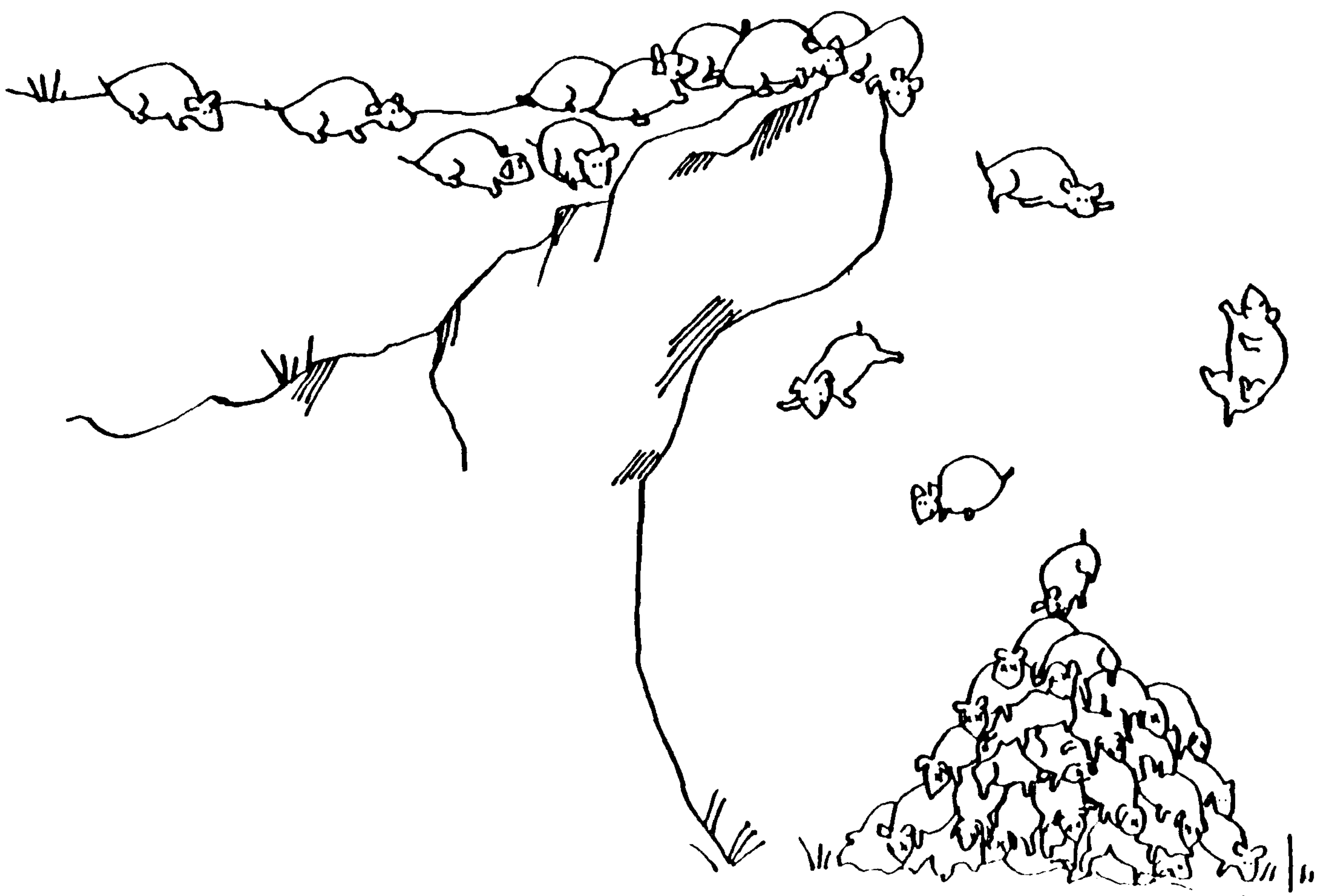
BUSINESS WEEK - 3 AUG 1981 "THE SPEED UP IN AUTOMATION"

EXECUTIVE MANAGEMENT TAKING "TOP DOWN" ACTION

- OFFICE AUTOMATION - 38 MILLION OF 50 MILLION WHITE COLLAR JOBS AFFECTED (WITH 20 TO 30 MILLION BY 1990) AT 20% VALUE ADDED PER EMPLOYEE.
- FLEXIBLE MANUFACTURING SYSTEM (FMS) - USERS EXPERIENCING IMPROVED MACHINE TOOL UTILIZATION AS MUCH AS 45% AND DECREASING WORKERS BY 30%
- CAD / CAM SYSTEMS - TO CUT MANUFACTURING LEADTIME BY 25% AND INCREASE PRODUCTIVITY AS MUCH AS FOURFOLD
- TOP EXECUTIVES - NOW FORCING SOLUTIONS IN ORDER TO REMAIN IN BUSINESS IN THE 1990's.
- DECISIONS - TO AUTOMATE ARE STARTING AT THE BOARD LEVEL AND MOVING DOWN.

BUSINESS WEEK - 3 AUG 1981 "THE SPEED UP IN AUTOMATION"

THE LEMMING APPROACH TO AUTOMATION



TECHNOLOGY INTEGRATION

- AN AVALANCHE OF UNCOORDINATED AUTOMATION TECHNOLOGY MODERNIZATION PROJECTS THREATENS TO BURY U.S. INDUSTRY

<u>UNLESS THERE IS</u>

- TECHNOLOGY INTEGRATION

<u>SOMETIMES REFERRED TO AS</u>

- COMPUTER INTEGRATED MANUFACTURING (CIM)


C OMPUTER I NTEGRATED M ANUFACTURING
VICE PRESIDENT
MANUFACTURING SYSTEM INTEGRATION

COMPUTER INTEGRATED MANUFACTURING

- MANUFACTURING, WHICH BEGINS WITH PRODUCT DESIGN AND ENDS WITH SUPPORT AND MAINTENANCE IN THE FIELD, IS A MONOLITHIC, INDIVISIBLE FUNCTION. --- <u>NO PART CAN BE SUCCESSFULLY CONSIDERED IN ISOLATION FROM ALL OTHER PARTS.</u>

- DIVERSE AS THE VARIOUS PARTS OF MANUFACTURING MAY SEEM, THERE IS A <u>COMMON THREAD</u> THAT RUNS THROUGH THE FULL SCOPE OF ALL MANUFACTURING ACTIVITIES. -- MANUFACTURING IS, IN THE ULTIMATE ANALYSIS, <u>A SERIES OF DATA PROCESSING OPERATIONS.</u>

DR. JOSEPH HARRINGTON
1980 CAD/CAM CONFERENCE

SIGNIFICANT IMPACTS ON U.S. HUMAN RESOURCES

- **SHORT PRODUCTION RUNS NOW ACCOUNT FOR 75% U.S. MANUFACTURING**
- **CAD/CAM AFFORDABLE FOR SMALL JOB SHOPS WITHIN DECADE**
- **CHANGES WILL AFFECT 45 MILLION JOBS IN U.S. NEXT 20 YEARS**
- **ONLY 13,000 CANDIDATES AVAILABLE IN 1981 TO FILL 29,000 ELECTRICAL AND COMPUTER SOFTWARE ENGINEERING SLOTS (BY 1985 SUPPLY WILL BE 15,000 VS. 51,000 DEMAND)**

BUSINESS WEEK 3 AUG 1981 "THE SPEED UP IN AUTOMATION"

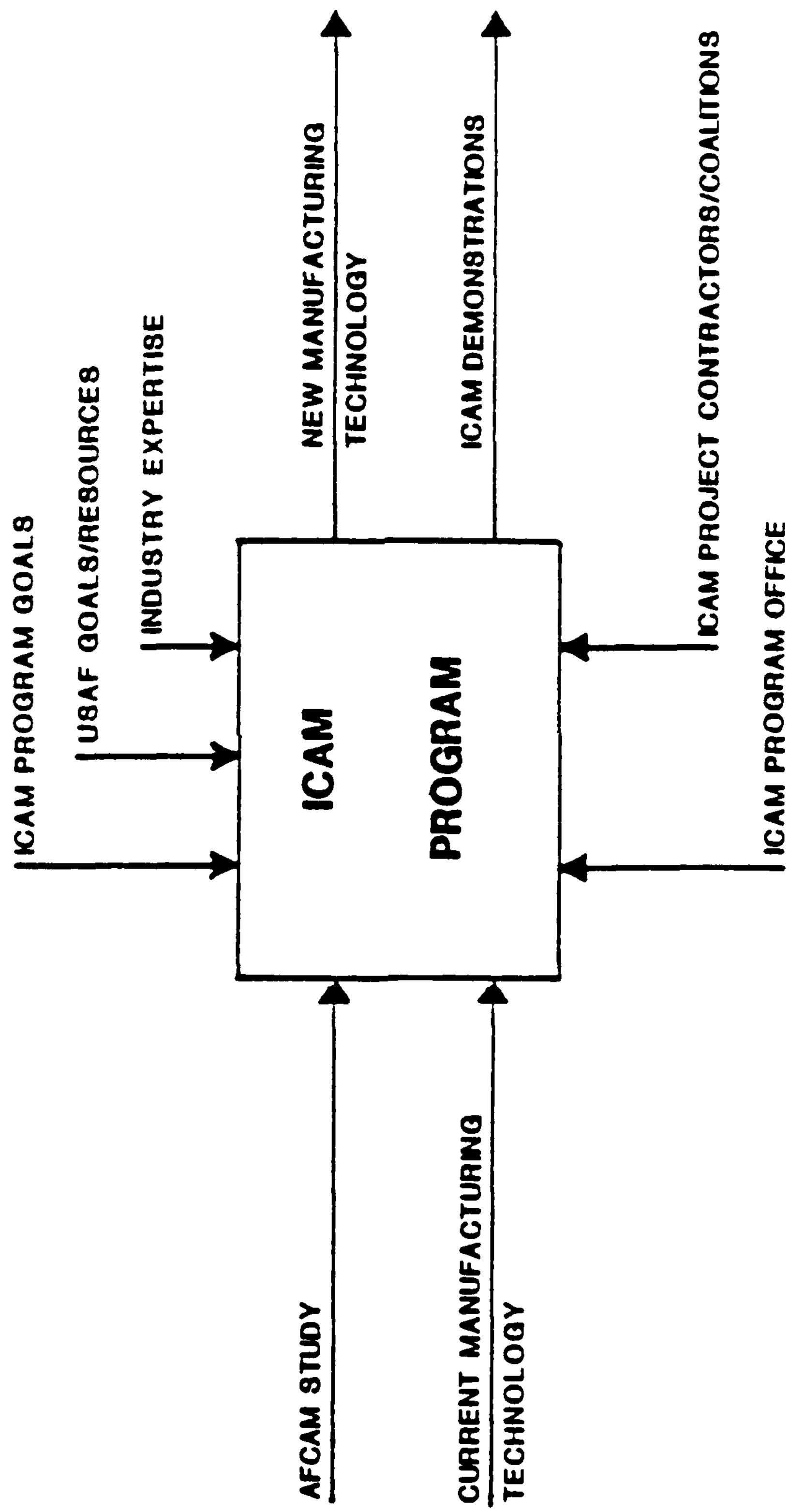
U.S. INDUSTRY AUTOMATION TECHNOLOGY

- NO OTHER COUNTRY MATCHES U.S. IN COMPUTER SOFTWARE AND COMPUTER AIDED DESIGN.
- 90% OF JAPAN'S CAD SYSTEMS IMPORTED FROM U.S. - $100 MILLION IN 1980 AND RISING.
- COMPUTER POWER COST DECREASING AVERAGE 50% EVERY 2 1/2 YEARS SINCE 1970.
- SOFTWARE DEVELOPMENT NOW PACING FACTORY AUTOMATION:
  - STANDARD GEOMETRIC SHAPE DEFINITION
  - INTEGRATED DATA BASES
  - COMMUNICATION PROTOCOLS
  - INFORMATION RESOURCE MANAGEMENT

BUSINESS WEEK - 3 AUG 1981 "THE SPEED UP IN AUTOMATION"

INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM) PROGRAM

ICAM PROGRAM



ICAM PROGRAM OBJECTIVES

- **REDUCE DEFENSE SYSTEM COSTS THROUGH CAM TECHNOLOGY**
- **ESTABLISH MEANS FOR INTEGRATED APPLICATION OF COMPUTER TECHNOLOGY**
- **IMPROVE LONG TERM COMPETENCE, EFFICIENCY AND RESPONSIVENESS TO DEFENSE NEEDS**
- **PROVIDE MECHANISM FOR ICAM TECHNOLOGY TRANSFER**
- **VALIDATE AND DEMONSTRATE COST SAVINGS & FLEXIBILITY OF ICAM METHODOLOGY**

ICAM PROGRAM OBJECTIVES

PRODUCTIVITY IMPROVEMENTS

THROUGH

COMPUTER TECHNOLOGY

AND

FACTORY MODERNIZATION

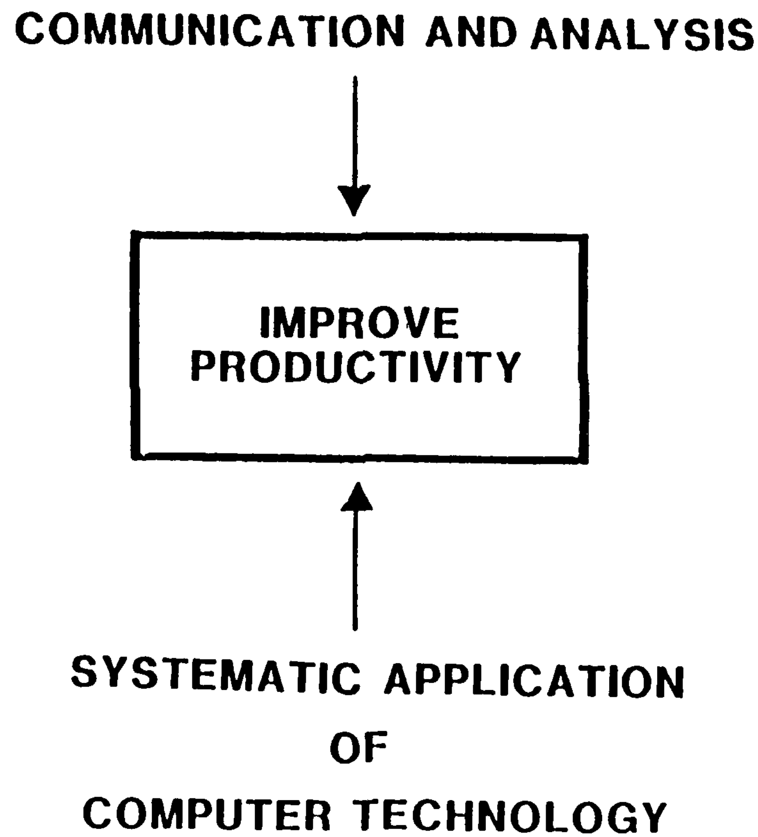
PURPOSE OF ICAM

IMPROVE PRODUCTIVITY

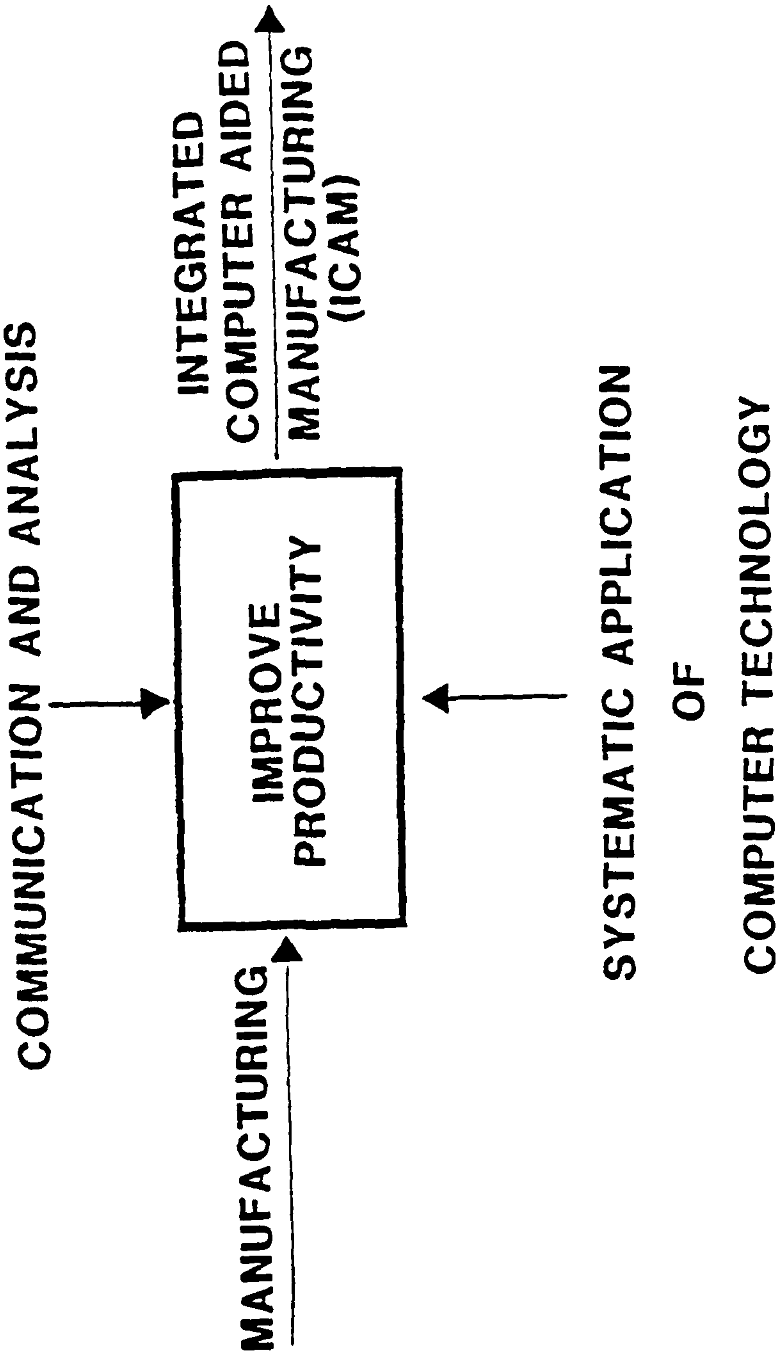
↑

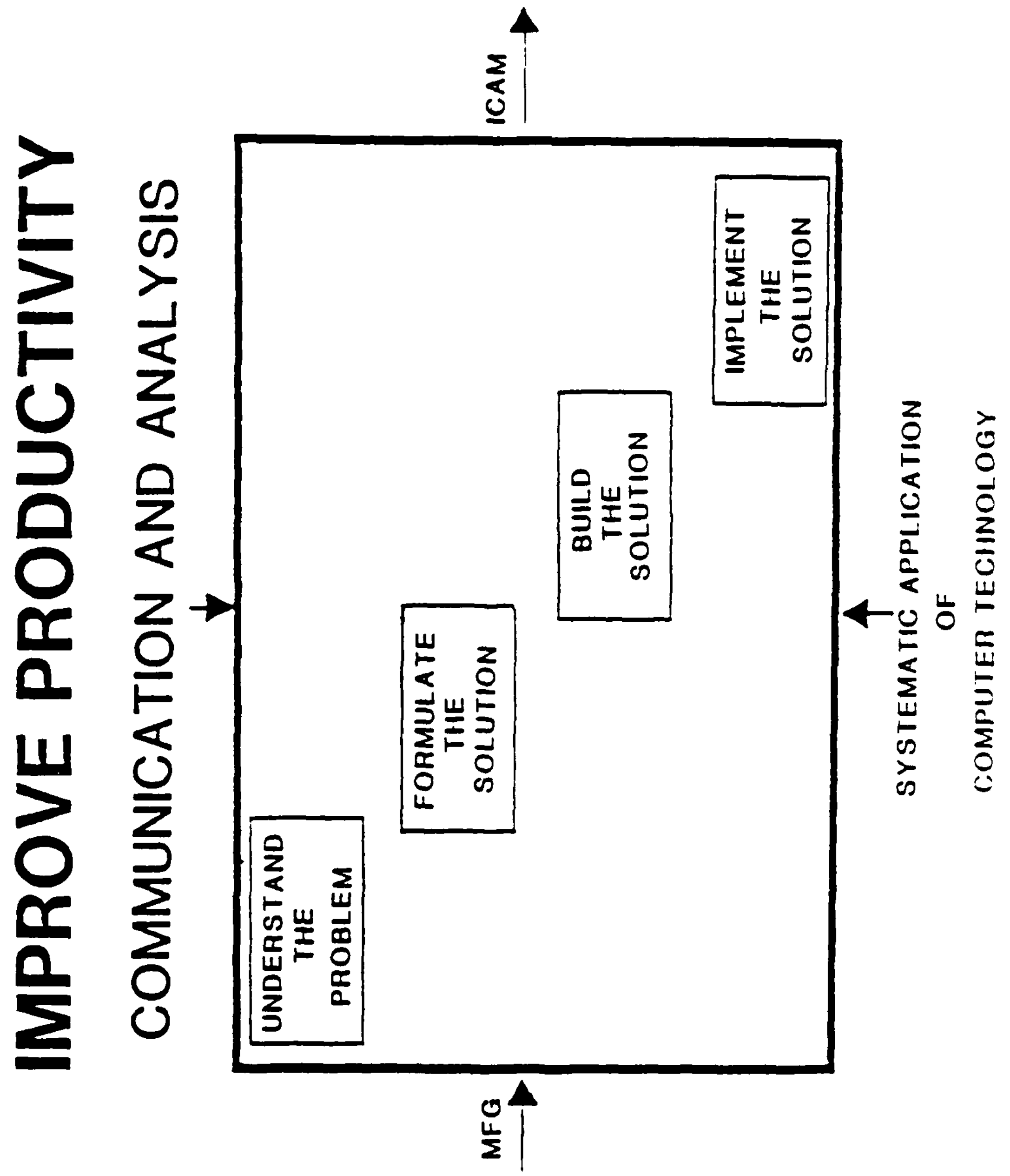
SYSTEMATIC APPLICATION
OF
COMPUTER TECHNOLOGY

ICAM APPROACH

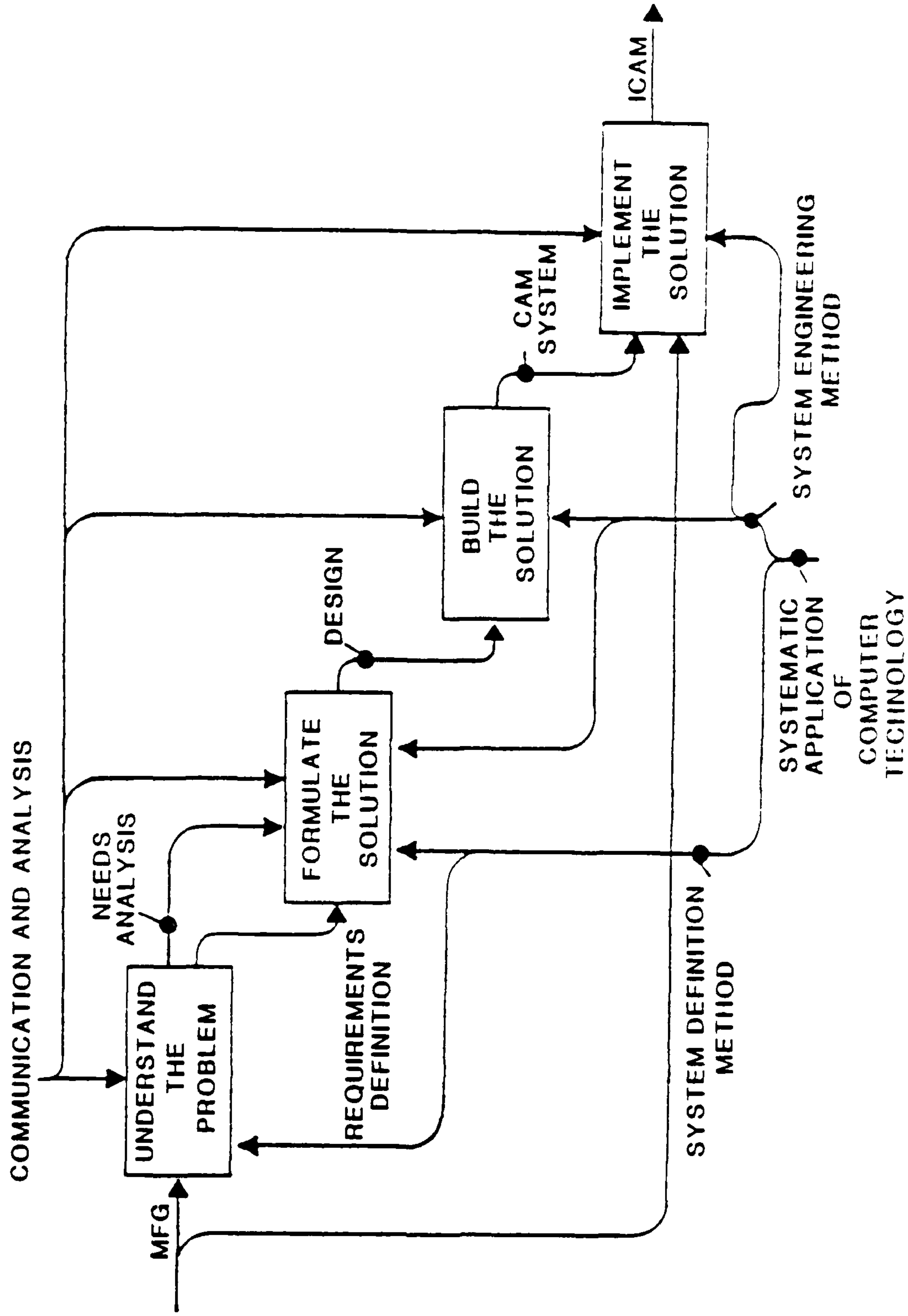


OBJECTIVE OF ICAM




IMPROVE PRODUCTIVITY
COMMUNICATION AND ANALYSIS
MFG
ICAM
UNDERSTAND THE PROBLEM
FORMULATE THE SOLUTION
BUILD THE SOLUTION
IMPLEMENT THE SOLUTION
SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY

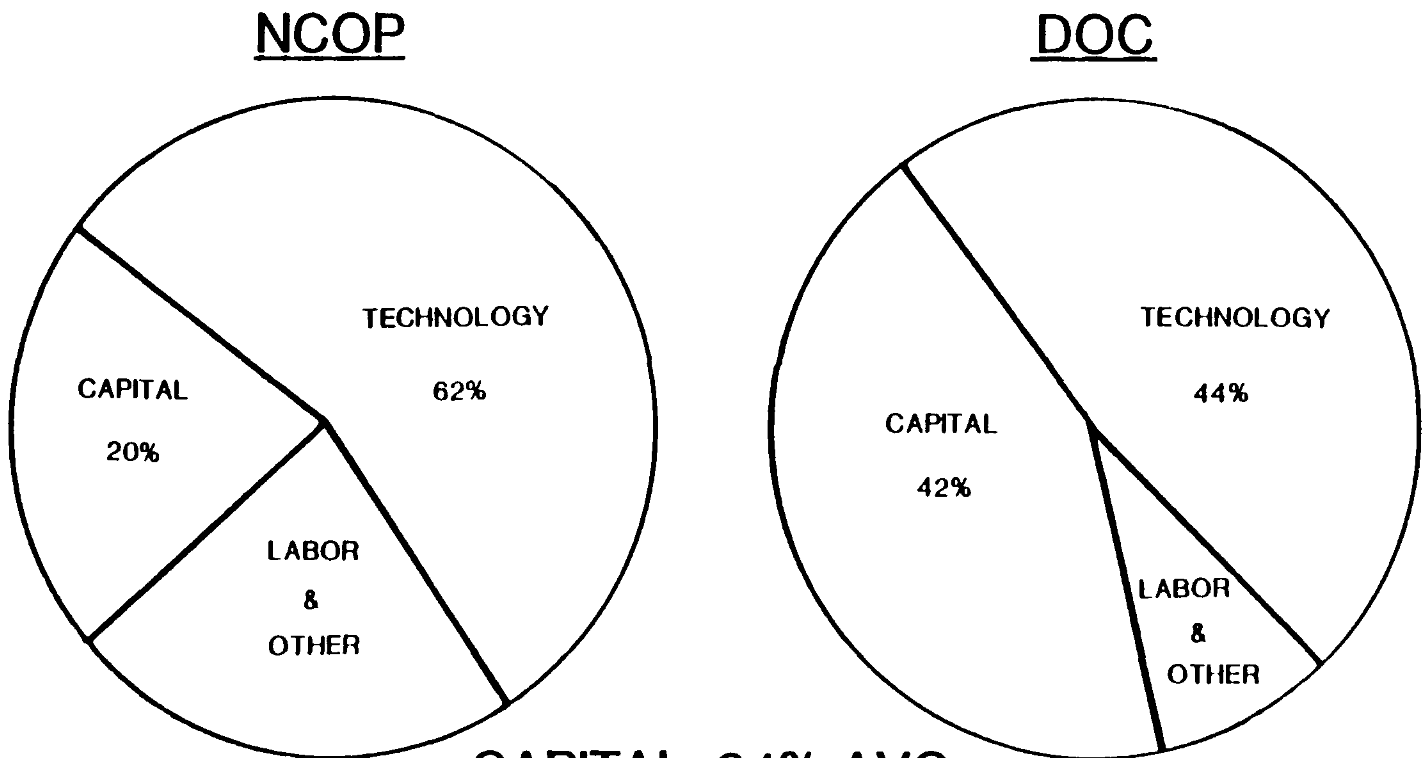
IMPROVE PRODUCTIVITY



MANUFACTURING TECHNOLOGY MODERNIZATION PROGRAM

(TECH MODS)

CONTRIBUTIONS TO PRODUCTIVITY INCREASES



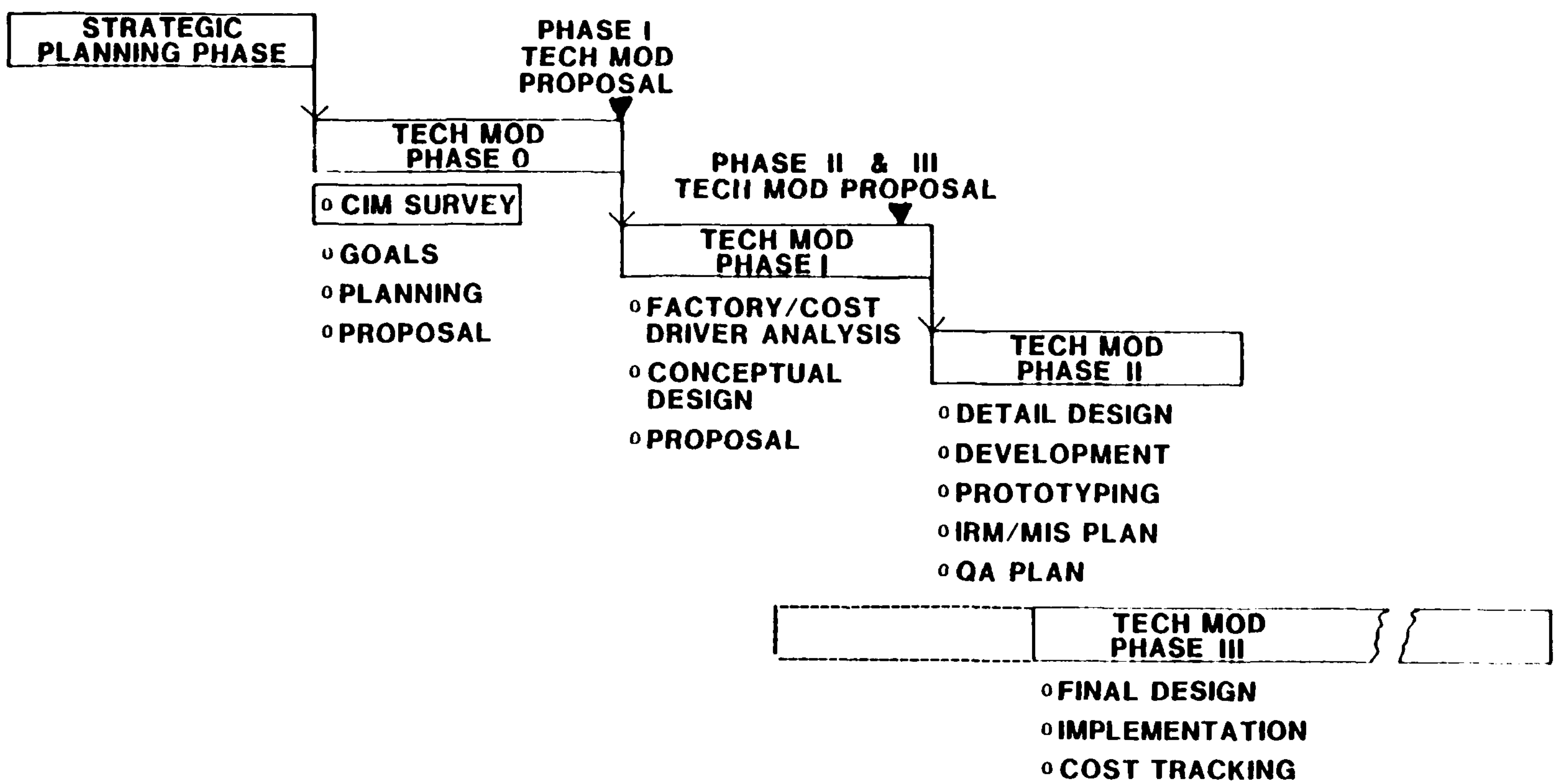
CAPITAL–31% AVG

TECHNOLOGY–53% AVG

NCOP – NATIONAL COUNCIL ON PRODUCTIVITY – DENISON

DOC – DEPARTMENT OF COMMERCE CHRISTENSEN, CUMMINGS & JORGENSEN

TECHNOLOGY MODERNIZATION FRAMEWORK



TECH MOD CONCEPT

PARTNERSHIP TO IMPROVE PRODUCTIVITY

INDUSTRY

- MODERNIZE MANUFACTURING FACILITIES
  - INVEST IN NEW SYSTEMS, NEW EQUIPMENT AND FACILITY IMPROVEMENTS
  - IMPLEMENT IMPROVED SYSTEMS
- REDUCE C OST OF WEAPONS SYSTEMS
- WINS
  - LARGER PROFIT AND MORE COMPETITIVE POSITION WITH REDUCED FINANCIAL RISK

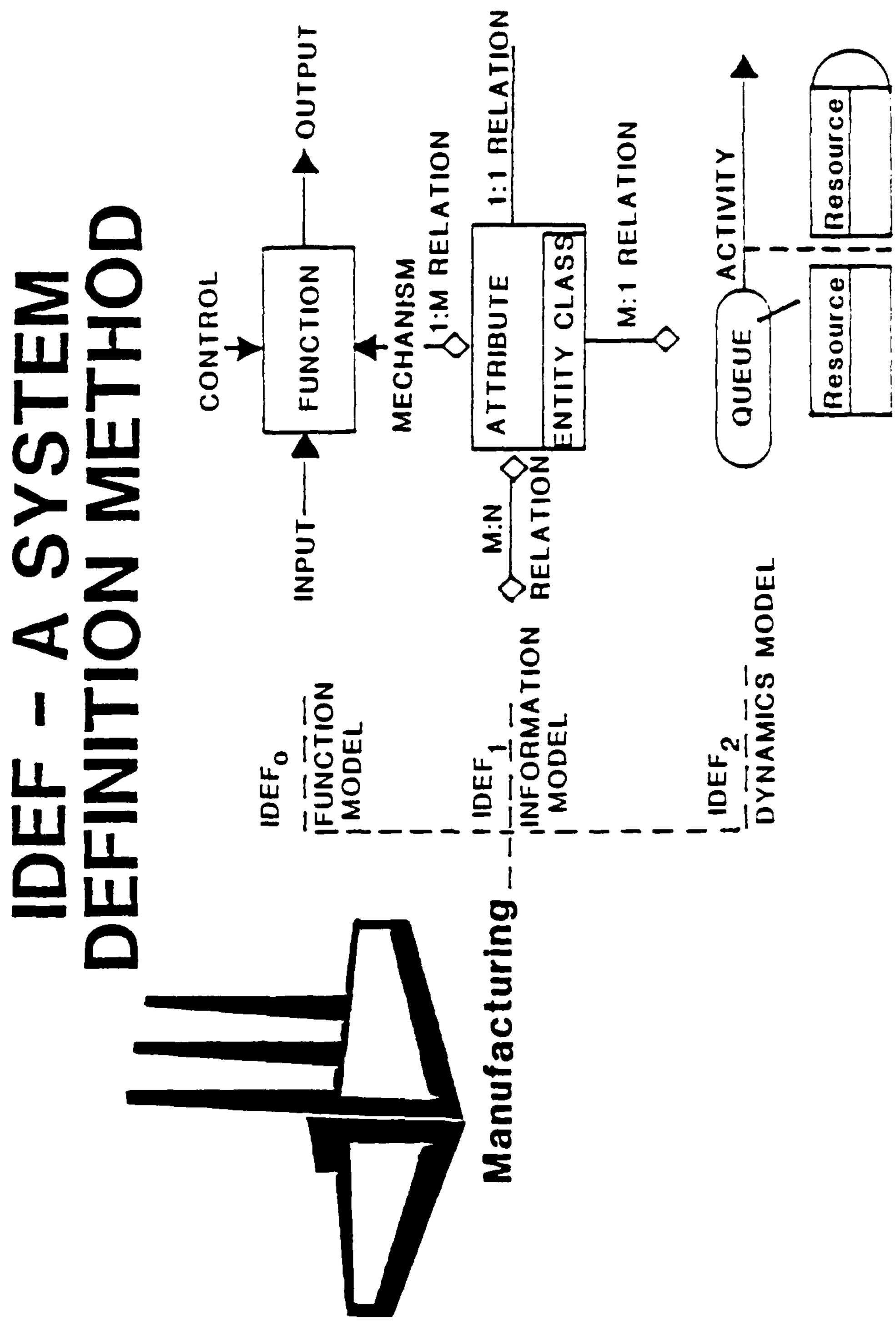
GOVERNMENT

- PROVIDE INCENTIVES
  - FUND ANALYSIS AND DESIGN
  - PROVIDE TERMINATION LIABILITY PROTECTION
  - PROVIDE AWARD FEES
  - SHARE SAVINGS
- WINS
  - MORE BANG FOR THE BUCK

TECH MOD PROGRAMS

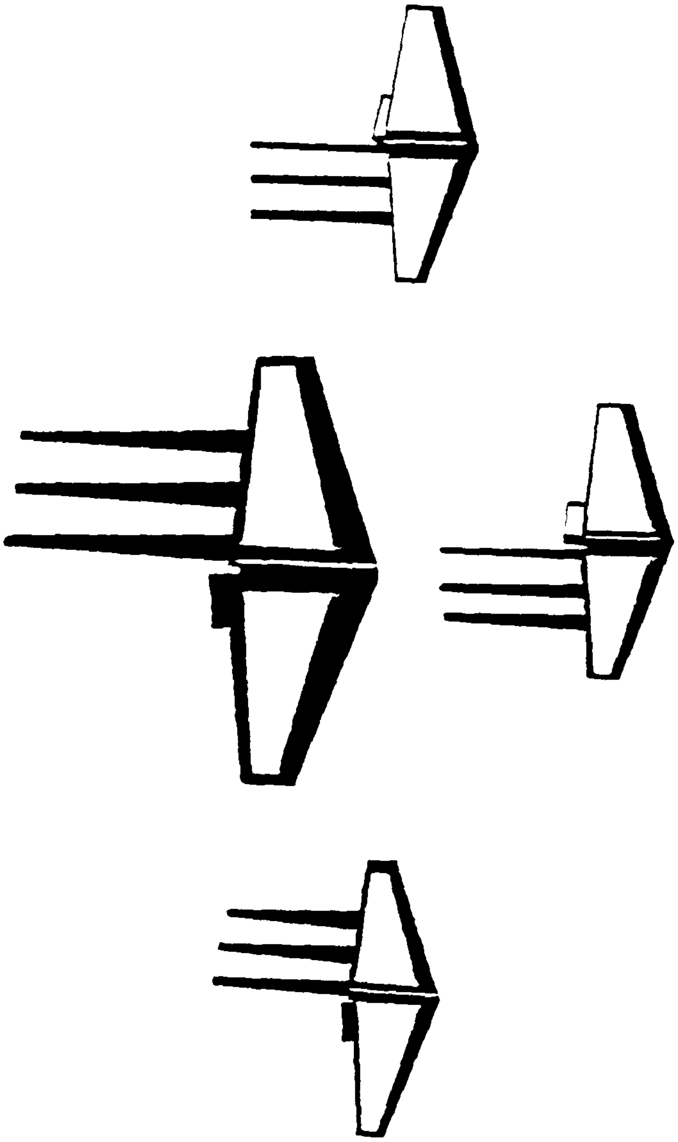
- ESTABLISH NEW PRODUCTION PROCESSES
- PROVIDE TECHNOLOGY TRANSFER
- STIMULATE IMPLEMENTATION & INVESTMENT
- DIRECTLY SUPPORTS SMALL BUSINESS & B/SIC INDUSTRIES (30–40%)
- BUILD UPON R&D PRECURSOR DEMONSTRATIONS
- IMPACT ACQUISITION & OPERATIONS & MAINTENANCE ROI

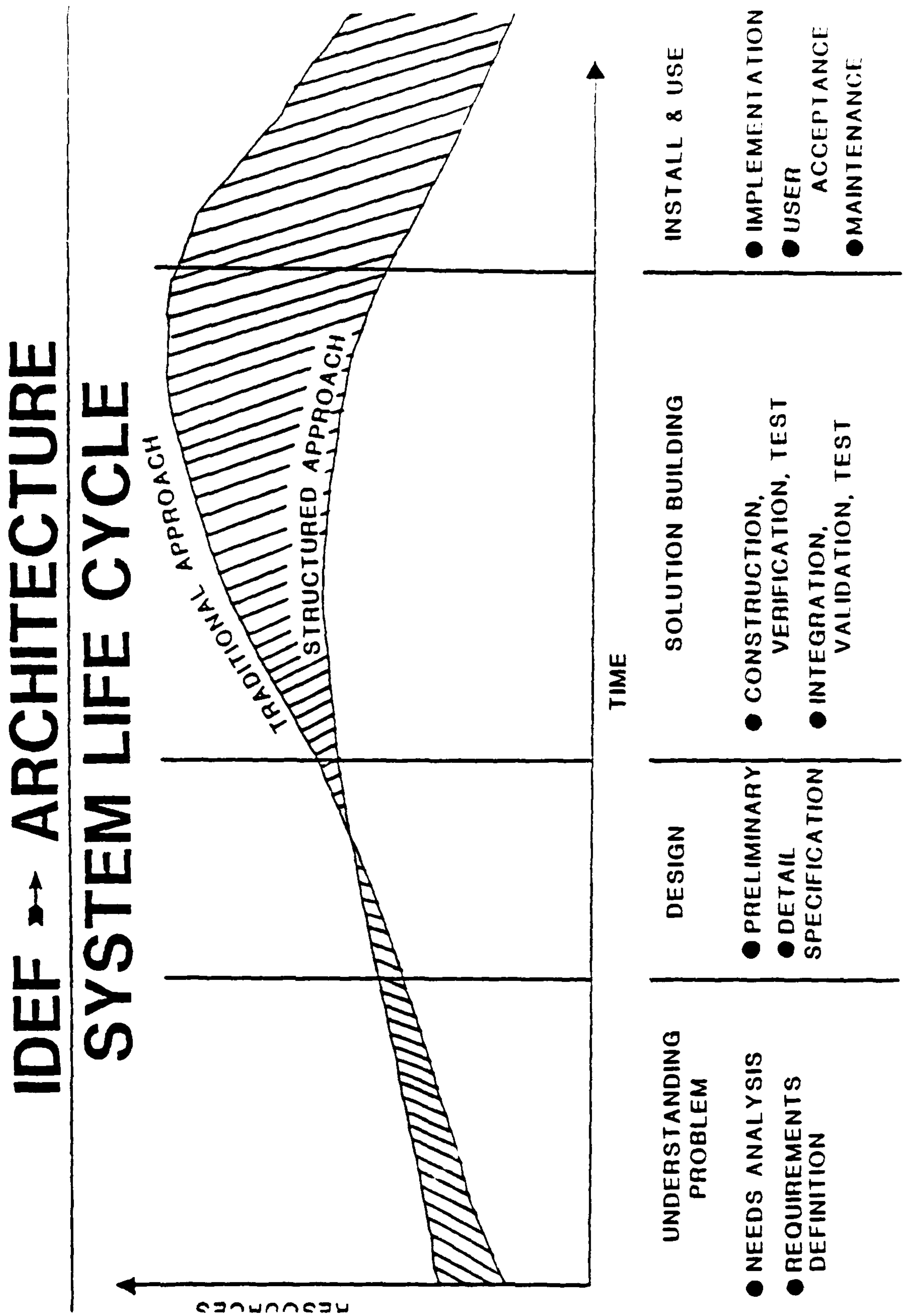
ICAM ANALYTICAL / PLANNING TOOLS

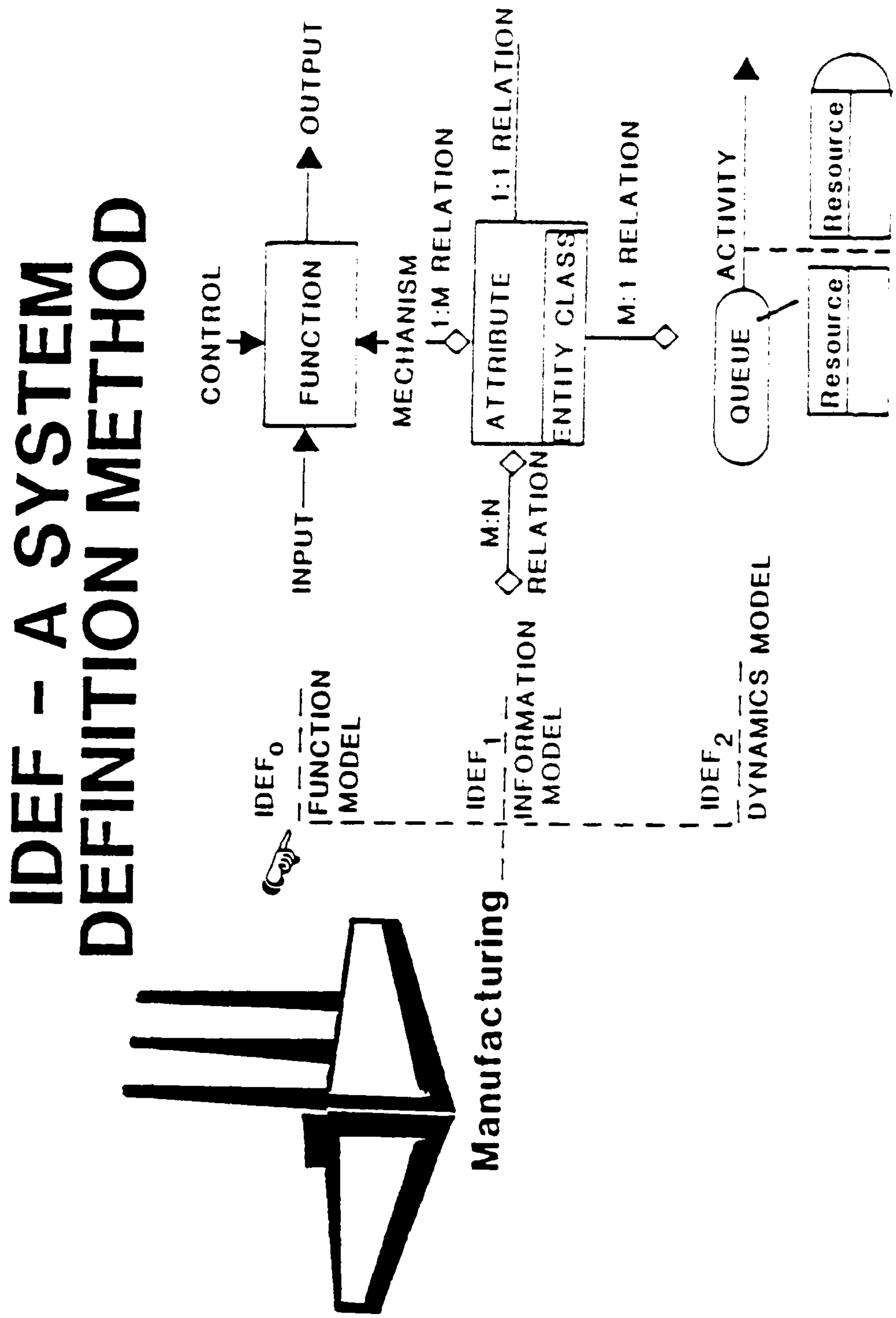

IDEF - A SYSTEM DEFINITION METHOD
Manufacturing
IDEF0
FUNCTION MODEL
IDEF1
INFORMATION MODEL
IDEF2
DYNAMICS MODEL
INPUT
CONTROL
FUNCTION
MECHANISM
OUTPUT
M:N RELATION
ATTRIBUTE
ENTITY CLASS
1:M RELATION
1:1 RELATION
M:1 RELATION
QUEUE
ACTIVITY
Resource
Resource

ICAM

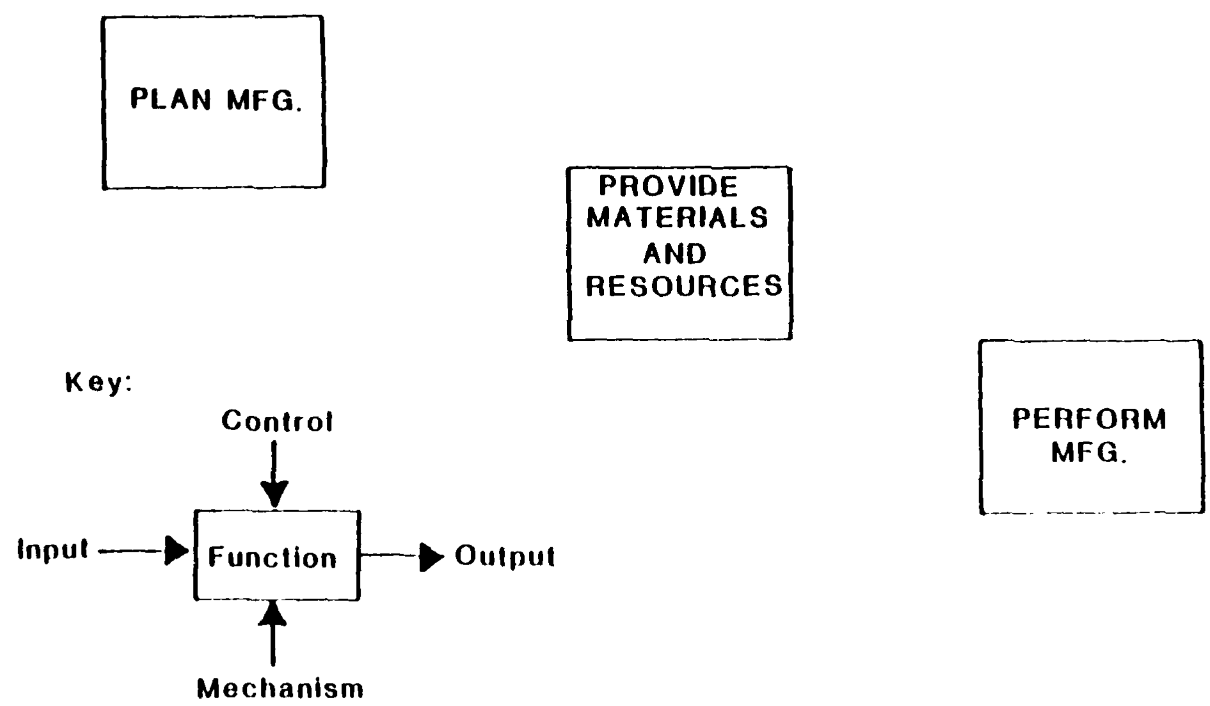
IDEF → ARCHITECTURE

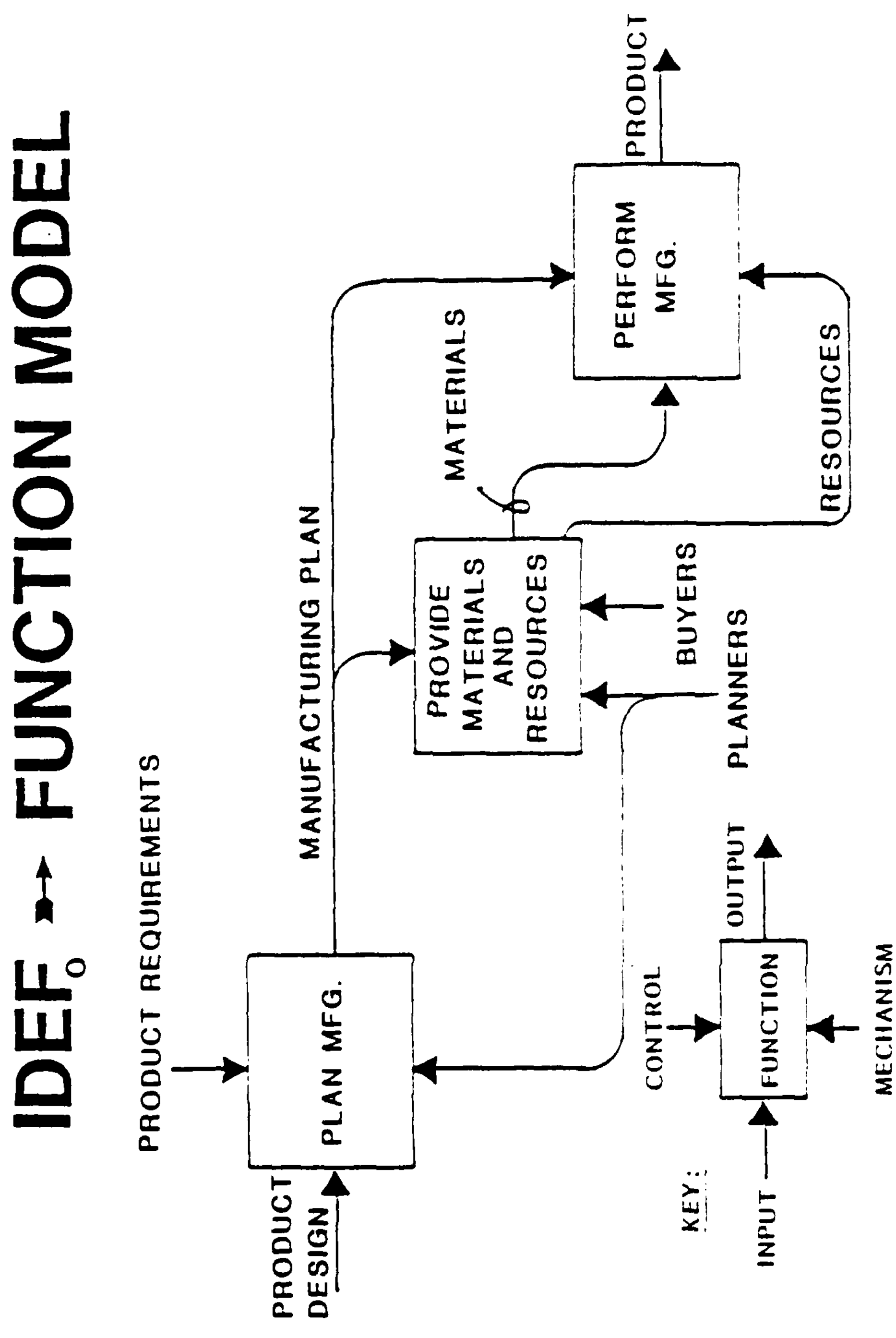



IDEF → ARCHITECTURE
SYSTEM LIFE CYCLE
TRADITIONAL APPROACH
STRUCTURED APPROACH
RESOURCES
TIME
UNDERSTANDING PROBLEM
● NEEDS ANALYSIS
● REQUIREMENTS DEFINITION
DESIGN
● PRELIMINARY
● DETAIL SPECIFICATION
SOLUTION BUILDING
● CONSTRUCTION, VERIFICATION, TEST
● INTEGRATION, VALIDATION, TEST
INSTALL & USE
● IMPLEMENTATION
● USER ACCEPTANCE
● MAINTENANCE

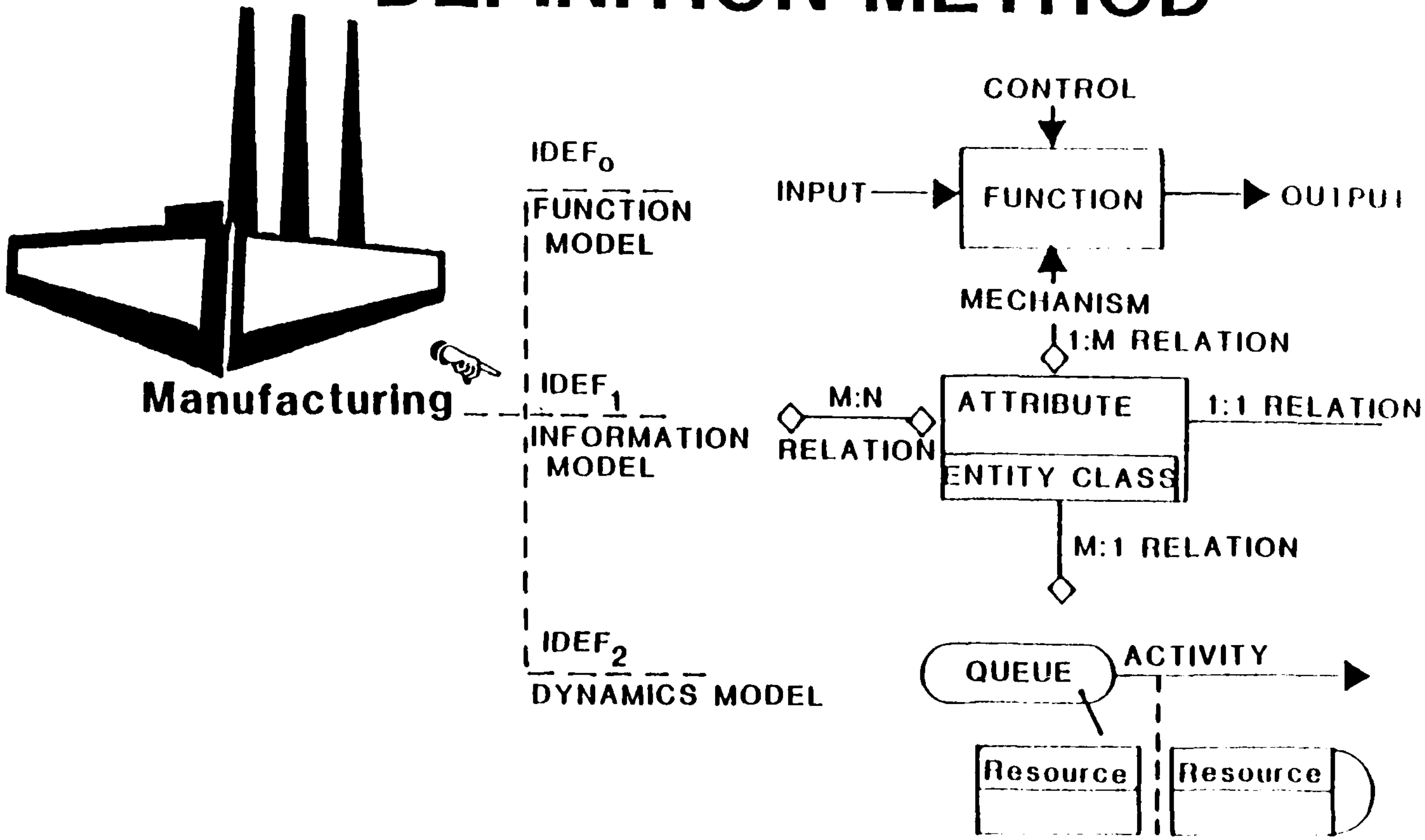

IDEF - A SYSTEM DEFINITION METHOD
Manufacturing
IDEF$_0$
FUNCTION MODEL
IDEF$_1$
INFORMATION MODEL
IDEF$_2$
DYNAMICS MODEL
CONTROL
INPUT
FUNCTION
OUTPUT
MECHANISM
1:M RELATION
1:1 RELATION
ATTRIBUTE
ENTITY CLASS
M:N RELATION
M:1 RELATION
QUEUE
ACTIVITY
Resource
Resource

IDEF$_0$ → FUNCTION MODEL

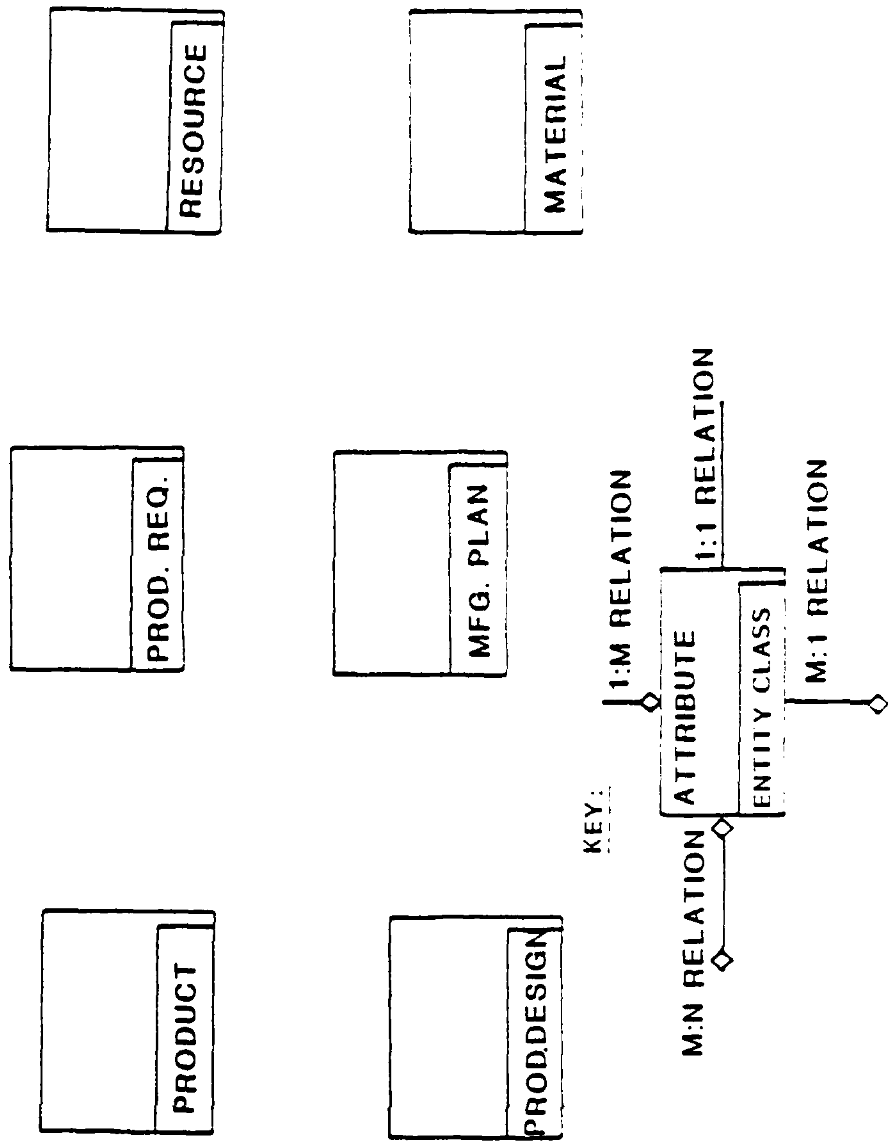



IDEF0 → FUNCTION MODEL
PRODUCT REQUIREMENTS
PLAN MFG.
PRODUCT DESIGN
MANUFACTURING PLAN
PROVIDE MATERIALS AND RESOURCES
BUYERS
PLANNERS
MATERIALS
RESOURCES
PERFORM MFG.
PRODUCT
KEY:
INPUT
CONTROL
FUNCTION
MECHANISM
OUTPUT

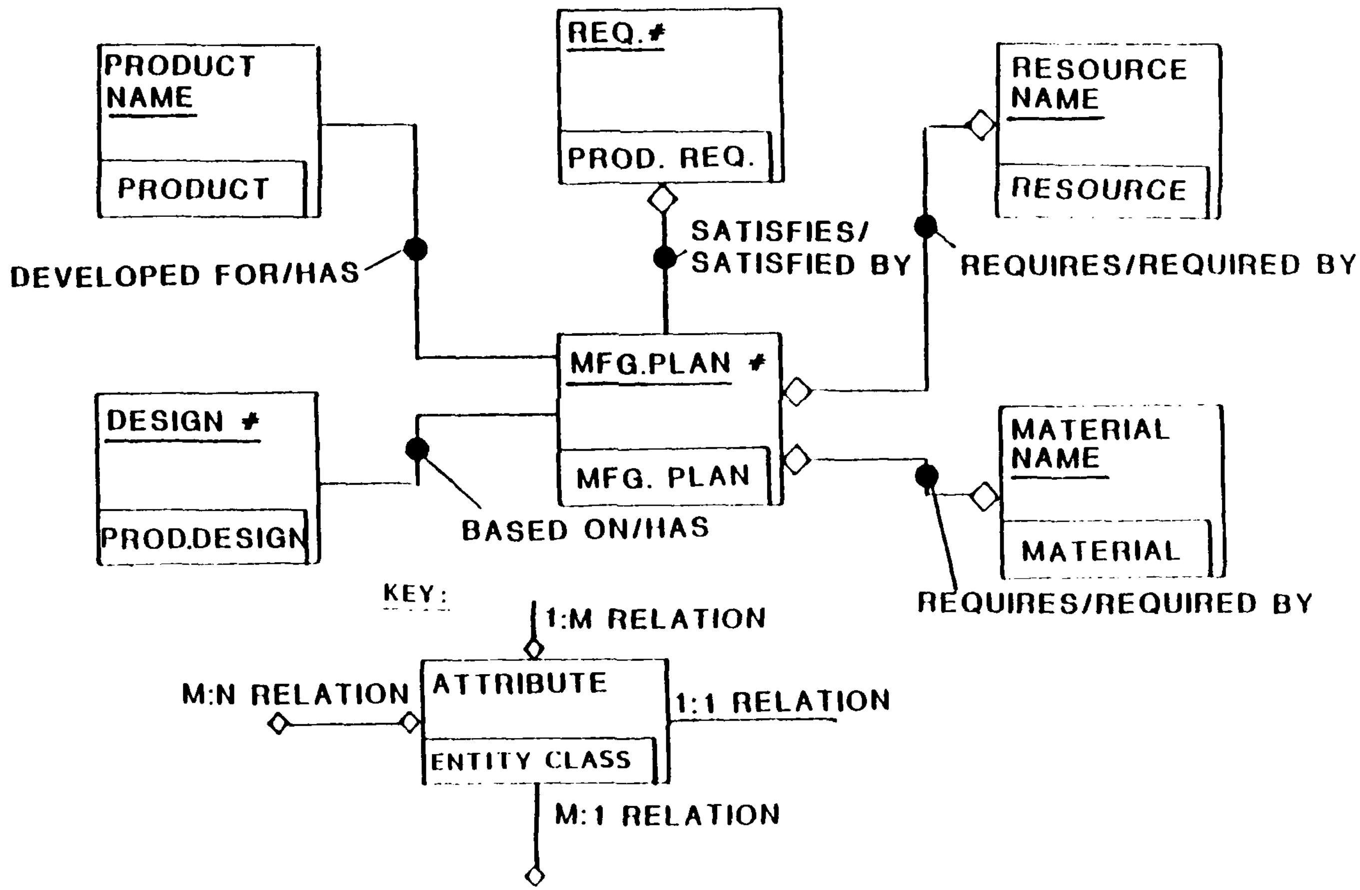
IDEF - A SYSTEM DEFINITION METHOD



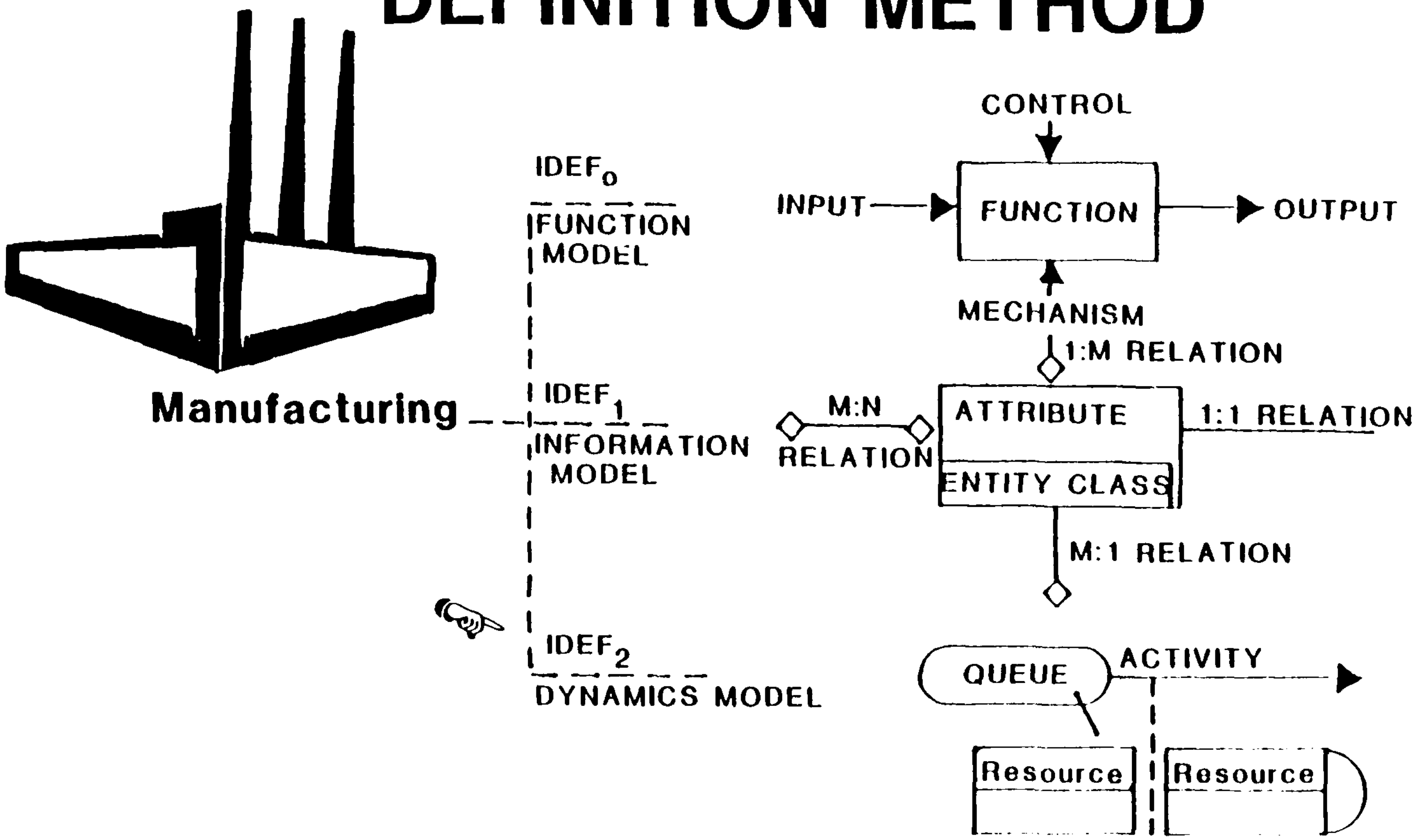
IDEF$_1$ → INFORMATION MODEL



IDEF$_1$ → INFORMATION MODEL

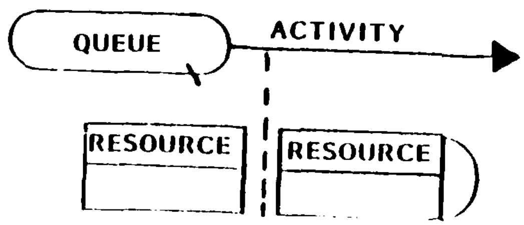


IDEF - A SYSTEM DEFINITION METHOD

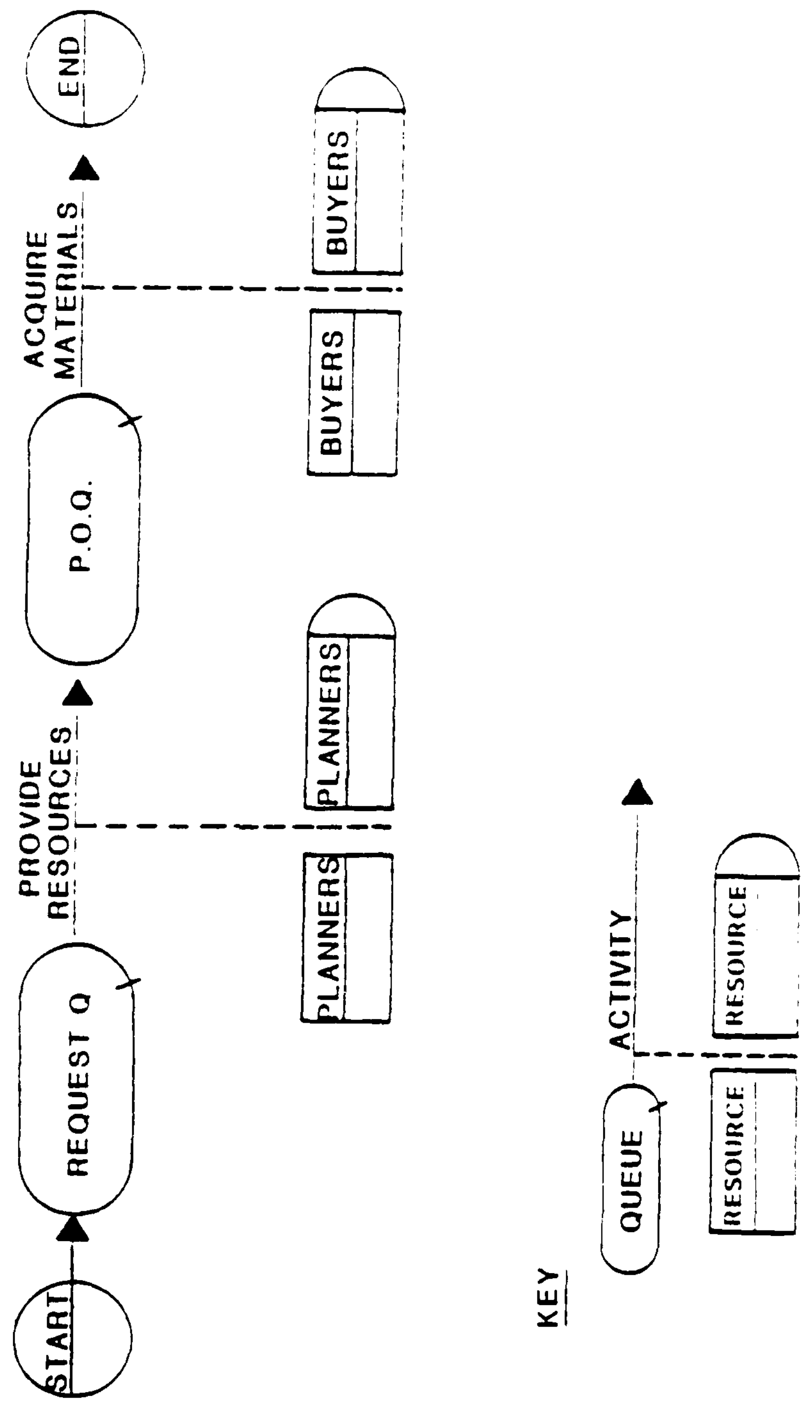


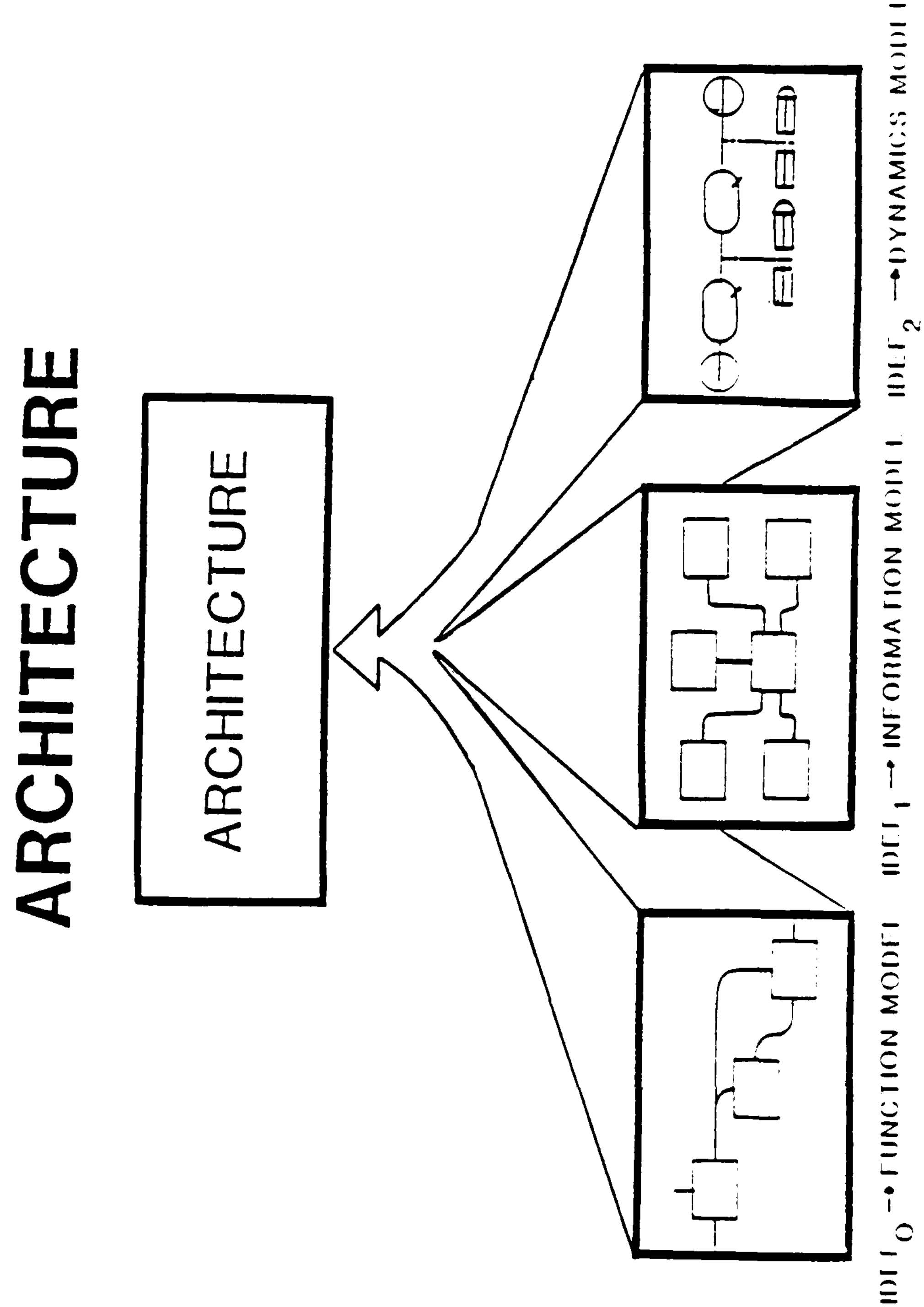
IDEF$_2$ ➛ DYNAMICS MODEL

KEY



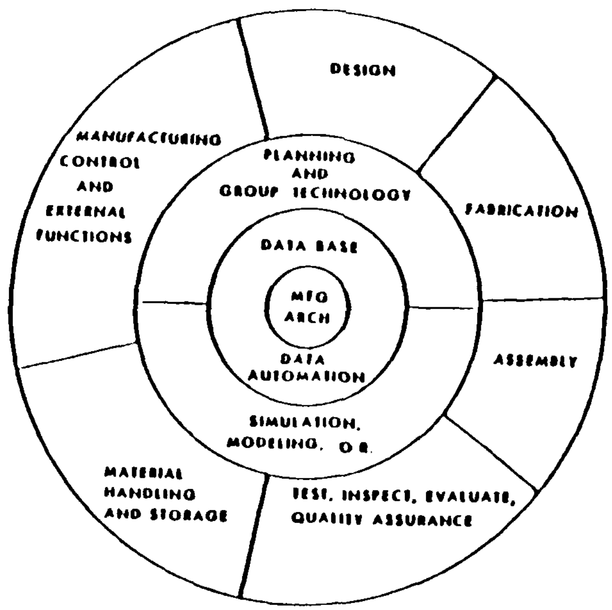
IDEF$_2$ → DYNAMICS MODEL



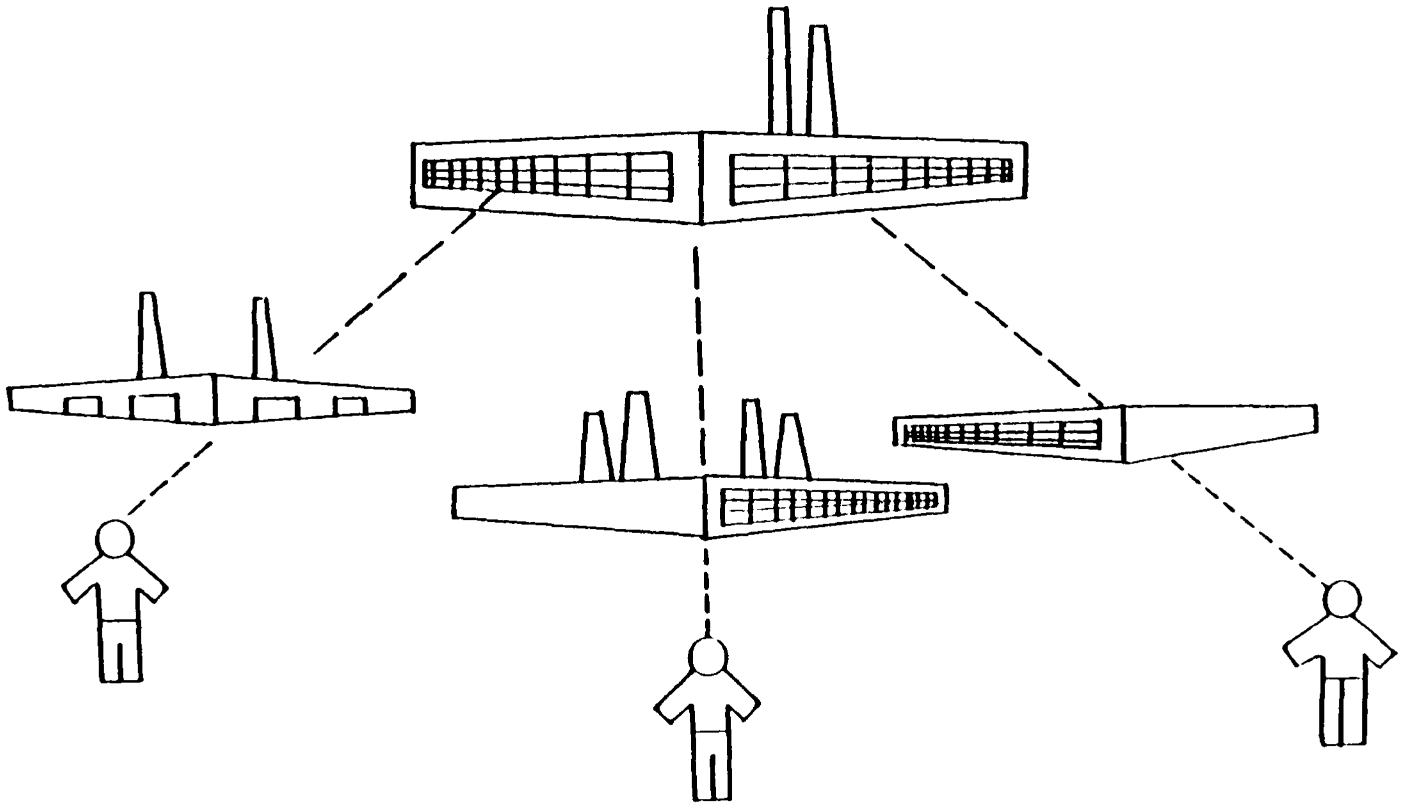

ARCHITECTURE
ARCHITECTURE
IDEF0 → FUNCTION MODEL
IDEF1 → INFORMATION MODEL
IDEF2 → DYNAMICS MODEL

ICAM

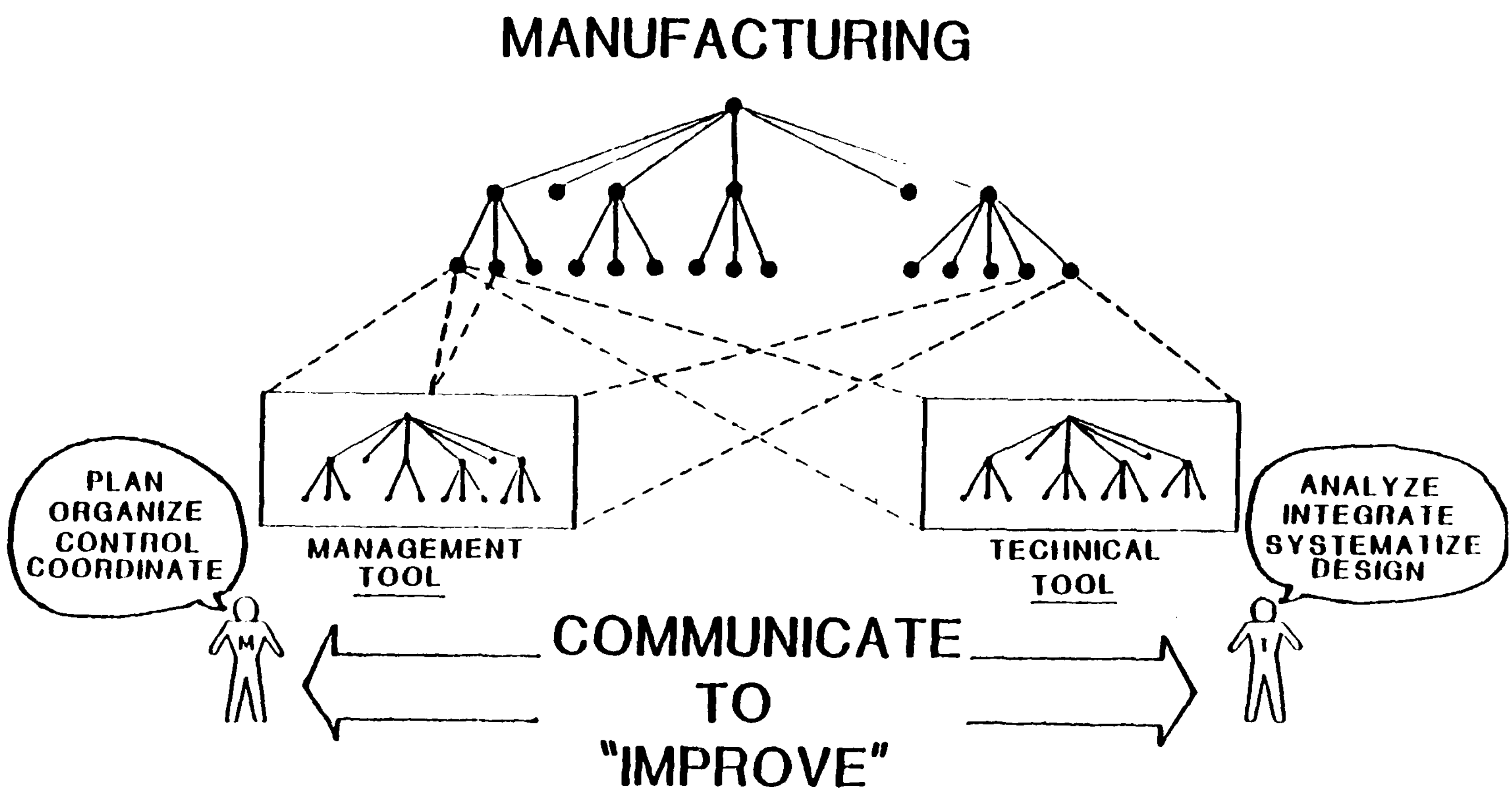
INTEGRATED COMPUTER-AIDED MANUFACTURING



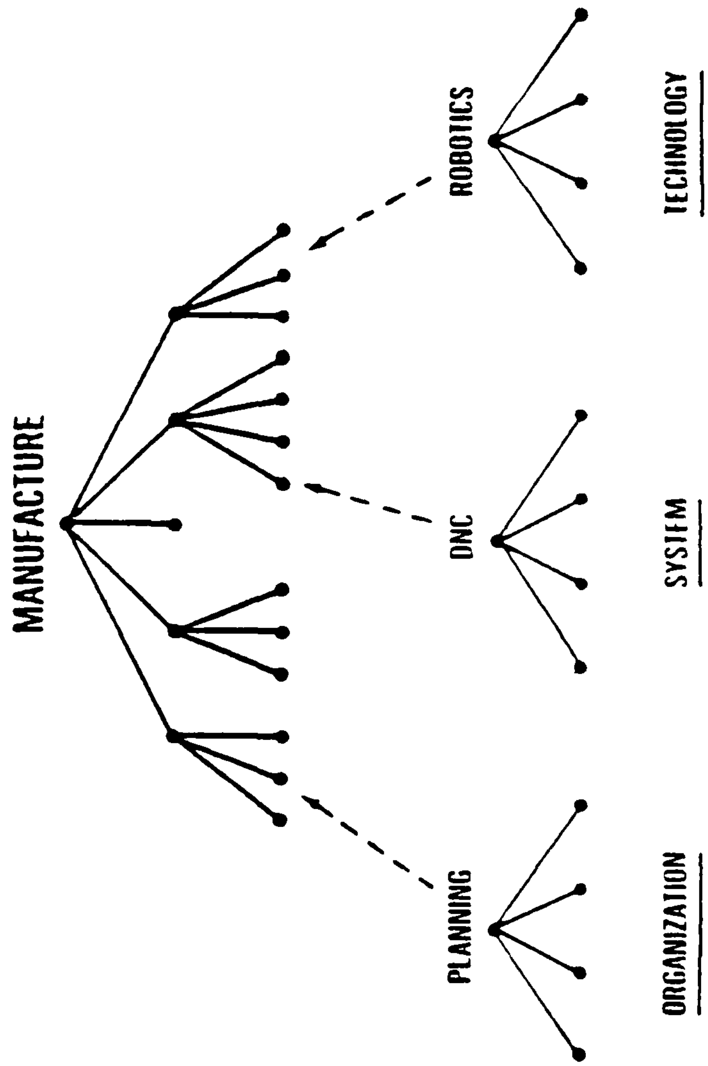
ARCHITECTURE
STANDARD FOR COMMUNICATION



ARCHITECTURE



STANDARD FOR COMMUNICATION



<u>IDEF</u> IS THE <u>METHOD</u>

<u>ARCHITECTURE</u> IS THE <u>MEANS</u>

<u>PRODUCTIVITY</u> IS THE <u>OBJECTIVE</u>

ICAM INTEGRATED SHEET METAL CENTER (ISMC)

MACHINE UTILIZATION ↑ 44%

NUMBER OF:

- MACHINES ↓ 44%
- FLOOR SPACE ↓ 39%
- PEOPLE ↓ 44%

THROUGHPUT ↑ 25%

COST:

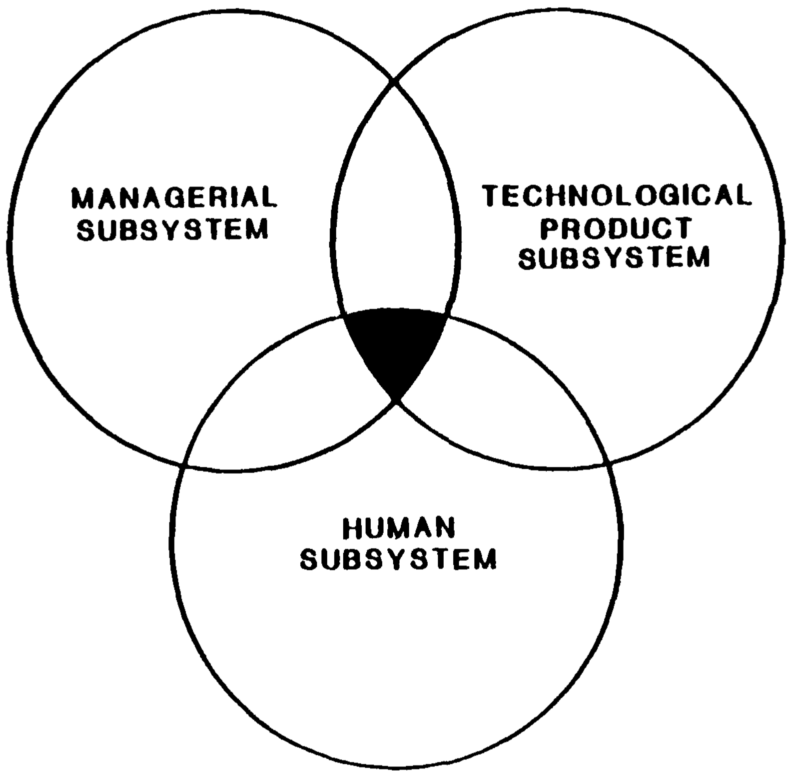
- INITIAL ↓ 17%
- ANNUAL ↓ 24%

INTEGRATED
STRATEGIC PLANNING
AND
INFORMATION RESOURCE
MANAGEMENT

RESOURCE MANAGEMENT

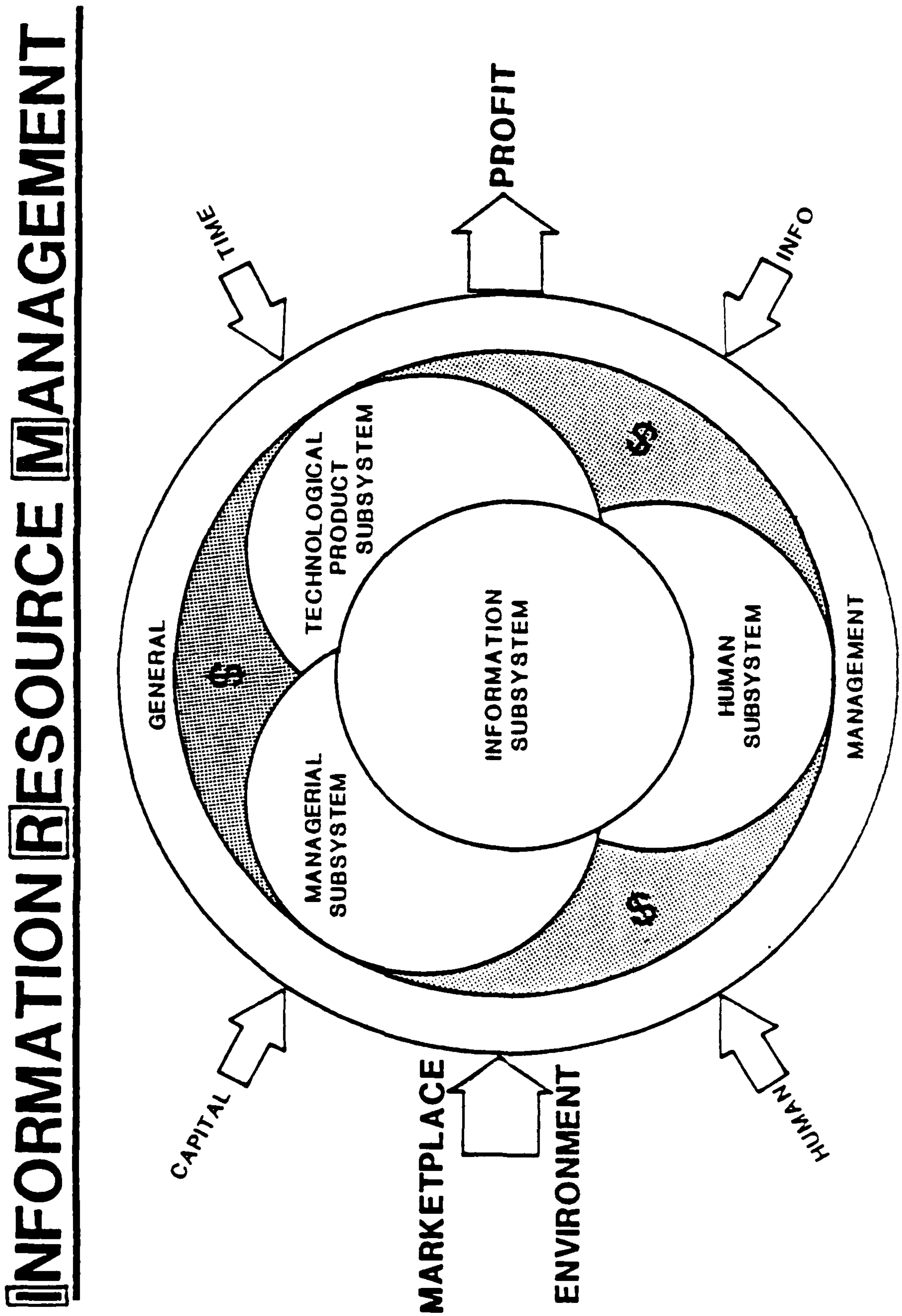
CAPITAL RESOURCES

TIME RESOURCES



HUMAN RESOURCES

INFORMATION RESOURCES


INFORMATION RESOURCE MANAGEMENT
PROFIT
TIME
INFO
CAPITAL
HUMAN
MARKETPLACE
ENVIRONMENT
GENERAL
MANAGEMENT
TECHNOLOGICAL PRODUCT SUBSYSTEM
INFORMATION SUBSYSTEM
HUMAN SUBSYSTEM
MANAGERIAL SUBSYSTEM
$
$
$

INFORMATION RESOURCE MANAGEMENT (IRM)

"INFORMATION IS THE MANAGER'S MAIN TOOL, INDEED THE MANAGER'S "CAPITAL", AND IT IS HE WHO MUST DECIDE WHAT INFORMATION HE NEEDS AND HOW TO USE IT."

PETER DRUCKER-"MANAGING THE INFORMATION EXPLOSION"

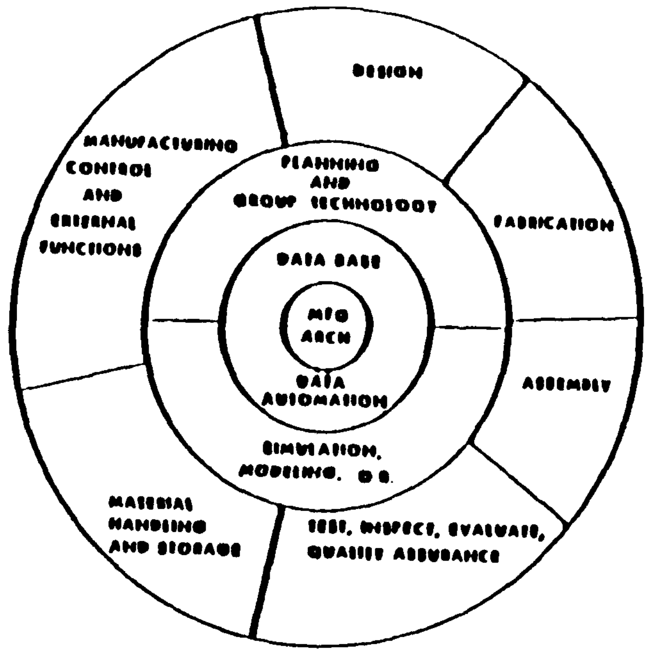
INTEGRATED STRATEGIC PLANNING AND IRM

- "ONLY 19% OF THE COMPANIES SURVEYED HAVE INTEGRATED THEIR STRATEGIC PLANNING AND INFORMATION RESOURCE MANAGEMENT (IRM) SYSTEMS"
- "THE COMPANIES THAT DID SO OUTPERFORMED THE REST OF THE SAMPLE BY ABOUT 300% OVER FIVE YEARS ON SUCH MEASURES AS :
  - AVERAGE RETURN ON EQUITY
  - RETURN ON TOTAL CAPITAL
  - NEW PROFIT MARGINS"

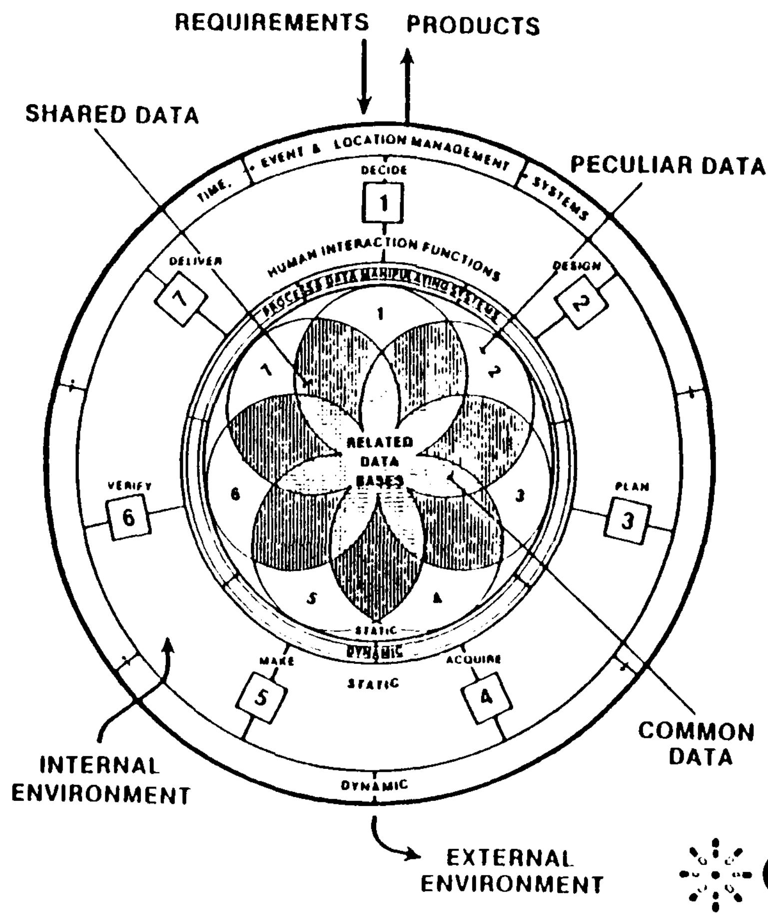
(REF: A.T. KEARNEY, INC, MANAGEMENT CONSULTANT SURVEY OF 40 OF 500 LARGEST U.S. INDUSTRIAL AND FINANCIAL INSTITUTIONS)

ICAM

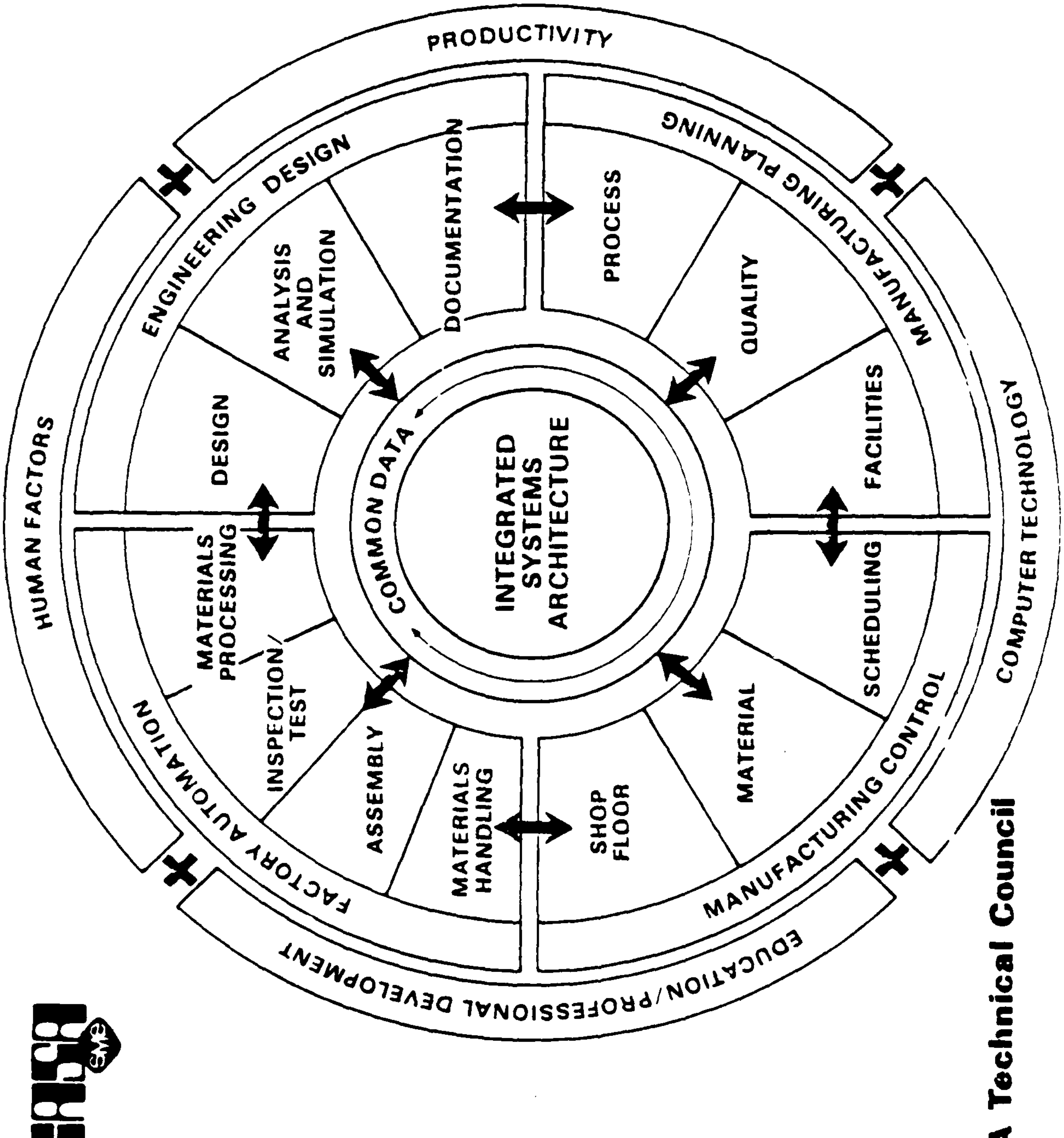
INTEGRATED COMPUTER-AIDED MANUFACTURING



DYNAMIC HUMAN DIRECTED COMPUTER-AIDED ACTIVITY MODEL



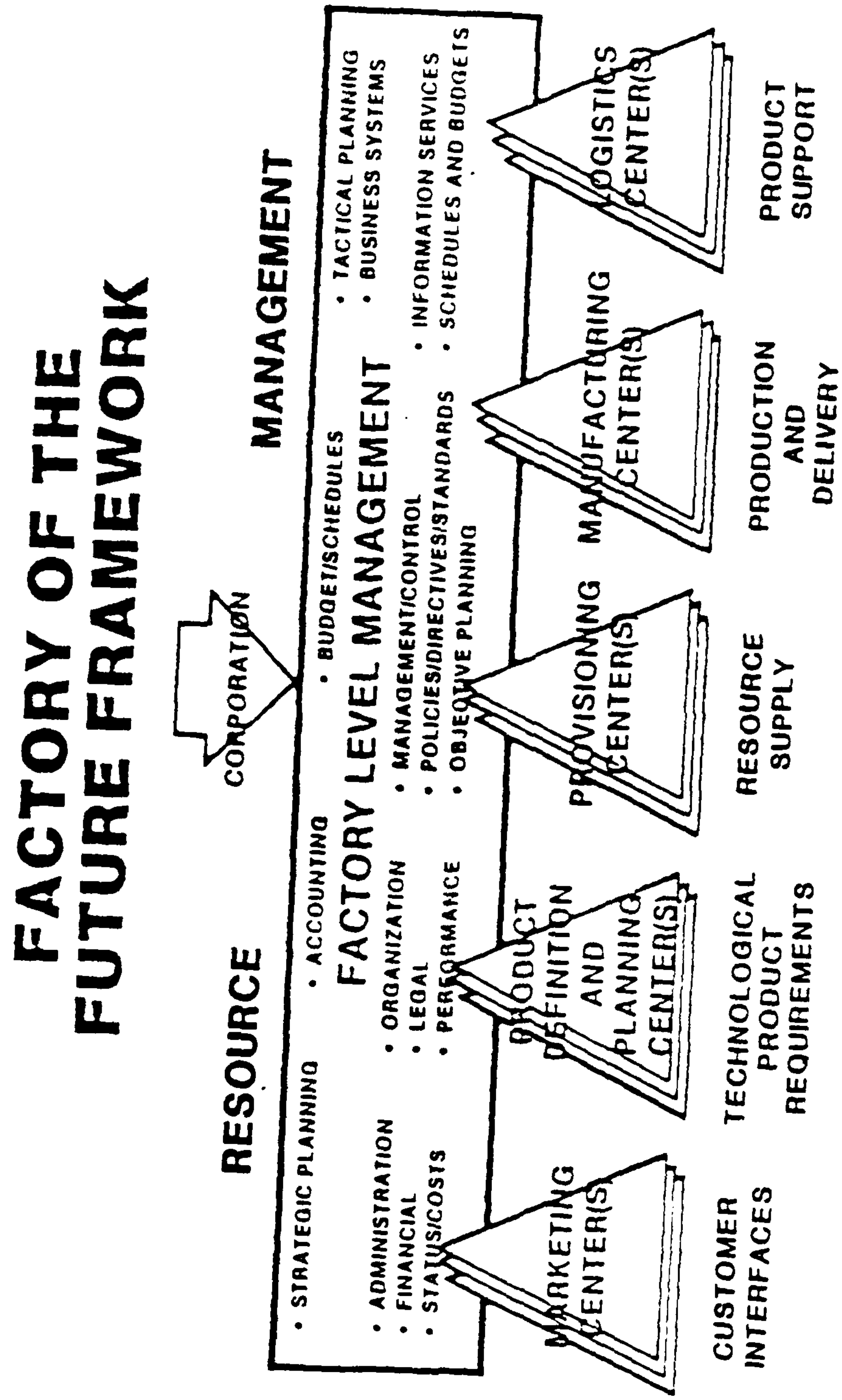
CAM-I



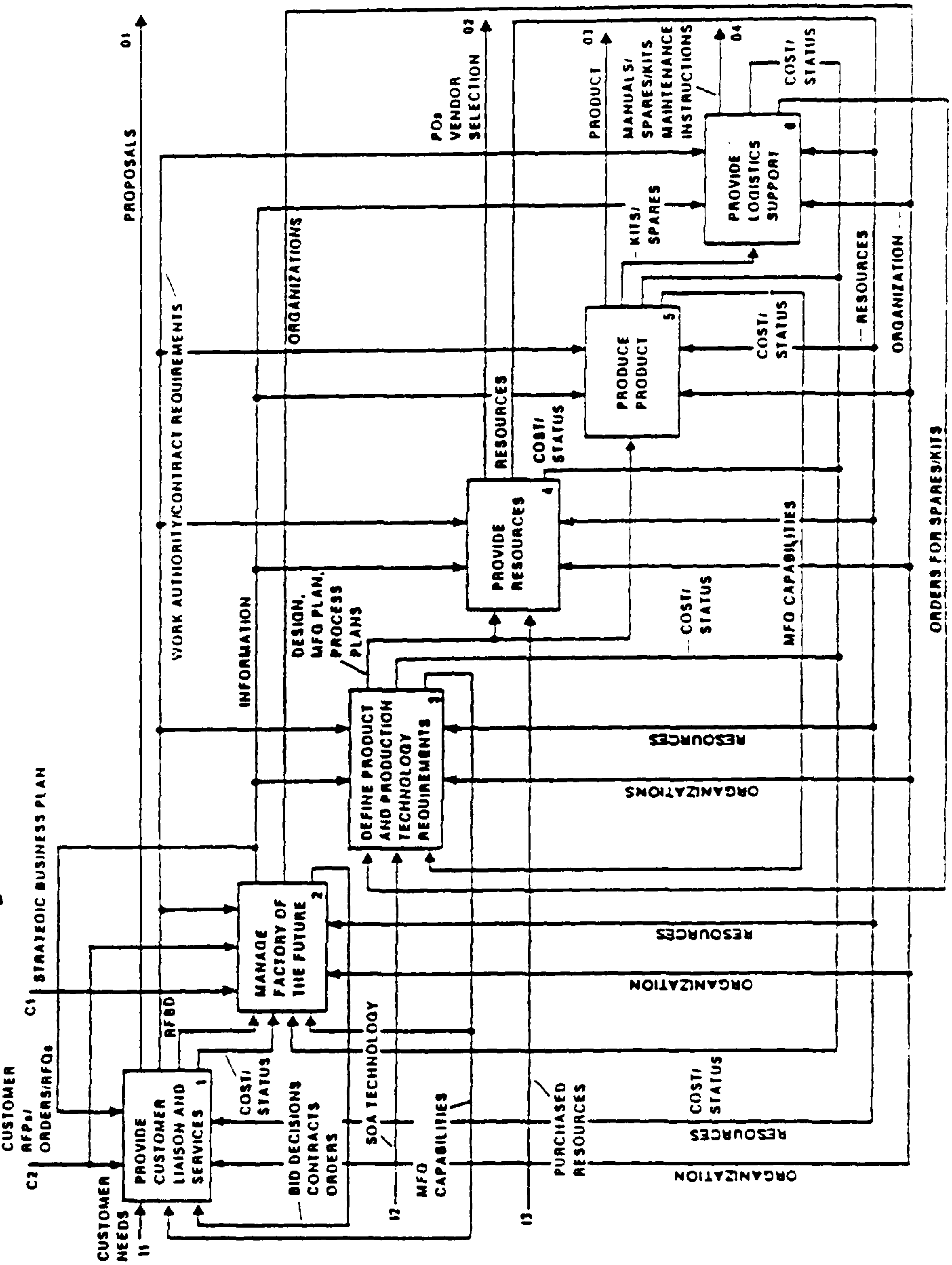
CASA Technical Council

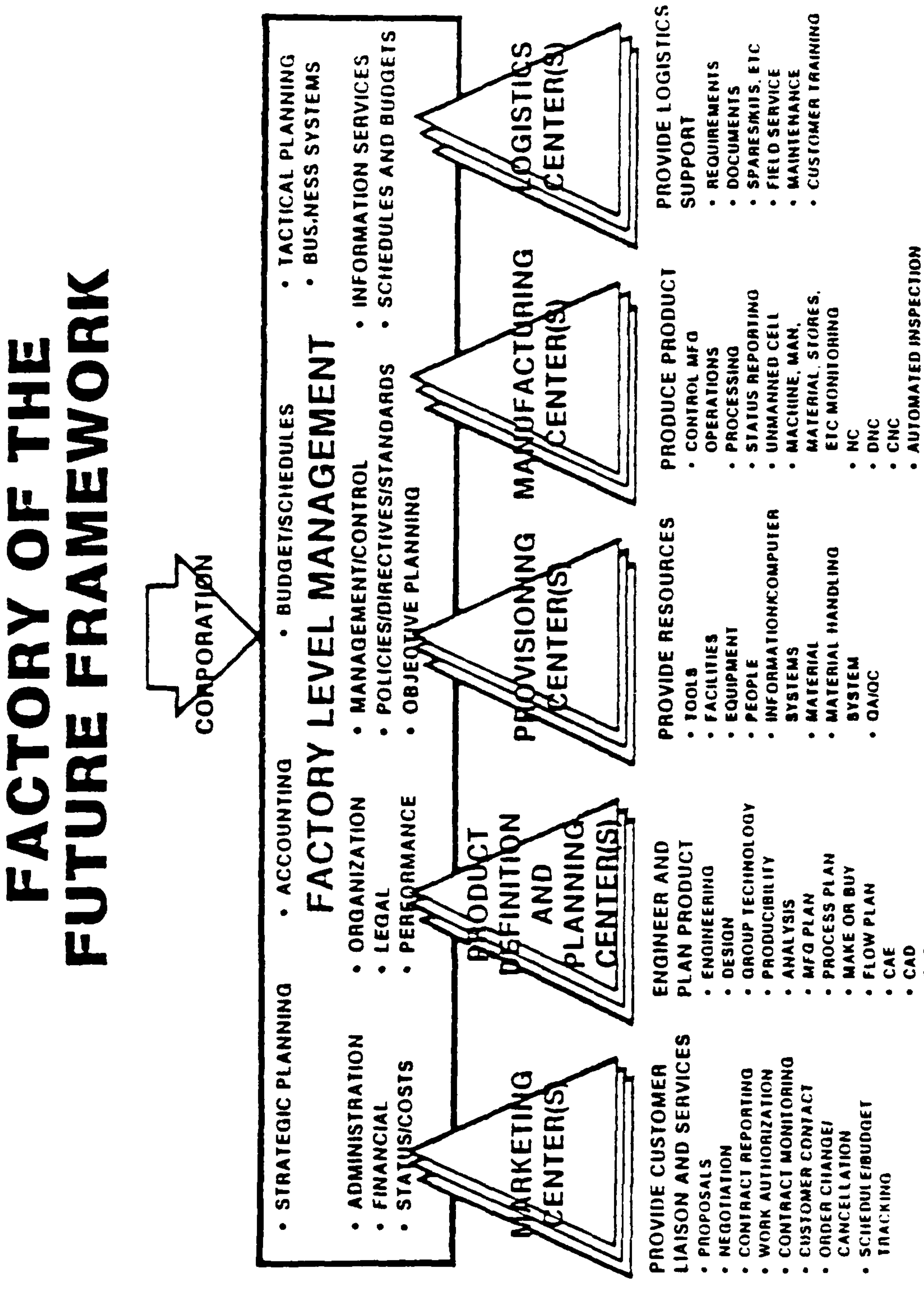
COMMON TERMINOLOGY

- FRAMEWORK
- ARCHITECTURE
- STRUCTURE
- "BLUE PRINT"
- "ROAD MAP"


FACTORY OF THE
FUTURE FRAMEWORK
RESOURCE
MANAGEMENT
CORPORATION
• STRATEGIC PLANNING
• ACCOUNTING
• BUDGET/SCHEDULES
• TACTICAL PLANNING
• BUSINESS SYSTEMS
FACTORY LEVEL MANAGEMENT
• ADMINISTRATION
• FINANCIAL
• STATUS/COSTS
• ORGANIZATION
• LEGAL
• PERFORMANCE
• MANAGEMENT/CONTROL
• POLICIES/DIRECTIVES/STANDARDS
• OBJECTIVE PLANNING
• INFORMATION SERVICES
• SCHEDULES AND BUDGETS
MARKETING CENTER(S)
PRODUCT DEFINITION AND PLANNING CENTER(S)
PROVISIONING CENTER(S)
MANUFACTURING CENTER(S)
LOGISTICS CENTER(S)
CUSTOMER INTERFACES
TECHNOLOGICAL PRODUCT REQUIREMENTS
RESOURCE SUPPLY
PRODUCTION AND DELIVERY
PRODUCT SUPPORT

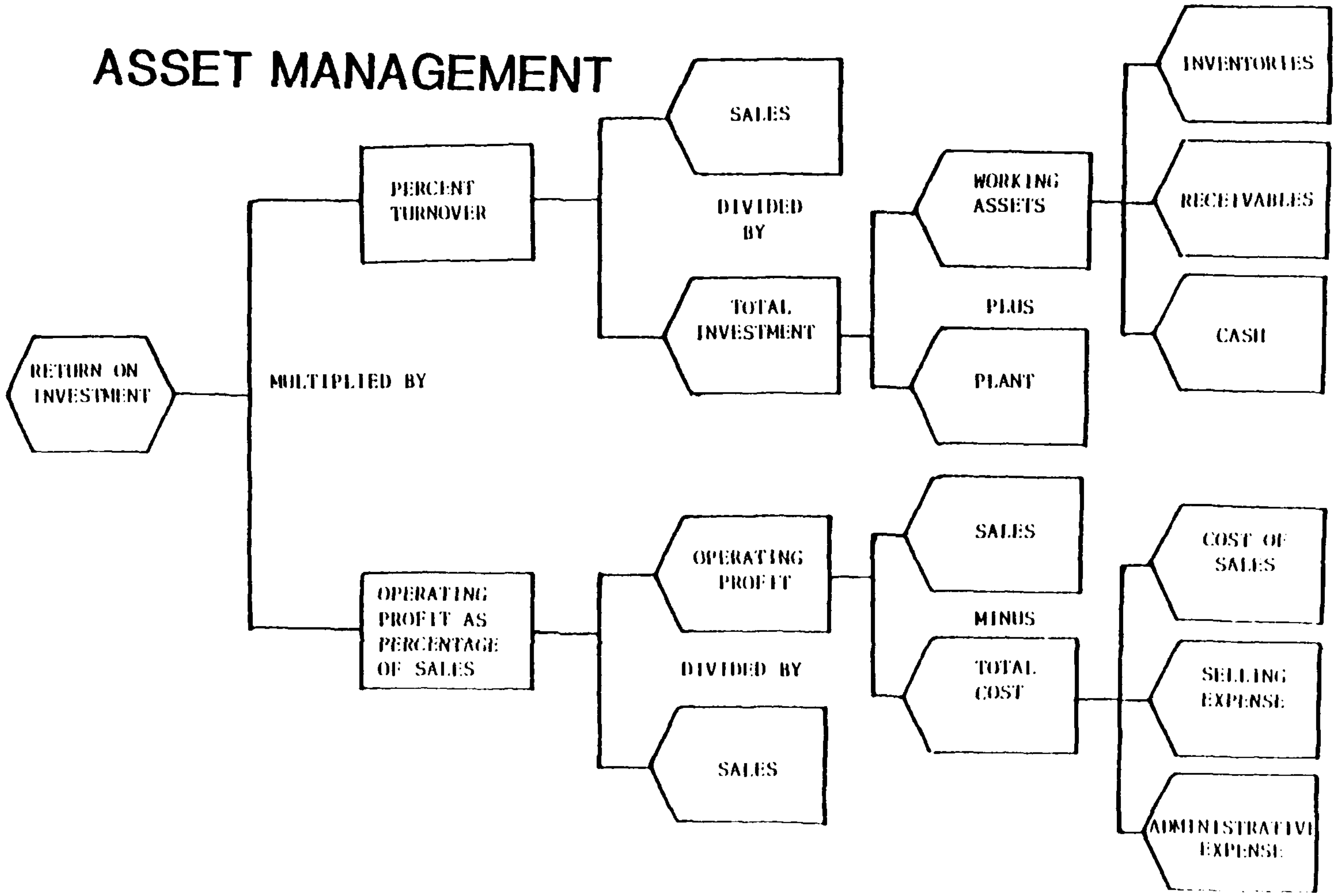
Factory of the Future Framework



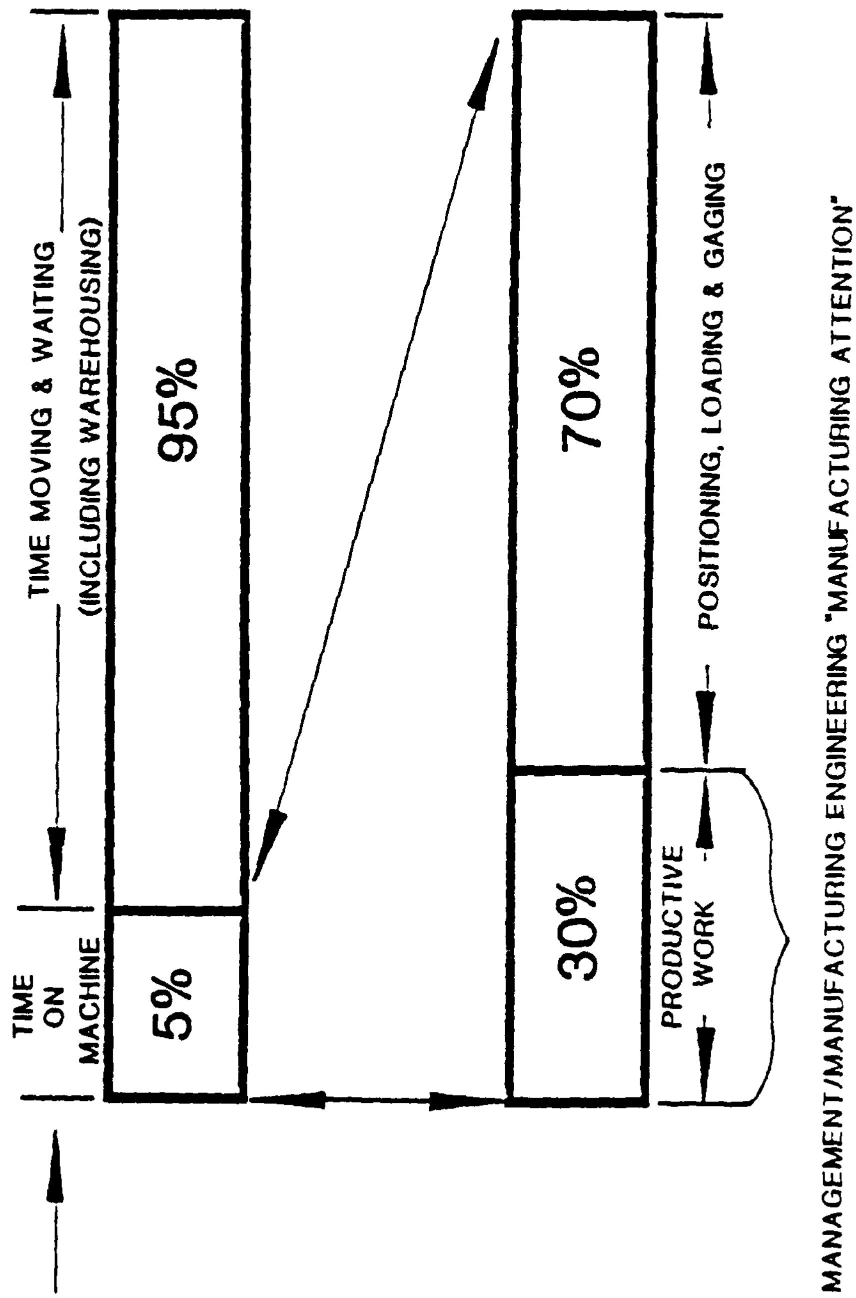

FACTORY OF THE
FUTURE FRAMEWORK
CORPORATION
• STRATEGIC PLANNING
• ACCOUNTING
• BUDGET/SCHEDULES
• TACTICAL PLANNING
• BUS.NESS SYSTEMS
FACTORY LEVEL MANAGEMENT
• ADMINISTRATION
• FINANCIAL
• STATUS/COSTS
• ORGANIZATION
• LEGAL
• PERFORMANCE
• MANAGEMENT/CONTROL
• POLICIES/DIRECTIVES/STANDARDS
• OBJECTIVE PLANNING
• INFORMATION SERVICES
• SCHEDULES AND BUDGETS
MARKETING CENTER(S)
PRODUCT DEFINITION AND PLANNING CENTER(S)
PROVISIONING CENTER(S)
MANUFACTURING CENTER(S)
LOGISTICS CENTER(S)
PROVIDE CUSTOMER LIAISON AND SERVICES
• PROPOSALS
• NEGOTIATION
• CONTRACT REPORTING
• WORK AUTHORIZATION
• CONTRACT MONITORING
• CUSTOMER CONTACT
• ORDER CHANGE/ CANCELLATION
• SCHEDULE/BUDGET TRACKING
ENGINEER AND PLAN PRODUCT
• ENGINEERING
• DESIGN
• GROUP TECHNOLOGY
• PRODUCIBILITY
• ANALYSIS
• MFG PLAN
• PROCESS PLAN
• MAKE OR BUY
• FLOW PLAN
• CAE
• CAD
• GPP
PROVIDE RESOURCES
• TOOLS
• FACILITIES
• EQUIPMENT
• PEOPLE
• INFORMATION/COMPUTER SYSTEMS
• MATERIAL
• MATERIAL HANDLING SYSTEM
• QA/QC
PRODUCE PRODUCT
• CONTROL MFG OPERATIONS
• PROCESSING
• STATUS REPORTING
• UNMANNED CELL
• MACHINE, MAN, MATERIAL, STORES, ETC MONITORING
• NC
• DNC
• CNC
• AUTOMATED INSPECTION
PROVIDE LOGISTICS SUPPORT
• REQUIREMENTS
• DOCUMENTS
• SPARES/KITS, ETC
• FIELD SERVICE
• MAINTENANCE
• CUSTOMER TRAINING

CAPITAL vs. RETURN ON INVESTMENT (ROI)

ASSET MANAGEMENT



INVENTORY "TIME IN SHOP"



TIME MANAGEMENT

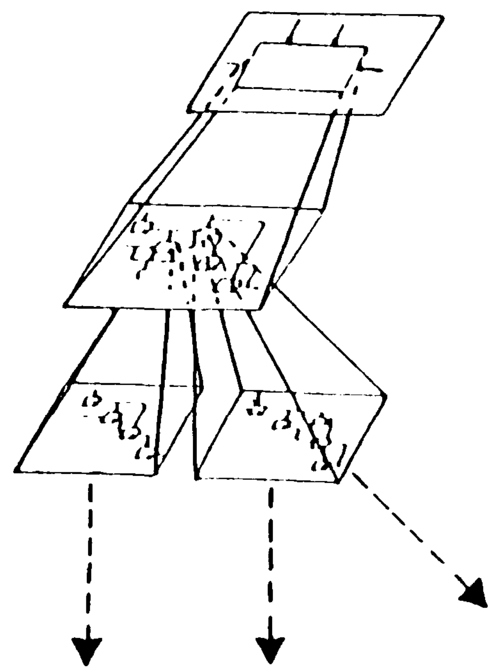
NODE INDEX

A-0 MANUFACTURE PRODUCT (CONTEXT)

AO MANUFACTURE PRODUCT

- A1 PLAN FOR MANUFACTURE
  - A11 ASSUME A STRUCTURE AND METHOD OF MANUFACTURE
  - A12 ESTIMATE REQUIREMENTS, TIME, AND COST TO PRODUCE
  - A13 DEVELOP PRODUCTION PLANS
  - A14 DEVELOP SUPPORT ACTIVITIES PLANS
- A2 MAKE AND ADMINISTER SCHEDULES AND BUDGETS
  - A21 DEVELOP MASTER SCHEDULE
  - A22 DEVELOP COORDINATING SCHEDULES
  - A23 ESTIMATE COSTS AND MAKE BUDGETS
  - A24 MONITOR PERFORMANCE TO SCHEDULE AND BUDGET
- A3 PLAN PRODUCTION
  - A31 CONTROL PLANNING
  - A32 DETERMINE DETAILED METHOD OF MANUFACTURE
  - A33 DEVELOP PRODUCTION INSTRUCTIONS
  - A34 VALIDATE RELEASE PLANNING

CORRESPONDING DECOMPOSITION STRUCTURE



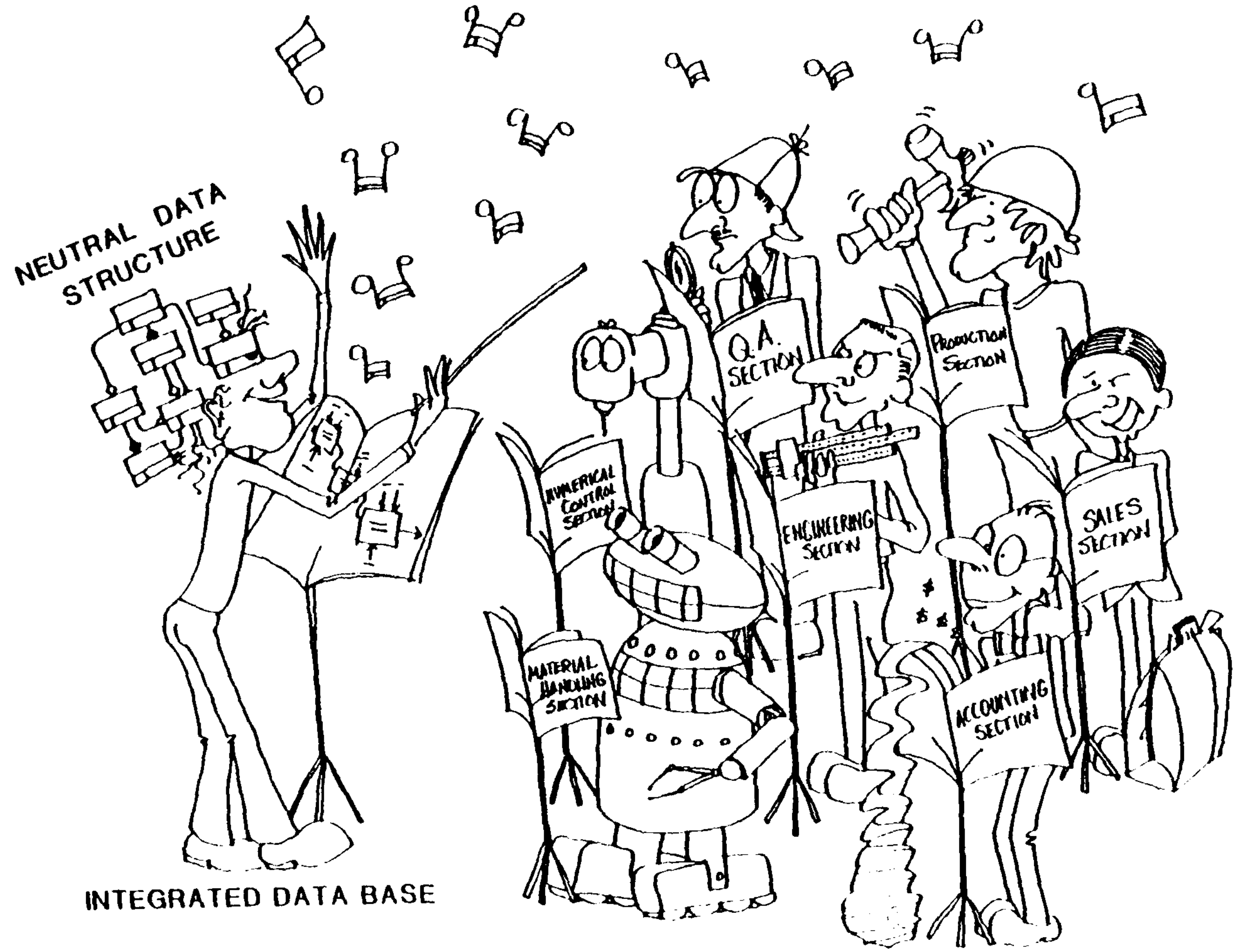
INFORMATION RESOURCE AND HUMAN RESOURCE MANAGEMENT

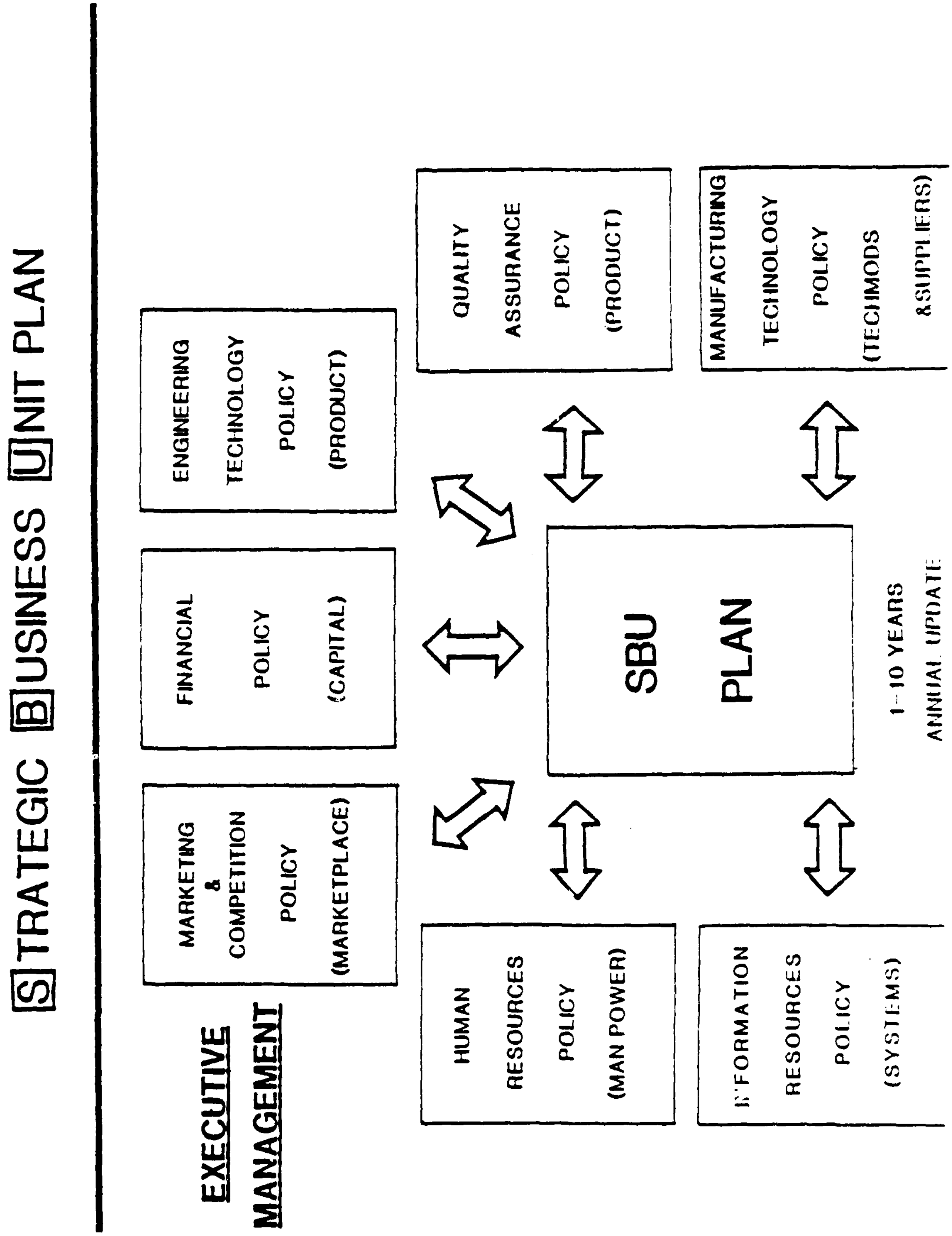
- **THE PRODUCT OF ANY EMPLOYEE THAT DOES NOT LAY HANDS ON THE HARDWARE PRODUCT IS <u>DATA</u> AND/OR <u>DECISIONS</u>.**
- **EMPLOYEE "PARTICIPATION" IS DEPENDENT UPON KNOWLEDGE OF <u>THEIR</u> SURROUNDING ENVIRONMENT <u>AND</u> CONTRIBUTION OF <u>THEIR</u> <u>DATA</u>.**
- **TEAM MANAGEMENT TECHNIQUES OFFER AN EXPLOSIVE IMPACT ON PRODUCTIVITY**
- **TMT STRUCTURED METHODOLOGIES CHANNEL THIS ENERGY TOWARD "TOP DOWN" PLANNING GOALS**

TEAM MANAGEMENT TECHNIQUES (TMT)

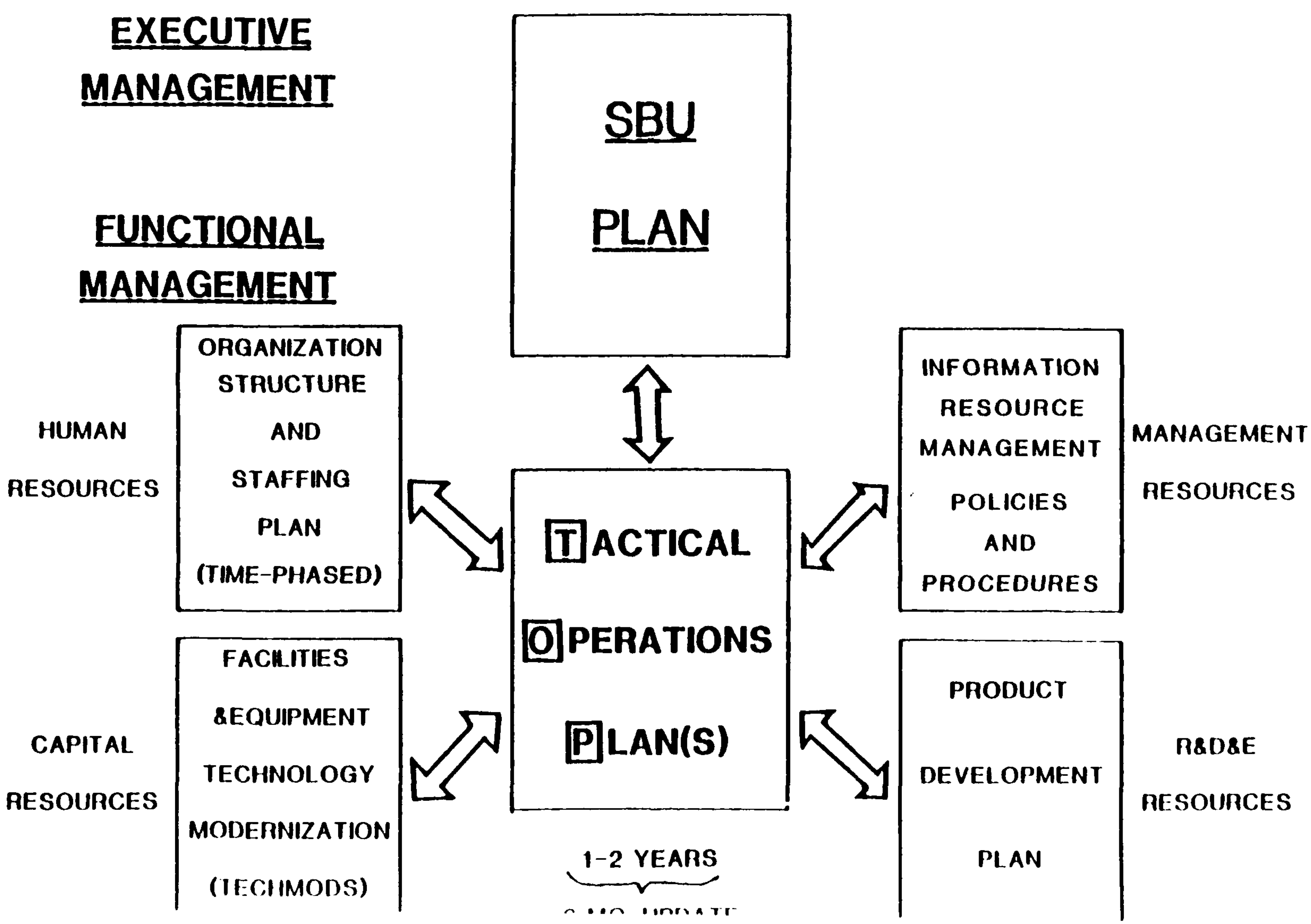
- PROJECT DEFINITION
- ASSIGN PROJECT TEAMS
- SELECT TEAM MEMBERS
- MANAGE TEAM MEETINGS
- STRUCTURED ANALYTICAL INTEGRATION TOOLS
  - $IDEF_0$ FUNCTION/ACTIVITY MODELS
  - $IDEF_1$ INFORMATION MODELS
  - $IDEF_2$ DYNAMICS MODELS
  - COST DRIVER ANALYSIS (COST MODELS)
- ANTICIPATE FUTURE PROBLEMS

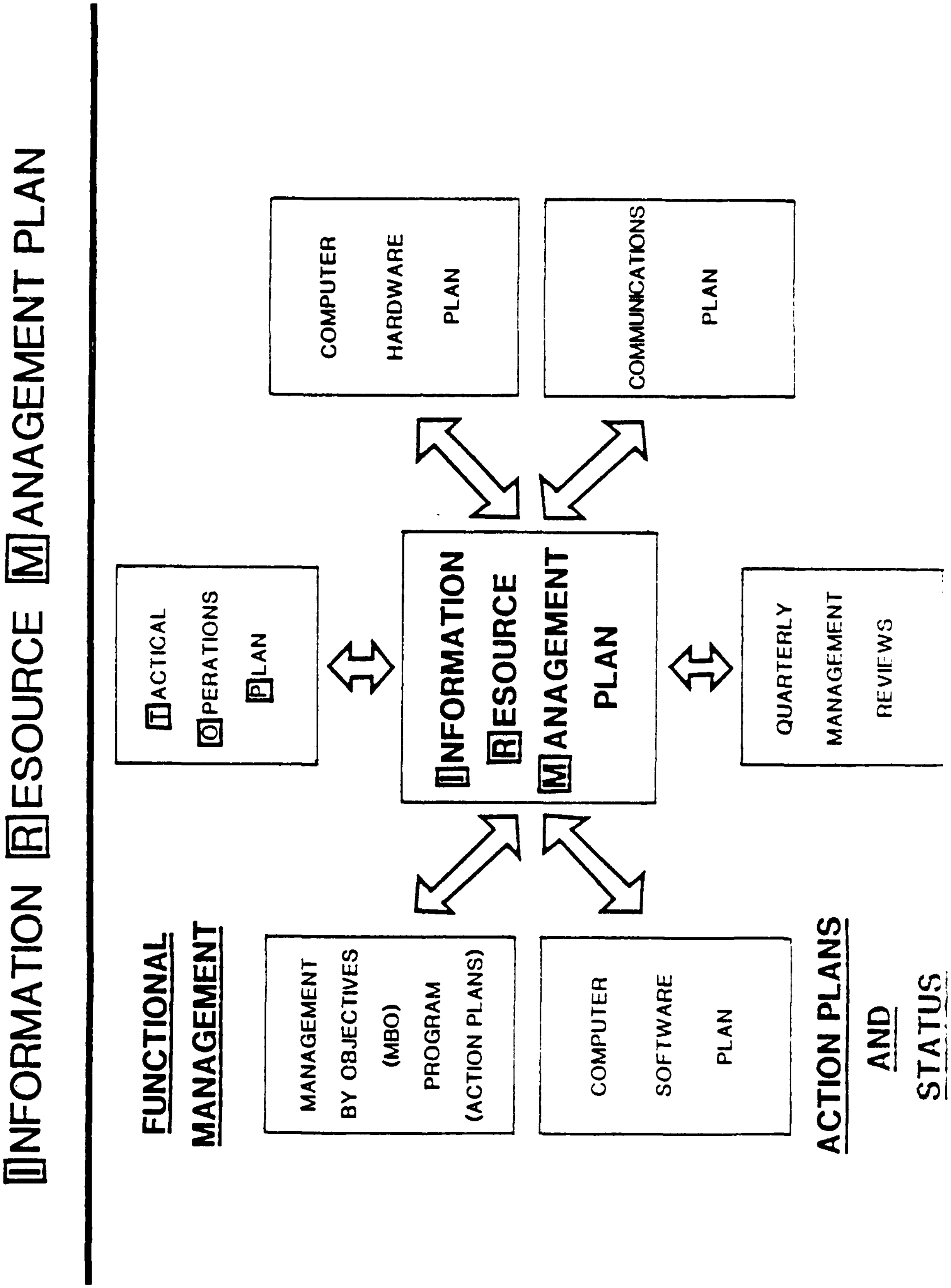
INFORMATION RESOURCE MANAGEMENT (IRM)



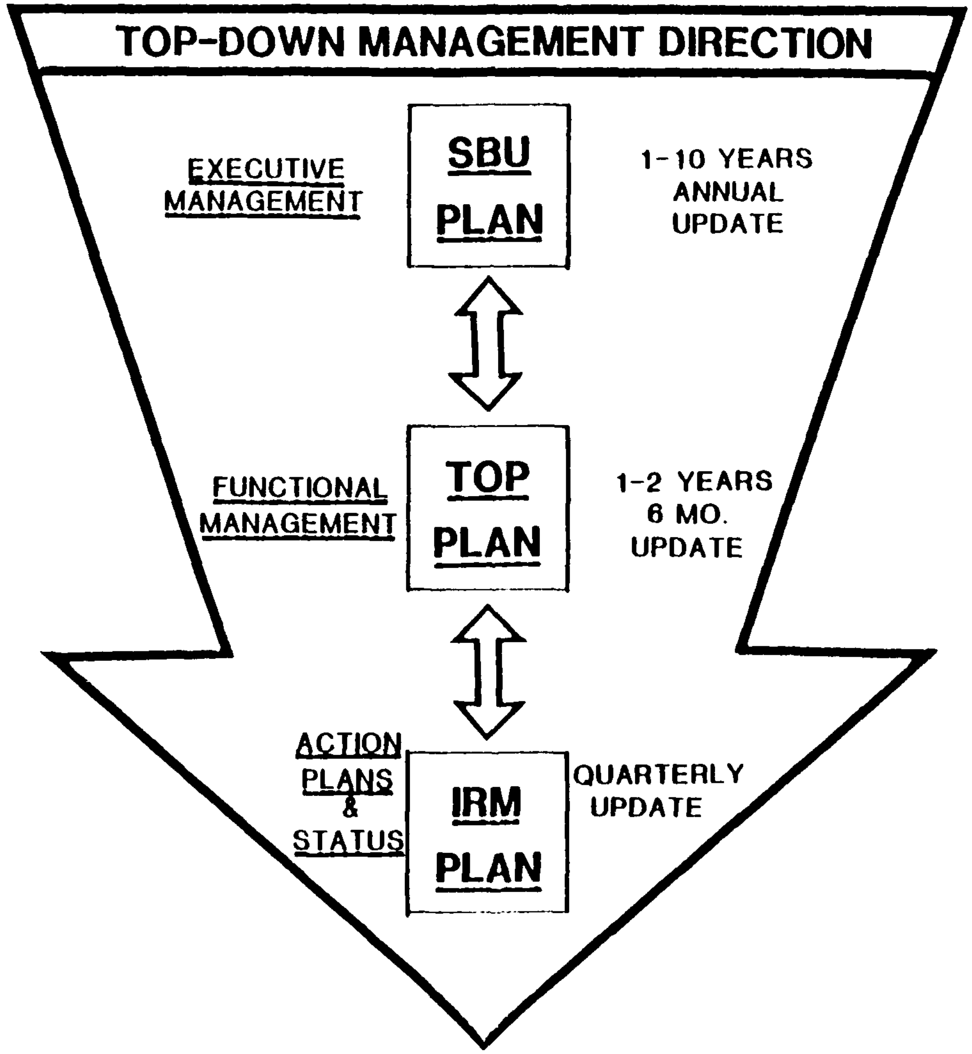

STRATEGIC BUSINESS UNIT PLAN
EXECUTIVE MANAGEMENT
MARKETING & COMPETITION POLICY (MARKETPLACE)
FINANCIAL POLICY (CAPITAL)
ENGINEERING TECHNOLOGY POLICY (PRODUCT)
HUMAN RESOURCES POLICY (MAN POWER)
QUALITY ASSURANCE POLICY (PRODUCT)
SBU PLAN
1–10 YEARS
ANNUAL UPDATE
INFORMATION RESOURCES POLICY (SYSTEMS)
MANUFACTURING TECHNOLOGY POLICY (TECHMODS & SUPPLIERS)

TACTICAL OPERATIONS PLAN(S)

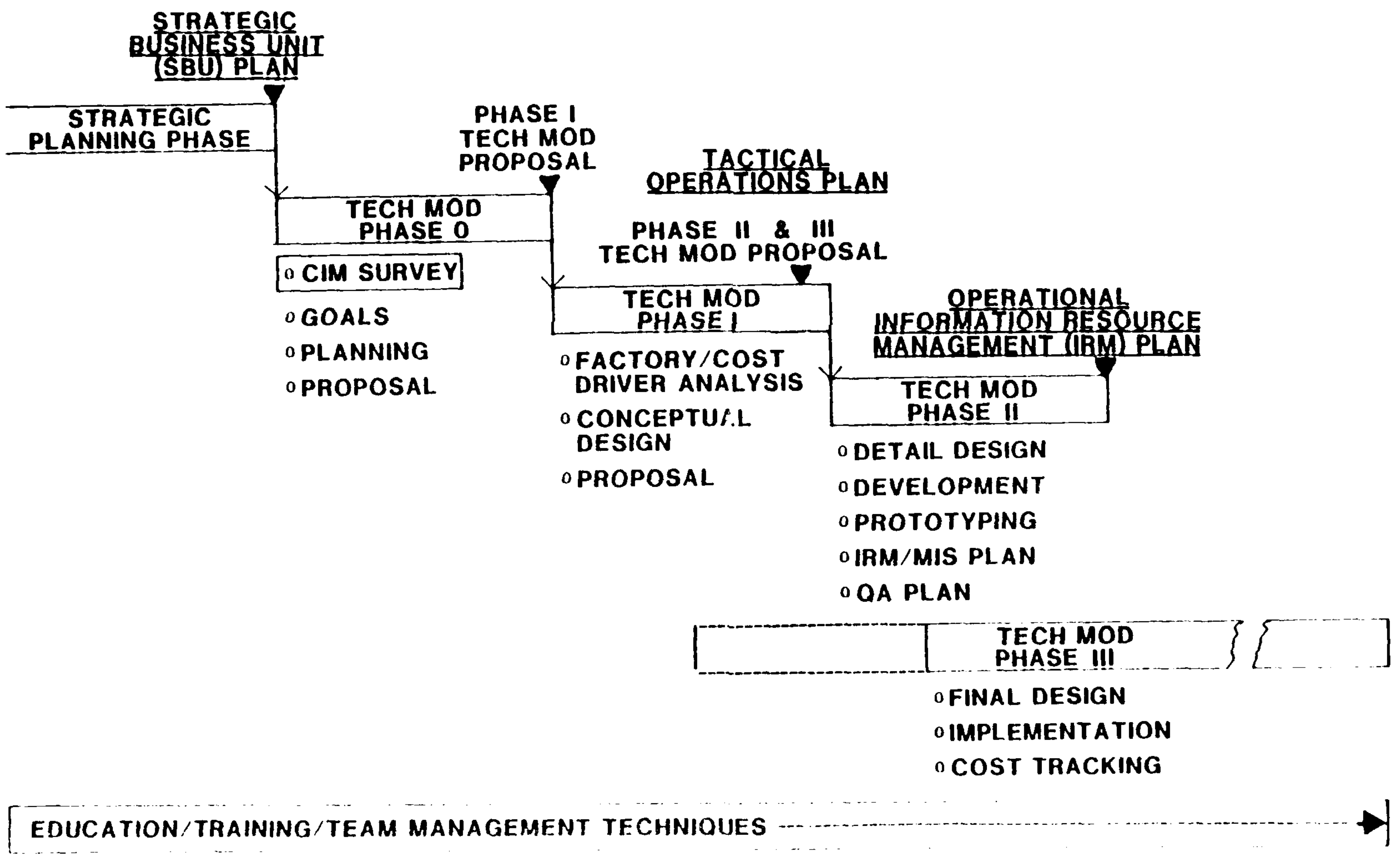



INFORMATION RESOURCE MANAGEMENT PLAN
FUNCTIONAL MANAGEMENT
TACTICAL OPERATIONS PLAN
COMPUTER HARDWARE PLAN
COMMUNICATIONS PLAN
INFORMATION RESOURCE MANAGEMENT PLAN
QUARTERLY MANAGEMENT REVIEWS
MANAGEMENT BY OBJECTIVES (MBO) PROGRAM (ACTION PLANS)
COMPUTER SOFTWARE PLAN
ACTION PLANS AND STATUS

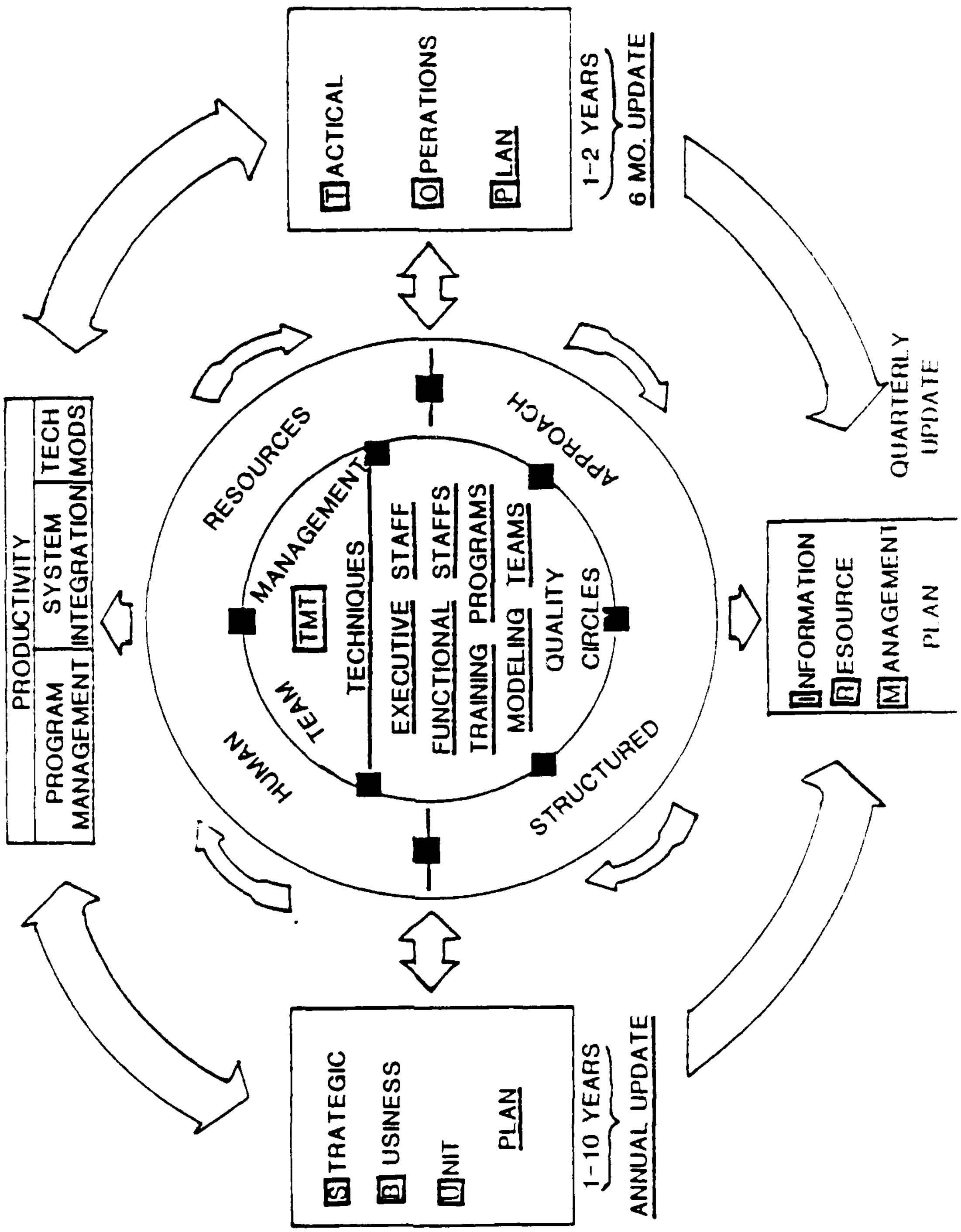
INFORMATION RESOURCE MANAGEMENT PROGRAM



TECHNOLOGY MODERNIZATION FRAMEWORK



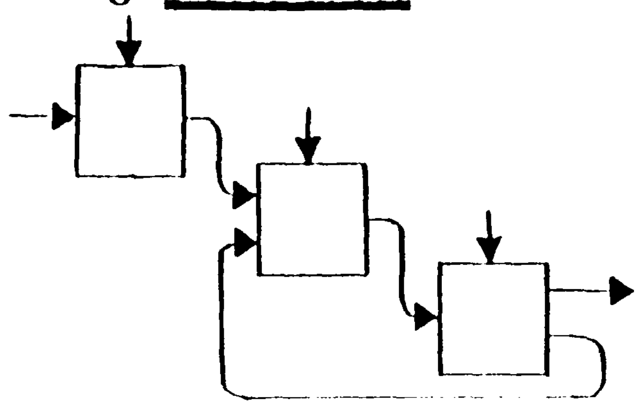
IRM=" TOP-DOWN " PRODUCTIVITY ENGINEERING



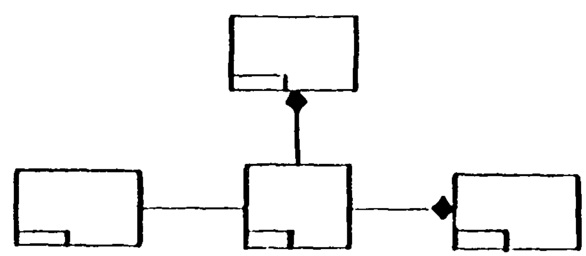
ICAM DEFINITION ➞ IDEF

SYSTEMATIC APPLICATION of COMPUTER TECHNOLOGY

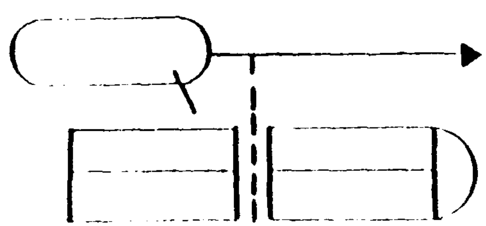
$IDEF_0$ **FUNCTION** MODELS

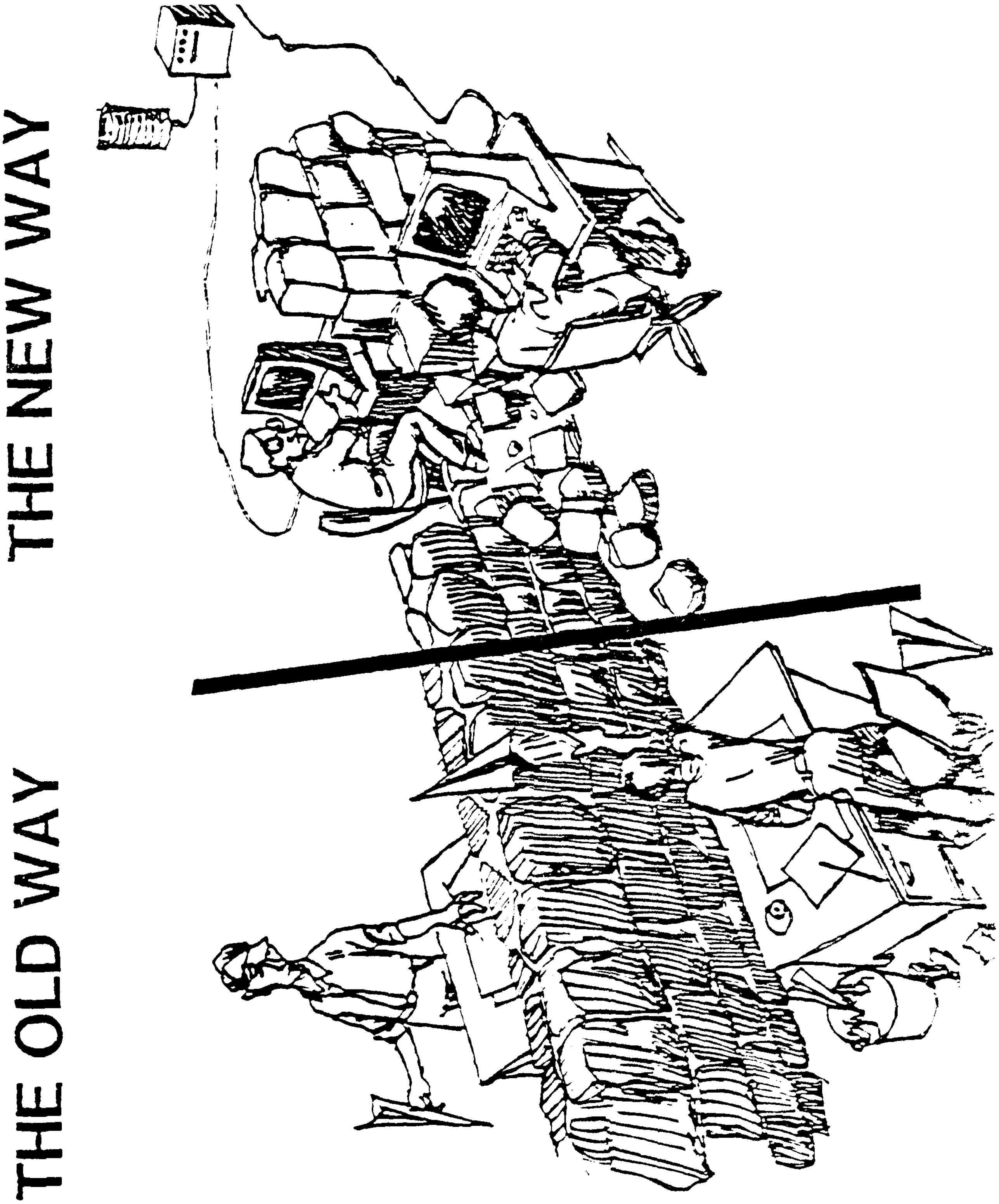


$IDEF_1$ **INFORMATION** MODELS

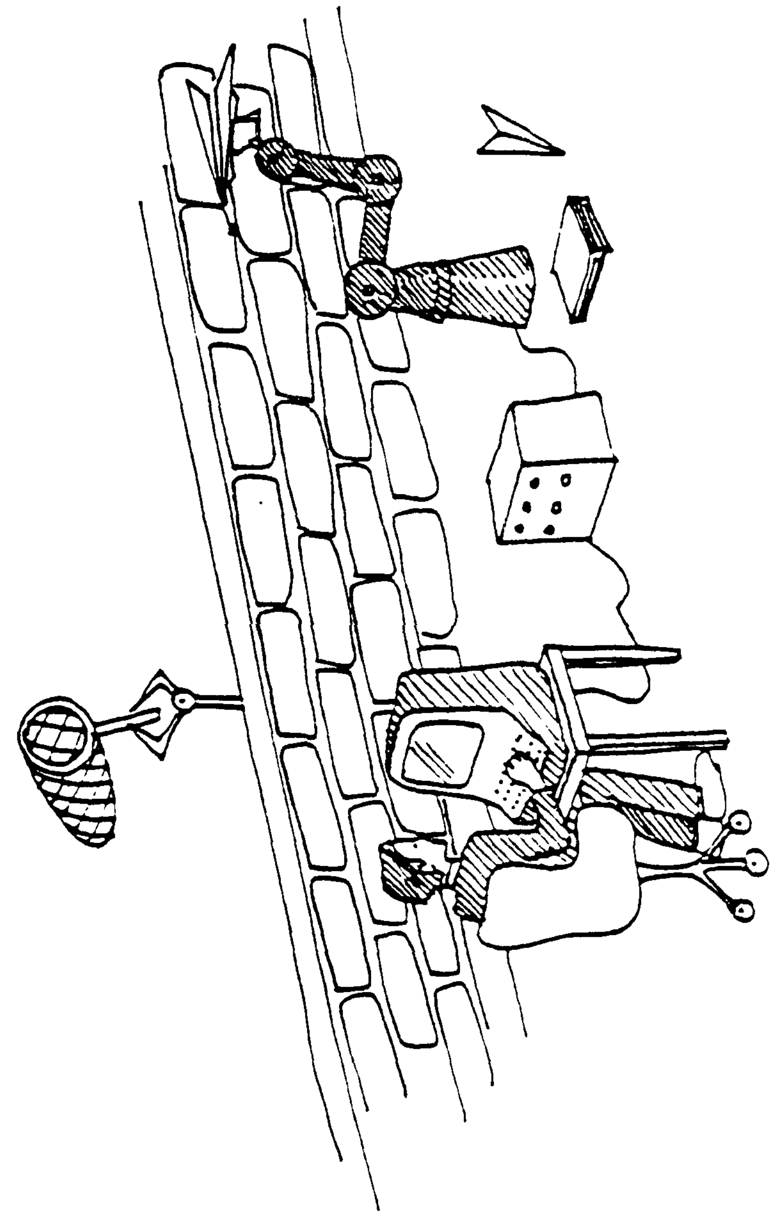


$IDEF_2$ **DYNAMICS** MODELS




THE OLD WAY
THE NEW WAY

THE WRONG WAY



SUMMARY

- THE PROBLEM
  - U.S. PRODUCTIVITY PERFORMANCE
  - U.S. INDUSTRY AUTOMATION TECHNOLOGY
- THE SOLUTION
  - <u>INTEGRATED</u> COMPUTER AIDED MANUFACTURING/TECH MODS
  - ICAM ANALYTICAL/PLANNING TOOLS
  - <u>INTEGRATED</u> STRATEGIC PLANNING & INFORMATION RESOURCE MANAGEMENT (IRM)

2.2 Technology Transfer Executive Overview "Train the Trainers" Manual

FOREWORD

This instructor's "Train the Trainers" Manual is designed to help orient and educate executive level management relative to the need for a structured approach to implementing new manufacturing technology, thereby gaining productivity. It provides an overview of the U.S. Air Force's Manufacturing Technology Modernization (TECH MOD) Program's use of related IDEF applications, concepts, and procedures. It also covers the use of ICAM Architecture in planning and controlling these Manufacturing Technology Modernization Programs to upgrade the U.S. industrial base.

This "Train the Trainers" Manual, coupled with the accompanying Presentation Manual, is designed to give the instructor maximum efficiency in orienting executive level personnel. It employs a step-by-step, section-by-section process, dealing with "top-down" Manufacturing Technology Modernization planning and "bottom-up" project impelemntation concepts and procedures.

2.2.1 Introduction

This is an instructor's "Train the Trainers" Manual intended to aid those teaching an executive overview of the Air Force Manufacturing Technology Modernization (TECH MOD) Program's use of ICAM IDEF Modeling Methodologies. Coupled with the instructor's Executive Overview Presentation Manual, it provides the elements and an order of presentation needed in teaching. The developing of style is left to the individual instructor.

This instructor's "Train the Trainers" Manual consists of: a guide to set-up and preparation, a step-by-step text, containing the objectives and procedures to be covered, concepts, and a suggested narration (with which to start).

The course materials are presented in a standardized format. Each page is composed of a copy of the presentation material, the instructional objective that must be covered with that material, and a suggested narration that may be followed until individual styles can be developed.

Overall planning for and conducting of actual executive training sessions is almost as critical to accomplishing participant learning objectives as the course presentation material. Attention must be given to planning for presentation set-up, pre-presentation, presentation, and post-presentation activities.

2.2.1.1 Presentation Set-Up

2.2.1.1.1 Audio/Visual Equipment:

a) Overhead vue foil projector

b) 35mm projector (if slides are used)

2.2.1.1.2 Audio/Visual Aids:

a) Overhead transparencies

b) 35mm color transparencies (when slides are used)

c) Training materials (handouts and/or manuals)

2.2.1.1.3 Room Set-up:

Everyone must be in hearing and seeing distance of the presentation.

REMEMBER: The best instructional program is no good if you can't hear and see it!

2.2.1.2 Pre-Presentation

- Review all training materials beforehand and be familiar with them.

- Make sure room, equipment, and materials are all in order and ready to go when you are.

  REMEMBER: Prior planning prevents poor performance!

- Set up audio/visual equipment.

- Get audio/visual aids ready for presentation.

  a) Make sure all overhead transparencies are in their order of presentation.

  b) Make sure all 35mm color transparencies (when slides are used) are in their order of presentation and that they are all placed in carousel right-reading, (a slide in backwards or upside down can throw your whole presentation off kilter).

- Handout copies of presentation materials may be provided if warranted by advance coordination.

2.2.1.3 Presentation

- Give introduction

  a) Include purpose and viewpoint of presentation.

  b) Set atmosphere conducive to learning.

- Go through training materials step-by-step.

- Use peer cross-referencing method to check for understanding.

  PEER CROSS-REFERENCING METHOD

  a) Ask who understands the point you've just presented.

  b) Ask who isn't clear about it.

  c) Ask if anyone who understands the point can explain it to those who don't.

  NOTE: If you don't get any takers, you must explain it over again, if possible, in different terms.

- REMEMBER:

  Just because you've presented the material doesn't mean that everyone has understood it.

2.2.1.4 Post Presentation

- Try not to leave any question unanswered. If you don't know, find out, and write or call with the answer.

- At some time, a sheet could be filled out with the name, organization, department, phone number, etc. of those attending. Get sheet typed and make copies to give to everyone. Use for:

  - historical record

  - contact sheet.

2.2.2 A Structured Approach to Manufacturing Technology and Productivity

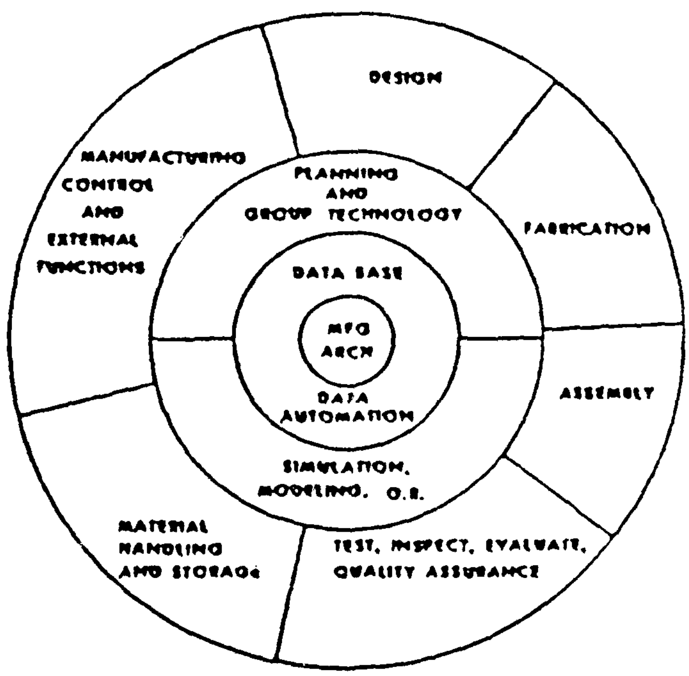
USAF MANUFACTURING TECHNOLOGY PROGRAM

A MANUFACTURING TECHNOLOGY MODERNIZATION

PROGRAM CONCEPT FOR

INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM)

IDEF/ARCHITECTURE METHODOLOGY



EXECUTIVE OVERVIEW "TRAIN THE TRAINERS" MANUAL

2-86

AD-A144 732 INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM) ARCHITECTURE PART 3 VOLUME..(U) SOFTECH INC WALTHAM MA A W SNODGRASS SEP 83 1080-37

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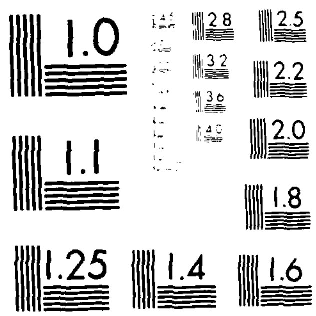
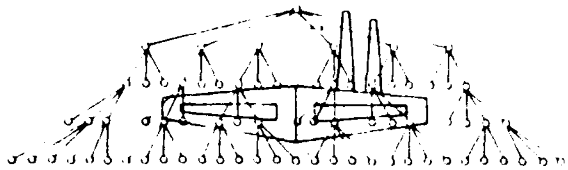


MICROCOPY RESOLUTION TEST CHART

EXECUTIVE OVERVIEW



A STRUCTURED APPROACH TO MANUFACTURING TECHNOLOGY AND PRODUCTIVITY

TITLE SLIDE:	Executive Overview - A structured Approach to Manufacturing <u>Technology</u> <u>and</u> <u>Productivity</u>.
COURSE OBJECTIVE AND NARRATION:	"THE PURPOSE OF THIS PRESENTATION IS TO ORIENT AND EDUCATE EXECUTIVE LEVEL MANAGEMENT RELATIVE TO THE NEED FOR A STRUCTURED APPROACH TO IMPLEMENTING NEW MANUFACTURING TECHNOLOGY, THEREBY GAINING PRODUCTIVITY. THIS OVERVIEW INCLUDES ANSWERS TO SUCH QUESTIONS AS:

(1) WHY DO I WANT MY COMPANY TO LEARN ICAM IDEF?

(2) HOW AM I GOING TO USE IT TO SOLVE MY PROBLEMS?

(3) WHAT ARE THE BENEFITS OF USING ICAM IDEF?

(4) WHAT OTHER COMPANIES HAVE USED IT AND HOW ARE THEY BENEFITING IN TERMS OF PRODUCTIVITY IMPROVEMENT?

INTRODUCTION

- THE PROBLEM
  - U.S. PRODUCTIVITY PERFORMANCE
  - U.S. INDUSTRY AUTOMATION TECHNOLOGY
- THE SOLUTION
  - INTEGRATED COMPUTER AIDED MANUFACTURING/TECH MODS
  - ICAM ANALYTICAL/PLANNING TOOLS
  - INTEGRATED STRATEGIC PLANNING & INFORMATION RESOURCE MANAGEMENT (IRM)

INSTRUCTIONAL OBJECTIVE: Provide an introductory overview for the Executive Overview presentation. (The flow of the overview material begins by conveying a summary of manufacturing problems as they are known to exist, followed by a summary of unintegrated automated manufacturing thrusts and other related efforts.)

NARRATION: "THE UNITED STATES HAS EXPERIENCED A DECLINE IN THE RATE OF PRODUCTIVITY INCREASE RELATIVE TO THE REST OF THE INDUSTRIAL NATIONS. THE HIGH RATE OF INFLATION, SOCIAL TRENDS, GOVERNMENT REGULATIONS, LACK OF CAPITAL IMPROVEMENT INCENTIVES AND THE LOW PRIORITY GIVEN TO MANUFACTURING RESEARCH AND DEVELOPMENT HAVE COMBINED TO SERIOUSLY REDUCE THE CAPABILITY OF U.S. INDUSTRY TO COMPETE IN THE INTERNATIONAL MARKETPLACE.

"SIMULTANEOUSLY, SIGNIFICANT ADVANCES HAVE BEEN MADE IN U.S. INDUSTRY AUTOMATION TECHNOLOGY AVAILABLE SUCH AS COMPUTER-AIDED DESIGN (CAD) SYSTEMS, ROBOTICS, MICRO-PROCESSORS AND MINICOMPUTERS, DNC/CNC/NC CONTROL SYSTEMS, AND TELECOMMUNICATIONS AND OFFICE AUTOMATION. WE HAVE NOT YET LEARNED TO IMPLEMENT THIS NEW TECHNOLOGY EFFECTIVELY ON AN INTEGRATED BASIS TO PROVIDE MAXIMUM PRODUCTIVITY IMPACT.

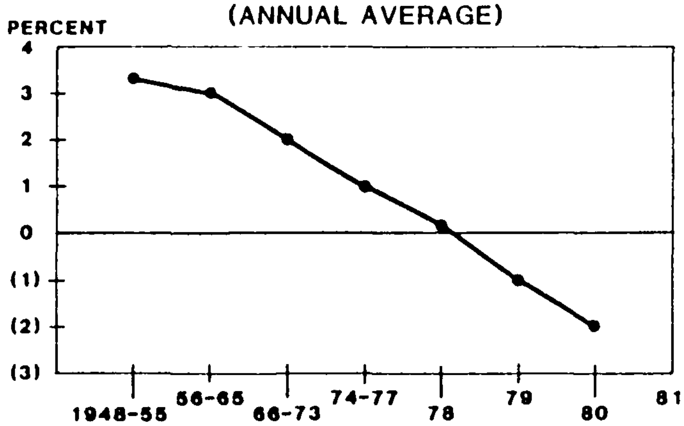
"WE BELIEVE THE SOLUTION TO THIS PROBLEM LIES IN INTEGRATED COMPUTER-AIDED MANUFACTURING AND MANUFACTURING TECHNOLOGY MODERNIZATION. (MANUFACTURING TECHNOLOGY MODERNIZATION MAY BE REFERRED TO HEREAFTER AS "TECH MODS" WHETHER OR NOT THE COMPANY EFFORT IS CONTRACTUALLY COMMITTED TO A MILITARY CUSTOMER OR STRICTLY AN IN-HOUSE COMPANY PROGRAM.)

"THE U.S. AIR FORCE INTEGRATED COMPUTER-AIDED MANUFACTURING PROGRAM (ICAM) HAS DEVELOPED ANALYTICAL AND PLANNING TOOLS TO ASSIST BOTH THE GOVERNMENT AND INDUSTRY IN ACCOMPLISHING COMPUTER-INTEGRATED MANUFACTURING (CIM). WE WILL DISCUSS THESE TOOLS FROM AN OVERVIEW PERSPECTIVE.

"WE RECOGNIZE THAT TECH MOD PROGRAMS MUST EMANATE FROM THE COMPANY'S OVERALL LONG-RANGE STRATEGIC BUSINESS PLAN IN SUPPORT OF PREDETERMINED COMPANY OBJECTIVES. WE WILL ALSO DISCUSS A POTENTIAL METHODOLOGY FOR INTEGRATING YOUR STRATEGIC PLANNING WITH INFORMATION RESOURCE MANAGEMENT UTILIZING THE ICAM ANALYTICAL AND PLANNING TOOLS."

THE PROBLEM

PRODUCTIVITY GROWTH RATE IN U.S.
(ANNUAL AVERAGE)



SOURCE U.S. DEPARTMENT OF COMMERCE

INSTRUCTIONAL OBJECTIVE: To provide an understanding of the declining U.S. productivity growth rate.

NARRATION: "INCREASED PRODUCTIVITY IS THE CORNERSTONE OF THE ICAM PROGRAM. NUMEROUS STUDIES HAVE IDENTIFIED THE DECREASE IN PRODUCTIVITY IN AMERICAN INDUSTRY. WHILE U.S. INFLATION RANGED FROM 2% TO 12% DURING THE YEARS OF 1950 - 1980, PRODUCTIVITY GROWTH DECLINED AS SHOWN ON AN ANNUAL AVERAGE BASIS. THE U.S. RANKS LOWEST AMONG THE MILITARY POWERS OF THE WESTERN WORLD IN BOTH PRODUCTIVITY AND INVESTMENT AS A PERCENT OF GROSS NATIONAL PRODUCT. THE MESSAGE IS LOUD AND CLEAR. U.S. INDUSTRY SUPPORTING DEFENSE READINESS IS DECLINING IN PRODUCTIVITY."

EXTERNAL ENVIRONMENT "CAUSES"

- SOCIAL TRENDS
- HIGH INFLATION RATE
- GOVERNMENT REGULATIONS
- R&D LOW PRIORITY
- LACK OF CAPITAL IMPROVEMENT INCENTIVES

INSTRUCTIONAL OBJECTIVE: To discuss external environment "causes" for U.S. productivity decline.

NARRATION: "WE ALL RECOGNIZE THAT THERE HAVE BEEN SIGNIFICANT EXTERNAL ENVIRONMENT INFLUENCES ON U.S. INDUSTRY DURING THE PERIOD OF PRODUCTIVITY DECLINE WE JUST DISCUSSED. WHILE WE DO NOT MINIMIZE THESE EXTERNAL CAUSES, WE MUST ALL COOPERATIVELY DO WHAT WE CAN TO COPE WITHIN OUR SURROUNDING ENVIRONMENT AND ATTACK THOSE AREAS WITHIN OUR OWN SPHERE OF INFLUENCE."

DECLINING PRODUCTIVITY "SYMPTOMS"

- OVERHEAD AND INDIRECT RESPONSIBLE FOR 60-70% OF PRODUCT COST
- AVERAGE MACHINE UTILIZATION LESS THAN 30%
- DIRECT FAB PROCESS ONLY 1 1/2% PART'S "SHOP LIFE"
- RISING LABOR COSTS BEING DIRECTLY PASSED ON TO CONSUMERS
- INCREASING SOCIAL PRESSURES

INSTRUCTIONAL OBJECTIVE: To focus attention on internal factory declining productivity "symptoms."

NARRATION: "VARIOUS PUBLISHED STUDIES INDICATE THAT THERE IS MUCH THAT WE CAN DO TO ATTACK DECLINING PRODUCTIVITY BY FOCUSING ON "SYMPTOMS" SUCH AS THESE:

SOME ARE STILL CONVINCED THAT THE KEY TO IMPROVED PRODUCTIVITY SUCCESS LIES IN PARING DIRECT LABOR CONTENT OF OUR PRODUCTS TO REDUCE COSTS. MANY TOP MANAGERS ARE NOW WAKING UP TO THE FACT THAT PRODUCTIVITY IMPROVEMENT PROGRAMS MUST EXTEND BEYOND THE BLUE COLLAR WORKERS.

RECENT STUDIES INDICATE THAT U.S. INDUSTRY'S AVERAGE MACHINE UTILIZATION IS LESS THAN 30%. WE CANNOT AFFORD TO CONTINUE ON THIS PATH.

INVENTORY CARRYING COSTS SIGNIFICANTLY IMPACT OUR OVERALL PRODUCTIVITY. RECENT STUDIES HAVE SHOWN THAT MATERIAL MAY SPEND ONLY ONE AND ONE-HALF PERCENT OF ITS "SHOP LIFE" ACTUALLY BEING WORKED UPON BETWEEN THE RECEIVING DOCK AND THE END PRODUCT SHIPMENT.

UNTIL RECENTLY MANY U.S. COMPANIES HAVE BEEN ABLE TO PASS RISING LABOR COSTS DIRECTLY ON TO THEIR CONSUMERS THEREBY FUELING INFLATION. WE NO LONGER CAN TOLERATE THIS PASS THROUGH.

WE ARE ALL EXPERIENCING SOCIAL PRESSURES CREATED BY DEMOGRAPHIC CHANGES, EDUCATIONAL LEVELS, AND THE EXPECTATION LEVEL OF OUR U.S. SOCIETY.

ALL OF THESE FACTORS ARE SYMPTOMATIC OF OUR DECLINING PRODUCTIVITY <u>BUT</u> REPRESENT INTERNAL AREAS WHEREIN INDIVIDUAL <u>U.S.</u> COMPANIES CAN DEFINITELY HAVE AN IMPACT ON OVERALL U.S. PERFORMANCE."

LOST PRODUCTIVITY

"AMERICAN WORKERS ACTUALLY ARE PRODUCING, ON AVERAGE, ONLY ABOUT 55% OF THE TIME THEY ARE ON THE JOB. THE RESULTING LOSS TOTALS 350 BILLION DOLLARS ANNUALLY."

T. BARRY & ASSOCIATES

INDUSTRIAL ENGRG-NOV.'80

INSTRUCTIONAL OBJECTIVE: To focus executive management attention on the fact that the productivity problem only appears to be caused by direct touch labor personnel.

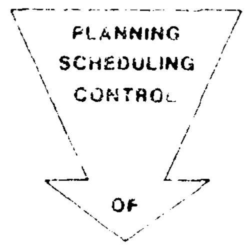
NARRATION: "AT FIRST GLANCE, THIS STATISTICAL STATEMENT BY THEODORE BARRY AND ASSOCIATES SEEMS TO SUPPORT THE BELIEF OF MANY THAT THE DECLINE IN U.S. PRODUCTIVITY IS CONTRIBUTABLE TO DIRECT TOUCH LABOR ON THE FACTORY FLOOR. WE MUST RECOGNIZE, HOWEVER, THAT PRODUCTIVITY IS NOT FOUND ONLY ON THE SHOP FLOOR. FROM THE DAYS OF FREDERICK W. TAYLOR, THROUGH MODERN INDUSTRIAL AND MANUFACTURING ENGINEERING, THE PRODUCTIVENESS OF FACTORY FLOOR LABOR HAS ACTUALLY BEEN IMPROVING. IT IS NOW TIME THE MANAGERS AND DESIGNERS OF THE FACTORY FOCUS ON OTHER AREAS; COMMUNICATION BETWEEN WORK CENTERS AND FACTORY MANAGEMENT, COMMUNICATION BETWEEN CENTERS, PRODUCT DESIGN, MATERIAL HANDLING, AND THE USE OF HUMAN AND INFORMATION RESOURCES."

45% OF DIRECT LABOR TIME IS NOT PRODUCTIVE

SOURCE

- **35% POOR SCHEDULING**
- **25% POOR INSTRUCTIONS**
- **15% INFLEXIBILITY**
- **25% POOR MATERIAL FLOW**

PAYOFF



PEOPLE
MATERIALS
FACILITIES

INSTRUCTIONAL OBJECTIVE: To focus executive management attention on the fact that the productivity problem only appears to be caused by direct touch labor personnel.

NARRATION: "WHEN THE 45% OF DIRECT LABOR TIME THAT WAS NOT PRODUCTIVE WAS EXAMINED CLOSELY, IT WAS FOUND THAT THE PROBLEM SOURCE WAS NOT IN THE FACTORY LABOR ITSELF. IF WE EXAMINE THE SOURCE AS 100%, WE FIND THAT 35% OF THE PROBLEM WAS POOR SCHEDULING, 25% WAS EITHER POOR DESIGN OR WORK INSTRUCTION, 15% WAS LACK OF FLEXIBILITY OF THE PROCESS AND 25% RESULTED FROM MATERIAL AVAILABILITY AND/OR POOR MATERIAL FLOW. TAKING THIS INTO CONSIDERATION, IT BECOMES CLEAR THAT PAYOFF ON THE FACTORY FLOOR IS IN THE AREA OF IMPROVED DESIGN, PROCESS PLANNING, SCHEDULING AND THE CONTROL OF PEOPLE, MATERIALS, AND FACILITIES.

"STUDIES OF THIS AREA BECOME EVEN MORE INTERESTING WHEN WE UNBURDEN THE DIRECT HOURLY FACTORY RATES AND PUSH THE COSTS BACK TO THE FUNCTION THAT ACTUALLY GENERATES THE COSTS. BY DEALING WITH THE UNBURDENED LABOR DOLLARS, WE CAN BEGIN TO IDENTIFY THE TRUE SOURCES OF COSTS (I.E. THE COST DRIVERS) AND IDENTIFY WHICH ARE MOST SENSITIVE TO IMPROVEMENTS. BY REDUCING THESE SOURCE COSTS, WE CAN REDUCE PRICE AND SIMULTANEOUSLY INCREASE PROFITABILITY FOR THE MANUFACTURING FIRM."

U.S. INDUSTRY

AUTOMATION TECHNOLOGY

INSTRUCTIONAL OBJECTIVE: To orient executive management to the potential problems inherent in unintegrated automated manufacturing thrusts.

NARRATION: "THERE IS, HOWEVER, A POTENTIAL SOLUTION TO THIS INCREASINGLY SERIOUS PROBLEM OF PRODUCTIVITY PERFORMANCE. IT IS CALLED COMPUTER INTEGRATED MANUFACTURING (CIM). THE KEY INGREDIENTS REQUIRED TO IMPLEMENT A CIM SYSTEM ARE AVAILABLE AS EXISTING STATE-OF-THE-ART TECHNOLOGY, OR ARE CURRENTLY DEFINED AS ENABLING TECHNOLOGY IN THE MANUFACTURING AND COMPUTER INFORMATION SYSTEMS AREA. IN FACT, THERE IS PROBABLY AN OVERABUNDANCE OF UNUSED TECHNOLOGY AVAILABLE.

WE SEEM TO HAVE FAILED TO PUT PROPER EMPHASIS ON LONG-TERM SOLUTIONS TO PROBLEMS REGARDING PRODUCT COSTS AND DIRECT AND INDIRECT LABOR PRODUCTIVITY. TO LEND CREDENCE TO THIS PREMISE CONSIDER THIS; THE PHENOMENAL SUCCESS OF THE JAPANESE IN IMPROVING THEIR MANUFACTURING PRODUCTIVITY HAS BEEN ACHIEVED BY APPLYING MANUFACTURING AND COMPUTER INFORMATION SYSTEM TECHNOLOGY DEVELOPED ELSEWHERE - PRIMARILY IN THE U.S."

U.S. INDUSTRY AUTOMATION TECHNOLOGY

- AUTOMATION INVESTMENTS WILL TRIPLE TO \$5+BILLION BY 1985.
- CAD SYSTEMS WILL CLIMB +35% ANNUALLY TO ESTIMATED \$2.5 BILLION IN 1985 FROM \$610 MILLION IN 1979.
- MINICOMPUTERS, NUMERICAL CONTROLS AND PROGRAMMABLE CONTROLLERS WILL CLIMB +35% ANNUALLY TO \$2.3 BILLION IN 1985 FROM \$570 MILLION IN 1980.
- ROBOTS WILL JUMP TO 80,000 UNITS BY 1985 FROM 2,000 UNITS IN 1981 TO TOTAL OF \$+600 MILLION.

BUSINESS WEEK [illegible] THE SPEEDUP IN AUTOMATION

INSTRUCTIONAL OBJECTIVE: To develop an understanding that "islands of technology" will not necessarily solve the U.S. productivity problem.

NARRATION: "U.S. INDUSTRY IS BEGINNING TO SPEED UP ITS AUTOMATION BUT THERE IS AN INHERENT DANGER IN THE APPROACH BEING TAKEN BY MANY COMPANIES. THERE ARE TOO MANY NON-INTEGRATED MODULES BEING INSTALLED. TURNKEY SYSTEMS ARE PROLIFERATING. THEY ARE DISJOINTED AND IT MAY BE VERY COSTLY, IF NOT IMPOSSIBLE, TO TIE THEM TOGETHER IN THE FUTURE. IT COULD BE A BIG WASTE AND A NASTY SURPRISE.

"PLEASE NOTE THAT OUR U.S. AUTOMATION INVESTMENTS ARE NOW NOT ONLY BEING MADE ON THE FACTORY FLOOR, BUT ARE IMPACTING UPON OTHER AREAS SUCH AS THE DESIGN PROCESS."

EXECUTIVE MANAGEMENT TAKING "TOP DOWN" ACTION

- OFFICE AUTOMATION - 38 MILLION OF 50 MILLION WHITE COLLAR JOBS AFFECTED (WITH 20 TO 30 MILLION BY 1990) AT 20% VALUE ADDED PER EMPLOYEE.
- FLEXIBLE MANUFACTURING SYSTEM (FMS) - USERS EXPERIENCING IMPROVED MACHINE TOOL UTILIZATION AS MUCH AS 45% AND DECREASING WORKERS BY 30%
- CAD CAM SYSTEMS - TO CUT MANUFACTURING LEADTIME BY 25% AND INCREASE PRODUCTIVITY AS MUCH AS FOURFOLD
- TOP EXECUTIVES - NOW FORCING SOLUTIONS IN ORDER TO REMAIN IN BUSINESS IN THE 1990's.
- DECISIONS - TO AUTOMATE ARE STARTING AT THE BOARD LEVEL AND MOVING DOWN.

BUSINESS WEEK - 3 AUG 1981 "THE SPEED UP IN AUTOMATION"

INSTRUCTIONAL OBJECTIVE: To develop an understanding that "islands of technology" will not necessarily solve the U.S. productivity problem.

NARRATION: "WE ARE ALSO WITNESSING A SIGNIFICANT TREND TOWARD AUTOMATING THE OFFICE AREAS OF U.S. INDUSTRY.

FLEXIBLE MANUFACTURING SYSTEMS, INCORPORATING SEVERAL MODULES OF TECHNOLOGY, ARE DEMONSTRATING SIGNIFICANT PRODUCTIVITY IMPROVEMENTS ON THE SHOP FLOOR.---IT IS INTERESTING TO NOTE THAT INSTRUCTIONS TO SUCH SYSTEMS MUST BE PRECISE AND ACCURATE BECAUSE THEY ARE ALL MADE EXPLICITLY BY THE COMPUTER TO ITS CONTROLLED MACHINERY.

WE LOOK FOR CAD/CAM SYSTEMS TO SIGNIFICANTLY IMPACT THE TIME SPAN REQUIRED TO DESIGN AND PRODUCE NEW OR UPDATED PRODUCTS.

CAUTION MUST BE EXERCISED, HOWEVER, TO AVOID UNSOUND AUTOMATION IMPLEMENTATION PROJECTS THAT ARE ONLY RESPONDING TO TOP-DOWN EXECUTIVE DIRECTION TO AUTOMATE. WE ALL KNOW WHAT THIS APPROACH RESULTED IN DURING THE INITIAL INTRODUCTION OF MORE ECONOMIC COMPUTING POWER IN THE 1960'S AND EARLY 1970'S."

THE LEMMING APPROACH TO AUTOMATION

INSTRUCTIONAL OBJECTIVE: To develop an understanding that "islands of technology" will not necessarily solve the U.S. productivity problem.

NARRATION: "WE MUST BE CAREFUL THAT WE DO NOT DEVELOP AND/OR FOLLOW THE LEMMING APPROACH TO AUTOMATION.

"EACH COMPANY MUST CAREFULLY STUDY ITS STRATEGIC BUSINESS PLAN AND CUSTOMER COMMITMENTS, TO DEVELOP A WELL CONCEIVED MANUFACTURING TECHNOLOGY MODERNIZATION PROGRAM WHICH IS CUSTOM TAILORED TO ITS OWN NEEDS AND OBJECTIVES."

TECHNOLOGY INTEGRATION

- AN AVALANCHE OF UNCOORDINATED AUTOMATION TECHNOLOGY MODERNIZATION PROJECTS THREATENS TO BURY U.S. INDUSTRY

<u>UNLESS THERE IS</u>

- TECHNOLOGY INTEGRATION

<u>SOMETIMES REFERRED TO AS</u>

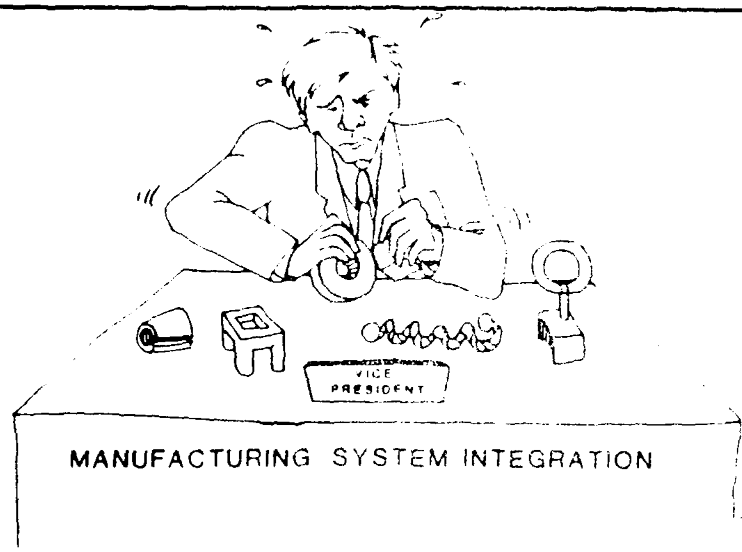
- COMPUTER INTEGRATED MANUFACTURING (CIM)

INSTRUCTIONAL OBJECTIVE: To develop an understanding that "islands of technology" will not necessarily solve the U.S. productivity problem.

NARRATION: "WE MUST EXERCISE CAUTION TO AVOID AN AVALANCHE OF UNCOORDINATED AUTOMATION TECHNOLOGY MODERNIZATION PROJECTS.

"WE MUST CAREFULLY PLAN AND CONTROL OUR TECH MOD PROGRAMS TO ENSURE THAT THERE IS TECHNOLOGY INTEGRATION, I.E. COMPUTER INTEGRATED MANUFACTURING (CIM)."

COMPUTER INTEGRATED MANUFACTURING



INSTRUCTIONAL OBJECTIVE: To develop an understanding that "islands of technology" will not necessarily solve the U.S. productivity problem.

NARRATION: "SAD BUT TRUE, WE ALL HAVE EITHER EXPERIENCED OR KNOW THOSE THAT HAVE EXPERIENCED THIS FRUSTRATION.

"MANY EXECUTIVES THAT WE TALK TO ACROSS THE COUNTRY ADMIT THAT THE PERCENTAGE OF CAPITAL APPROPRIATION REQUESTS INVOLVING COMPUTERS HAS SIGNIFICANTLY MULTIPLIED THE LAST FEW YEARS. IT SEEMS WE CAN HARDLY UNDERTAKE A PROJECT ON THE FACTORY FLOOR, IN THE DESIGN AREA, OR IN THE ADMINISTRATIVE OFFICE THAT DOES NOT CONTAIN SOME FORM OF MICROPROCESSOR, MINICOMPUTER, OR MAIN-FRAME SUPPORT REQUIREMENT.

COMPUTER INTEGRATED MANUFACTURING

- **MANUFACTURING, WHICH BEGINS WITH PRODUCT DESIGN AND ENDS WITH SUPPORT AND MAINTENANCE IN THE FIELD, IS A MONOLITHIC, INDIVISIBLE FUNCTION. --- NO PART CAN BE SUCCESSFULLY CONSIDERED IN ISOLATION FROM ALL OTHER PARTS.**

- **DIVERSE AS THE VARIOUS PARTS OF MANUFACTURING MAY SEEM, THERE IS A COMMON THREAD THAT RUNS THROUGH THE FULL SCOPE OF ALL MANUFACTURING ACTIVITIES. -- MANUFACTURING IS, IN THE ULTIMATE ANALYSIS, A SERIES OF DATA PROCESSING OPERATIONS.**

DR JOSEPH HARRINGTON
1980 CAD/CAM CONFERENCE

INSTRUCTIONAL OBJECTIVE: To orient executive management to the need for a "top-down factory analysis" approach to manufacturing technology modernization.

NARRATION: "WE MUST STEP BACK AND CONSIDER THESE TWO KEY POINTS MADE BY DR. JOSEPH HARRINGTON AT A 1980 CAD/CAM CONFERENCE:

> NO PART OF THE MANUFACTURING ENTERPRISE CAN BE SUCCESSFULLY CONSIDERED IN ISOLATION OF ALL OTHER PARTS.
>
> THE COMMON THREAD RUNNING THROUGH ALL OF THE MANUFACTURING ENTERPRISE IS A SERIES OF DATA PROCESSING OPERATIONS.---WE DO NOT NECESSARILY MEAN COMPUTER DATA PROCESSING, WE ARE DISCUSSING ALL DATA PROCESSING INCLUDING PENCILS, AND PAPER, TELECOMMUNICATIONS, CONVERSATIONS, AND COMPUTER DATA PROCESSING."

SIGNIFICANT IMPACTS ON OUR HUMAN RESOURCES

- SHORT PRODUCTION RUNS NOW ACCOUNT FOR 75% U.S. MANUFACTURING
- CAD CAM AFFORDABLE FOR SMALL JOB SHOPS WITHIN DECADE
- CHANGES WILL AFFECT 45 MILLION JOBS IN U.S. NEXT 20 YEARS
- ONLY 13,000 CANDIDATES AVAILABLE IN 1981 TO FILL 29,000 ELECTRICAL AND COMPUTER SOFTWARE ENGINEERING SLOTS (BY 1985 SUPPLY WILL BE 15,000 VS. 51,000 DEMAND)

BUSINESS WEEK [illegible]

INSTRUCTIONAL OBJECTIVE: To [illegible] management relative to external factors that will affect their human resources.

NARRATION: "WE MUST ALSO REALIZE THAT THIS RAPIDLY CHANGING ENVIRONMENT WILL IMPACT HOW WE CONDUCT OUR BUSINESS WITH THE OUTSIDE WORLD IN THE FUTURE.

"MOST OF US HAVE LEARNED THAT SHORT BATCH PRODUCTION RUNS NOW ACCOUNT FOR 75% OF ALL U.S. MANUFACTURING. WE NO LONGER HAVE THE COMFORT OF LONG-TERM PRODUCTION PROCESS RUNS TO DEPEND UPON.

"CAD/CAM IS BECOMING AFFORDABLE FOR SMALL JOB SHOPS AND IT MAY BE VERY DIFFICULT FOR LARGE SLOW MOVING ORGANIZATIONS TO COMPETE WITH THE FLEXIBILITY OF THESE SMALLER ORGANIZATIONS IN THE FUTURE.

"THE AUTOMATION CHANGES WE HAVE BEEN DISCUSSING WILL AFFECT IN SOME WAY A MINIMUM OF 45 MILLION JOBS IN THE U.S. IN THE NEXT TWENTY YEARS IN SOME WAY.

"AT THE SAME TIME WE ARE FACED WITH DISLOCATION AND RETRAINING OF OUR HUMAN RESOURCE SKILLS, WE MUST ALSO LEARN TO COPE WITH A SHORTAGE OF PERSONNEL IN THE AREAS THAT AUTOMATION IS AFFECTING. WE MAY ONLY BE ABLE TO SUPPLY A PERCENTAGE OF THE TECHNICAL TALENT REQUIRED USING PRESENT PROGRAM DEVELOPMENT AND MAINTENANCE METHODS. IT IS PAINFULLY OBVIOUS MORE CAREFUL PLANNING AND NEW APPROACHES MUST BE TAKEN IN ORDER TO COPE."

U.S. INDUSTRY AUTOMATION TECHNOLOGY

- NO OTHER COUNTRY MATCHES U.S. IN COMPUTER SOFTWARE AND COMPUTER AIDED DESIGN.
- 90% OF JAPAN'S CAD SYSTEMS IMPORTED FROM U.S. - $100 MILLION IN 1980 AND RISING.
- COMPUTER POWER COST DECREASING AVERAGE 50% EVERY 2 1/2 YEARS SINCE 1970.
- SOFTWARE DEVELOPMENT NOW PACING FACTORY AUTOMATION:
  - STANDARD GEOMETRIC SHAPE DEFINITION
  - INTEGRATED DATA BASES
  - COMMUNICATION PROTOCOLS
  - INFORMATION RESOURCE MANAGEMENT

BUSINESS WEEK 3 AUG 1981 "THE SPEED UP IN AUTOMATION"

INSTRUCTIONAL OBJECTIVE: To orient executive management relative to U.S. potential leadership areas.

NARRATION: "ALL IS NOT GLOOM AND DOOM. TODAY NO OTHER COUNTRY MATCHES THE U.S. IN COMPUTER SOFTWARE AND COMPUTER-AIDED DESIGN .

"IN 1980, 90 PERCENT OF JAPAN'S CAD SYSTEMS WERE IMPORTED FROM THE U.S. WE MUST NOTE, HOWEVER, THAT JAPAN PROCURED $100 MILLION WORTH OF CAD SYSTEMS IN 1980 AND THAT EXPENDITURE LEVEL IS RISING.

"COMPUTER POWER COST HAS DECREASED FIFTY PERCENT EVERY TWO AND HALF YEARS IN THE U.S. SINCE 1970. FOR EXAMPLE, IBM MEMORY COST HAS DROPPED FROM $600,000 PER MEGABYTE (MILLION CHARACTERS) TO A LEVEL OF $25,000 PER MEGABYTE IN 1980.

"SOFTWARE DEVELOPMENT IS NOW PACING FACTORY AUTOMATION AND INTEGRATION. WORK REMAINS TO BE ACCOMPLISHED IN THE AREAS OF STANDARD GEOMETRIC SHAPE DEFINITION, INTEGRATED DATABASES, COMMUNICATIONS PROTOCOL, AND THE OVERALL SUBJECT OF INFORMATION RESOURCE MANAGEMENT.

"WE STILL HAVE THE POTENTIAL, IF WE RAPIDLY EXPLOIT U.S. INDUSTRY'S AUTOMATION TECHNOLOGY LEAD, TO REGAIN AND/OR MAINTAIN OUR WORLDWIDE LEADERSHIP POSITION IN THE AREAS OF BOTH DEFENSE READINESS AND ECONOMIC COMPETITIVENESS."

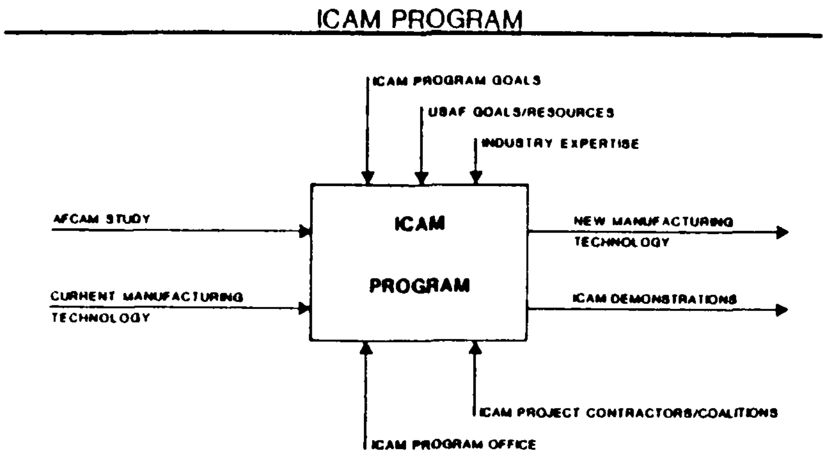
INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM) PROGRAM

INSTRUCTIONAL OBJECTIVE: To introduce the U.S. Air Force Integrated Computer-Aided Manufacturing (ICAM) Program and its contribution to potential productivity gains.

NARRATION: "THUS FAR, WE HAVE DISCUSSED THE PRODUCTIVITY PERFORMANCE PROBLEM AND THE AUTOMATION TECHNOLOGY AVAILABLE TO U.S. INDUSTRY TO SOLVE SAME.

"WE HAVE ALSO SURMISED THAT UNINTEGRATED MANUFACTURING AUTOMATION THRUSTS COULD BE VERY EXPENSIVE AND ILL-ADVISED.

"LET'S NOW TAKE A LOOK AT THE U.S. AIR FORCE'S ICAM PROGRAM AND ITS POTENTIAL CONTRIBUTION TO THE SOLUTION OF THESE PROBLEMS."



INSTRUCTIONAL OBJECTIVE: To orient executive management relative to the ICAM Program.

NARRATION: "THE U.S. AIR FORCE ICAM PROGRAM WAS INITIATED IN 1977 FOLLOWING A JOINT AIR FORCE/INDUSTRY COMPUTER-AIDED MANUFACTURING STUDY. THE "FUNCTION" OF THE ICAM PROGRAM WAS TO UTILIZE THIS A.F. CAM STUDY AND CURRENT MANUFACTURING TECHNOLOGY AS "INPUTS." THE ICAM PROGRAM±S GOALS, COUPLED WITH U.S. AIR FORCE GOALS/RESOURCES AND INDUSTRY EXPERTISE, ARE THE "CONTROLS."

THE "MECHANISMS" THAT THE AIR FORCE HAS UTILIZED ON THE ICAM PROGRAM WERE THE ESTABLISHMENT OF AN ICAM PROGRAM OFFICE AT THE AIR FORCE MATERIAL LABORATORIES, COUPLED WITH ICAM PROJECT PRIME CONTRACTORS WITH SUPPORTING COALITIONS OF AEROSPACE COMPANIES, COMMERCIAL COMPANIES, ACADEMIA, AND OTHER GOVERNMENT AGENCIES.

THE "OUTPUT" OF THE ICAM PROGRAM HAS BEEN AND WILL CONTINUE TO BE NEW MANUFACTURING TECHNOLOGY WITH ACTUAL ICAM DEMONSTRATIONS."

ICAM PROGRAM OBJECTIVES

- REDUCE DEFENSE SYSTEM COSTS THROUGH CAM TECHNOLOGY
- ESTABLISH MEANS FOR INTEGRATED APPLICATION OF COMPUTER TECHNOLOGY
- IMPROVE LONG TERM COMPETENCE, EFFICIENCY AND RESPONSIVENESS TO DEFENSE NEEDS
- PROVIDE MECHANISM FOR ICAM TECHNOLOGY TRANSFER
- VALIDATE AND DEMONSTRATE COST SAVINGS & FLEXIBILITY OF ICAM METHODOLOGY

INSTRUCTIONAL OBJECTIVE: To orient executive management relative to ICAM Program objectives.

NARRATION: "THE ICAM PROGRAM ESTABISHED THESE FIVE OBJECTIVES EARLY IN THE PROGRAM."

(READ AND DISCUSS EACH OF THE FIVE OBJECTIVES)

ICAM PROGRAM OBJECTIVES

PRODUCTIVITY IMPROVEMENTS

THROUGH

COMPUTER TECHNOLOGY

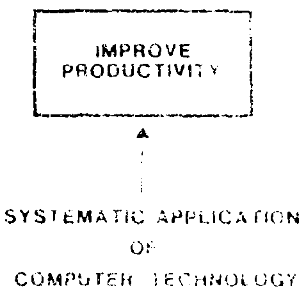
AND

FACTORY MODERNIZATION

INSTRUCTIONAL OBJECTIVE: To summarize ICAM Program objectives for executive management.

NARRATION: "IN SUMMARY, THE OBJECTIVE OF THE ICAM PROGRAM IS TO OBTAIN PRODUCTIVITY IMPROVEMENTS THROUGH THE SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY AND FACTORY MODERNIZATION."

PURPOSE OF ICAM



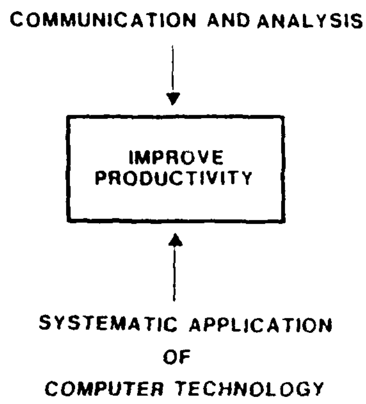
INSTRUCTIONAL OBJECTIVE: To orient executive level management to the ICAM life cycle, IDEF0 function modeling, and the purpose of ICAM.

NARRATION: "THE PURPOSE OF THE ICAM PROGRAM IS TO IMPROVE PRODUCTIVITY. WHAT DISTINGUISHES THE ICAM GOAL FROM TRADITIONAL PRODUCTIVITY GOALS IS THAT THE ICAM PROGRAM RECOGNIZES THAT PRODUCTIVITY CAN BE IMPROVED NOT JUST THROUGH THE APPLICATION OF NEW TECHNOLOGY, BUT AS WELL THROUGH THE SUCCESSFUL INTEGRATION OF THAT TECHNOLOGY INTO EXISTING MANUFACTURING.

RECOGNIZING THAT MANUFACTURING IS A VERY COMPLEX ENVIRONMENT COMPRISED OF MANY PEOPLE, SYSTEMS, AND TECHNOLOGIES, THE MECHANISM WE RECOMMEND TO IMPROVE PRODUCTIVITY IS THE SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY.

SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY IS UTILIZING A STRUCTURED APPROACH TO PLANNING, ORGANIZING, CONTROLLING, AND COORDINATING THE DEVELOPMENT AND IMPLEMENTATION OF NEW TECHNOLOGY."

ICAM APPROACH



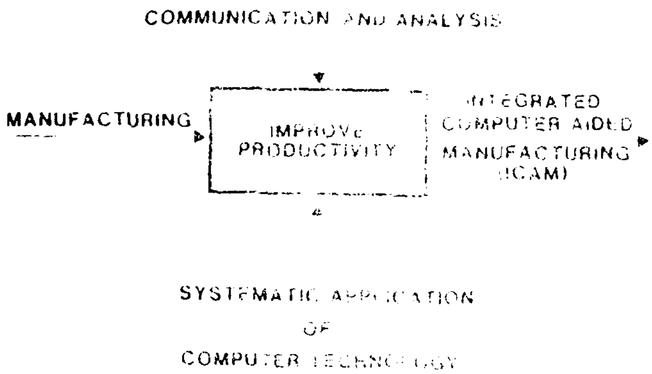
INSTRUCTIONAL OBJECTIVE: To orient executive level management to the ICAM life cycle, IDEF0 function modeling, and the purpose of ICAM.

NARRATION: "BECAUSE OF THE COMPLEXITIES OF MANUFACTURING, NO ONE PERSON COMPLETELY UNDERSTANDS HOW BEST TO IMPROVE MANUFACTURING PRODUCTIVITY.

THERE IS A TREMENDOUS NEED TO BETTER UNDERSTAND, COMMUNICATE AND ANALYZE MANUFACTURING AND ITS COMPLEXITIES. TO IMPROVE PRODUCTIVITY, A COMMON UNDERSTANDING OF THE EXISTING MANUFACTURING PROBLEM AND THE FUTURE MANUFACTURING SOLUTION IS NECESSARY. THIS COMMON UNDERSTANDING MUST BE COMMUNICATED TO AND ANALYZED BY MANY DIFFERENT PEOPLE, RANGING FROM THE SHOP FLOOR USER, TO THE MANUFACTURING ANALYST, TO THE SYSTEM DEVELOPER, AND LAST BUT NOT LEAST, THE MANAGEMENT.

"THIS COMMUNICATION AND ANALYSIS APPROACH ACTS AS THE <u>CONTROL</u> IN OUR ICAM APPROACH."

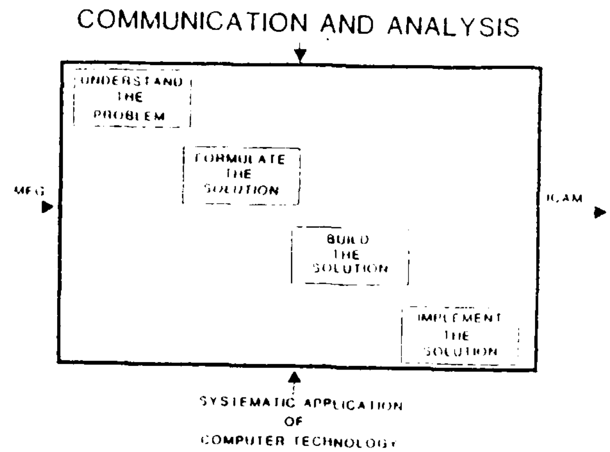
OBJECTIVE OF ICAM



INSTRUCTIONAL OBJECTIVE: To orient executive level management to the ICAM life cycle, IDEF0 function modeling, and the purpose of ICAM.

NARRATION: "THE OBJECTIVE OF ICAM IS TO INPUT EXISTING MANUFACTURING, TO CONTROL THE IMPROVEMENT OF PRODUCTIVITY THROUGH CONSISTENT COMMUNICATION AND ANALYSIS THROUGH THE MECHANISM OF SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY, AND TO OBTAIN THE END RESULT OUTPUT OF INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM)."

IMPROVE PRODUCTIVITY



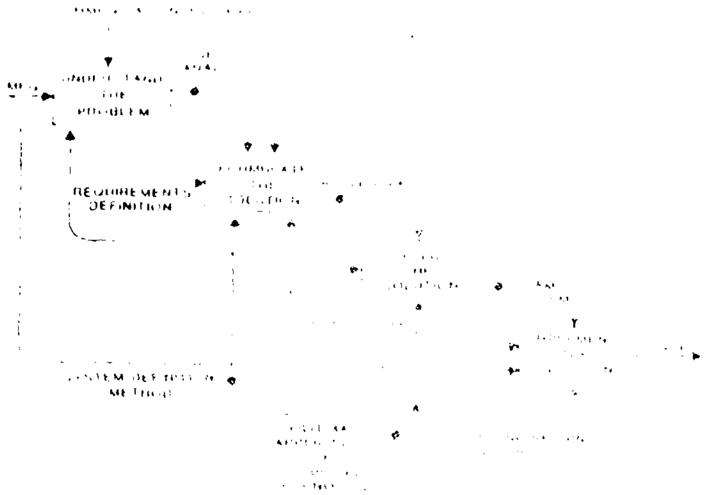
INSTRUCTIONAL OBJECTIVE: To orient executive level management to the ICAM life cycle, IDEFO function modeling, and the purpose of ICAM.

NARRATION: "IF WE DECOMPOSE THE FUNCTION BOX WE HAVE BEEN DISCUSSING AND TAKE A DEEPER LOOK AT THE PROCESS OF IMPROVING MANUFACTURING PRODUCTIVITY, WE FIND FOUR BASIC STEPS THAT NEED TO BE TRAVERSED.

THESE STEPS FORM THE ICAM PROGRAM SYSTEM DEVELOPMENT LIFE CYCLE OF: 1) UNDERSTAND THE PROBLEM, 2) FORMULATE THE SOLUTION, 3) BUILD THE SOLUTION, AND 4) IMPLEMENT THE SOLUTION.

EACH STEP IS FUNDAMENTAL IN TRANSFORMING EXISTING MANUFACTURING INTO THE FUTURE INTEGRATED COMPUTER-AIDED MANUFACTURING ENVIRONMENT. THE ICAM PROGRAM SYSTEM DEVELOPMENT LIFE CYCLE IS SIMILAR TO OTHER SUCH LIFE CYCLES - BEGINNING WITH THE STATEMENT OF THE PROBLEM AND CULMINATING IN THE IMPLEMENTATION OF A SOLUTION."

IMPROVE PRODUCTIVITY



INSTRUCTIONAL OBJECTIVE: To present executive level management to the ICAM life cycle, IDEF0 function modeling, and the purpose of ICAM.

NARRATION: "THE ICAM PROGRAM RECOGNIZED THAT THE TRADITIONAL PROBLEM STATEMENT IS [illegible] INADEQUATE TO OBTAIN A COMPLETE UNDERSTANDING OF THE PROBLEM. WHY? BECAUSE THE TYPICAL PROBLEM STATEMENT MERELY IDENTIFIES SYMPTOMS OF PROBLEM OCCURRENCES. TO REALLY UNDERSTAND THE PROBLEM, WE NEED TO GO BEYOND THE SYMPTOMS.

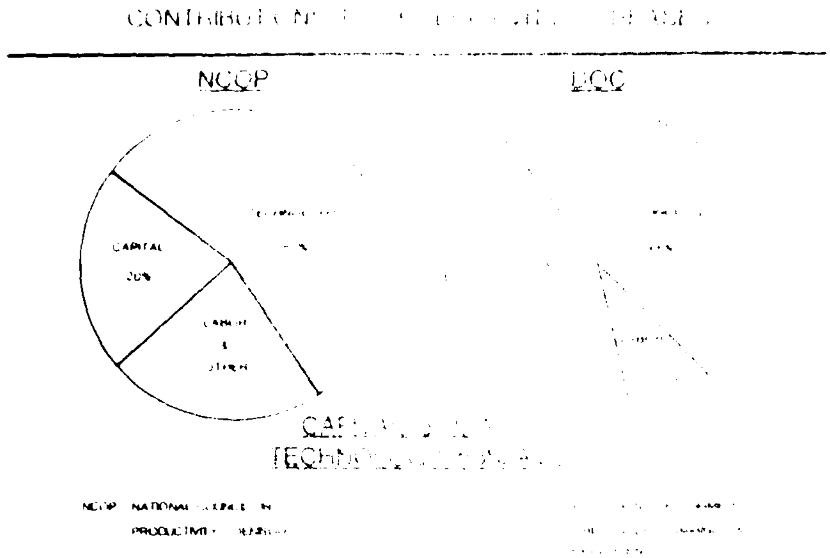
WE NEED TO STUDY [illegible] ENVIRONMENT WITHIN WHICH THE PROBLEM OCCURS, TO DETERMINE THE NEEDS OF THAT ENVIRONMENT, IF IT IS TO PERFORM AS IT SHOULD, AND TO DEFINE THE ENVIRONMENT IN A MANNER THAT WILL PERMIT AN IN-DEPTH UNDERSTANDING OF THE CHARACTERISTICS (FUNCTIONS, INFORMATION AND DYNAMICS) WHICH ESTABLISH THE EXISTING ENVIRONMENT AND ITS PERFORMANCE.

TO ENABLE AN IN-DEPTH UNDERSTANDING OF THE ENVIRONMENT, THE ICAM PROGRAM ESTABLISHED A SYSTEM DEFINITION METHOD KNOWN AS THE ICAM DEFINITION (IDEF) METHOD. IDEF CAPTURES, IN A STRUCTURED REPRESENTATION, THE CHARACTERISTICS OF MANUFACTURING THAT WILL ENHANCE OUR UNDERSTANDING OF MANUFACTURING AND HOW TO IMPROVE IT.

MANUFACTURING TECHNOLOGY
MODERNIZATION PROGRAM
(TECH MODS)

INSTRUCTIONAL OBJECTIVE: To orient executive management to the need for, and the recommended approach to, a Manufacturing Technology Modernization (TECH MOD) Program.

NARRATION: "BEFORE WE DISCUSS THE ICAM DEVELOPED ANALYTICAL AND PLANNING TOOLS IN MORE DETAIL, LET'S EXAMINE AND DISCUSS THE TECHNOLOGY MODERNIZATION FRAMEWORK WITHIN WHICH THEY CAN BE EFFECTIVELY APPLIED TO ASSIST YOU IN YOUR PRODUCTIVITY IMPROVEMENT EFFORTS."



INSTRUCTIONAL OBJECTIVE: To [illegible] management relative to the [illegible] modern-[illegible] [illegible] of capital.

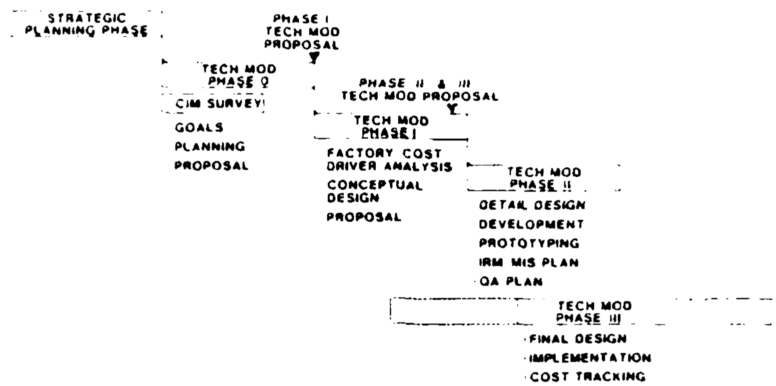
NARRATION: "THESE TWO NATIONAL STUDIES RELATIVE TO 'CONTRIBUTIONS TO PRODUCTIVITY INCREASES' DIFFER SOMEWHAT IN THEIR END RESULT PERCENTAGE ALLOCATIONS. THE NATIONAL COUNCIL ON PRODUCTIVITY (NCOP) STUDY BY THE BROOKINGS INSTITUTE CONTRIBUTES OVER HALF OF ALL PRODUCTIVITY GAIN IN MANUFACTURING TO TECHNOLOGICAL INNOVATION AND, INTERESTINGLY ENOUGH, A THIRD OF THAT TO COMPUTING POWER ALONE.

"THE DEPARTMENT OF COMMERCE (DOC) STUDY CONTRIBUTED SOMEWHAT HEAVIER EMPHASIS TO CAPITAL EXPENDITURES.

OUR PURPOSE TODAY IS NOT TO ARGUE THE MERITS OF EITHER STUDY SO WE HAVE JUST AVERAGED THE STATISTICAL DATA TO SHOW A 53 PERCENT AVERAGE CONTRIBUTION BY TECHNOLOGY MODERNIZATION AND A 31 PERCENT AVERAGE CONTRIBUTION CONTRIBUTED TO CAPITAL EXPENDITURES

"ASSUMING THAT WE BELIEVE AND SUPPORT THESE STATISTICS, IT IS PAINFULLY CLEAR THAT WE MUST CHANGE COURSE IF WE ARE TO SOLVE THE U.S. PRODUCTIVITY PROBLEM."

TECHNOLOGY MODERNIZATION FRAMEWORK



INSTRUCTIONAL OBJECTIVE: To provide executive management and understanding of a manufaturing technology modernization (TECH MOD) framework.

NARRATION: AS WE HAVE JUST DISCUSSED, TECHNOLOGY AND CAPITAL INVESTIMENT ARE GENERALLY RECOGNIZED AS THE DOMINANT FACTORS IN PRODUCTIVITY GROWTH. THESE FACTORS ARE THE BASIS OF THIS PROGRAM'S NAME: "TECHNOLOGY" -- THE ESTABLISHMENT OF ADVANCED MANUFACTURING TECHNOLOGY, "MODERNIZATION" -- THE CAPITAL INVESTMENT REQUIRED TO IMPLEMENT ADVANCED MANUFACTURING TECHNOLOGY.

A MILITARY TECHNOLOGY MODERNIZATION (TECH MOD) PROGRAM COUPLES THE CONTRACTUAL TOOLS TO INCREASE CONTRACTOR CAPITAL INVESTMENT IN CONTEMPORARY AND ADVANCED TECHNOLOGY WITH MANUFACTURING STATE-OF-THE-ART ADVANCES SO THAT MAXIMUM PRODUCTIVITY ENHANCEMENT CAN BE ACHIEVED.

"THE AIR FORCE TECH MOD CONCEPT RESULTED FROM THE CONVICTION OF THE F16 PROGRAM MANAGER, MAJOR GENERAL JAMES ABRAHAMSON, THAT CAPITAL INVESTMENT COULD

REDUC[illegible]
POLICY PRE[illegible]

AND EQUIPMENT [illegible]
REALIZED [illegible]
THE COMPANY'S [illegible]
MENTS DID NOT [illegible] MAKE ADDITIONAL
CAPITAL INVESTMENT [illegible]
NEGOTIATION [illegible]
KEY MODIFICA[illegible]
INCLUDED: [illegible]
SEPARATE CONTRA[illegible]
TECHNOLOGY AN[illegible]
$100M IN SEV[illegible]
PROTECTION [illegible]
1158 AIRCRAF[illegible]
TRACT TARGET [illegible]
ACCORDING TO A [illegible]
FEE OF $1M PER [illegible]

"POTENTIAL [illegible]
EXCESS OF $[illegible]
SHARE OF THE [illegible]
$220M. AS [illegible]
THE AIR FO[illegible]
BUSINESS [illegible]
PROCUREMENT[illegible]

"ALTHOUGH [illegible]
COMPLETELY [illegible]
FEW MINUTE[illegible]
ENSURE MUTU[illegible]
PHASE REFER[illegible]
PLANNING A[illegible]
REFERRED T[illegible]
COMPUTER [illegible]
AN INTEGRAL [illegible]
TECHNOLOGY STA[illegible] RELATIVE
TO YOUR STRA[illegible] AND THE TECHNOLOGIES
AVAILABLE.

"AFTER REVI[illegible]
PROPOSAL, PHA[illegible]
FACTORY WIDE [illegible] ANALYSIS.
THIS ANALY[illegible] MODERNI-
ZATION PRO[illegible]
DESIGNED. [illegible]
AND PHASE [illegible]
PROPOSED [illegible]
AND COST SAV[illegible]

"PHASE II OF THE TECH MOD PROGRAM IS THE PHASE WHEREIN DETAILED DESIGNS ARE ACCOMPLISHED, ENABLING TECHNOLOGY DEVELOPMENT TAKES PLACE, PROJECTS ARE PROTOTYPED HEURISTICALLY, AND INTEGRATED INFORMATION RESOURCE MANAGEMENT (IRM)/MANAGEMENT INFORMATION SYSTEM (MIS) PLANS ARE COORDINATED AND FINALIZED. IN ADDITION, AIR FORCE TECH MODS REQUIRE A COMPREHENSIVE OVERALL QUALITY ASSURANCE (Q.A.) PLAN.

"PHASE III OF THE TECH MOD IS THE PHASE WHEREIN FINAL DESIGNS ARE COMPLETED, BUILDING AND EQUIPMENT MODIFICATIONS ARE MADE, SYSTEMS ARE INSTALLED AND PROJECT COST SAVINGS ARE TRACKED TO ENSURE THAT PROGRAM OBJECTIVES ARE ACHIEVED.

THE DOTTED BAR EXTENDING BACK INTO PHASE I INDICATES THAT, IN MANY CASES, PROJECTS ARE IDENTIFIED EARLY IN THE PROGRAM THAT THE CONTRACTOR WISHES TO IMMEDIATELY IMPLEMENT AND GAIN THE SAVINGS. THE TECH MOD PROGRAM CONCEPT DOES NOT PROHIBIT SUCH ACTION."

TECH MOD CONCEPT

PARTNERSHIP TO IMPROVE PRODUCTIVITY

INDUSTRY	GOVERNMENT
● MODERNIZE MANUFACTURING FACILITIES	● PROVIDE INCENTIVES
INVEST IN NEW SYSTEMS NEW EQUIPMENT AND FACILITY IMPROVEMENTS	FUND ANALYSIS AND DESIGN
IMPLEMENT IMPROVED SYSTEMS	PROVIDE TERMINATION LIABILITY PROTECTION
● REDUCE COST OF WEAPONS SYSTEMS	PROVIDE AWARD FEES
	SHARE SAVINGS
● WINS	● WINS
LARGER PROFIT AND MORE COMPETITIVE POSITION WITH REDUCED FINANCIAL RISK	MORE BANG FOR THE BUCK

INSTRUCTIONAL OBJECTIVE: To orient executive management to the fact that the Air Force Tech Mod Concept is a partnership to improve productivity.

NARRATION: "THE U.S. AIR FORCE T CONCEPT IS INTENDED TO BE A PARTNERSHIP BETWEEN GOVERNMENT AND INDUSTRY TO IMPROVE PRODUCTIVITY.

"ON THE INDUSTRY SIDE OF THE LEDGER, THE TECH MOD MODERNIZES MANUFACTURING FACILITIES BY INCENTIVIZING INDUSTRY TO INVEST IN NEW SYSTEMS, NEW EQUIPMENT AND FACILITY IMPROVEMENTS AND TO IMPLEMENT IMPROVED SYSTEMS. THE RESULT OF THIS ACTION IS REDUCED COST OF WEAPON SYSTEMS AND WINS LARGER PROFITS AND MORE COMPETITIVE POSITION FOR INDUSTRY WITH REDUCED FINANCIAL RISK.

"ON THE GOVERNMENT SIDE OF THE LEDGER, THE GOVERNMENT PROVIDES INCENTIVES TO FUND ANALYSIS AND DESIGN, AND PROVIDES TERMINATION LIABILITY PROTECTION COUPLED WITH AWARD FEES. THE GOVERNMENT EXPECTS TO SIGNIFICANTLY SHARE IN THE SAVINGS RESULTING FROM THE TECH MOD PROGRAM. IT THEREBY WINS MORE 'BANG FOR THE BUCK."

TECH MOD PROGRAMS

- ESTABLISH NEW PRODUCTION PROCESSES
- PROVIDE TECHNOLOGY TRANSFER
- STIMULATE IMPLEMENTATION & INVESTMENT
- DIRECTLY SUPPORTS SMALL BUSINESS & B/SIC INDUSTRIES (30-40%)
- BUILD UPON R&D PRECURSOR DEMONSTRATIONS
- IMPACT ACQUISITION & OPERATIONS & MAINTENANCE ROI

INSTRUCTIONAL OBJECTIVE: To orient executive management relative to TECH MOD program activities.

NARRATION: "TECH MOD PROGRAMS ESTABLISH NEW PRODUCTION PROCESSES AND PROVIDE FOR TECHNOLOGY TRANSFER BETWEEN COMPANIES.

TECH MOD PROGRAMS STIMULATE IMPLEMENTATION OF NEW TECHNOLOGY AND SYSTEMS AND THE INVESTMENT BY DEFENSE CONTRACTORS. THEY DIRECTLY SUPPORT SMALL BUSINESS AND BUILD UPON R & D PRECURSOR DEMONSTRATION.

"IT IS THE INTENT OF TECH MOD PROGRAMS TO IMPACT THE GOVERNMENT'S ACQUISITION, OPERATIONS AND MAINTENANCE "RETURN ON INVESTMENT (ROI)."

ICAM ANALYTICAL / PLANNING TOOLS

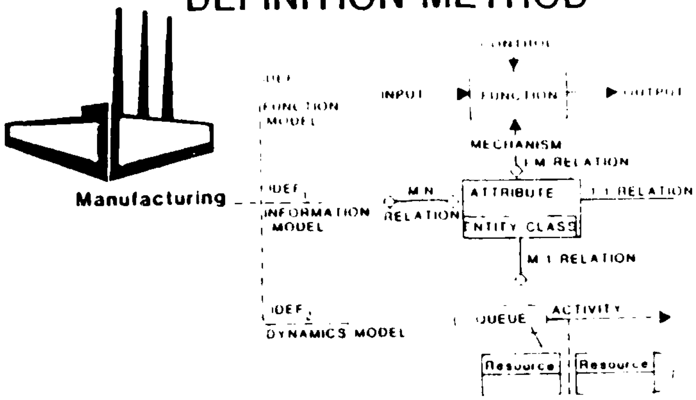
INSTRUCTIONAL OBJECTIVE: To convince executive management that the ICAM Program has developed useful analytical and planning tools for managing the introduction of new technology.

NARRATION: "AS WE DISCUSSED EARLIER, THE ICAM PROGRAM RECOGNIZED THAT THE SUCCESSFUL INTEGRATION OF NEW TECHNOLOGY MAY BE AS SIGNIFICANT, IF NOT MORE SO, THAN TECHNOLOGY ITSELF IN TERMS OF CONTRIBUTING TO PRODUCTIVITY IMPROVEMENT.

THERE ARE MANY ASPECTS TO TECHNOLOGY IMPLEMENTATION, BUT ONE STANDS OUT AMONG ALL OTHERS. IF NOT DONE, IT WILL EITHER PRECLUDE OR SERIOUSLY HAMPER IMPROVED PRODUCTIVITY NO MATTER HOW WELL EVERYTHING ELSE IS DONE.

THAT KEY FACTORY IS UNDERSTANDING THE EXISTING ENVIRONMENT. THAT IS WHY THE "SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY" IS EMPHASIZED IN THE ICAM PROGRAM PURPOSE."

IDEF - A SYSTEM DEFINITION METHOD



INSTRUCTIONAL OBJECTIVE: To answer the question "What is IDEF"? for executive level management.

NARRATION: "IDEF IS THE "ICAM DEFINITION" METHOD, LANGUAGE OR TECHNIQUE. IDEF IS A MODELING METHODOLOGY WHOSE PURPOSE IS TO GRAPHICALLY CAPTURE CHARACTERISTICS OF THE MANUFACTURING FUNCTIONS, INFORMATION SUPPORT FUNCTIONS, AND THE DYNAMICS OF THE FUNCTION AND INFORMATION INTERACTION.

"WE CAN DEFINE IDEF AS SHOWN IN THIS GRAPHIC THREE-PRONGED SYSTEM DEFINITION METHOD BY WHICH WE CAN:

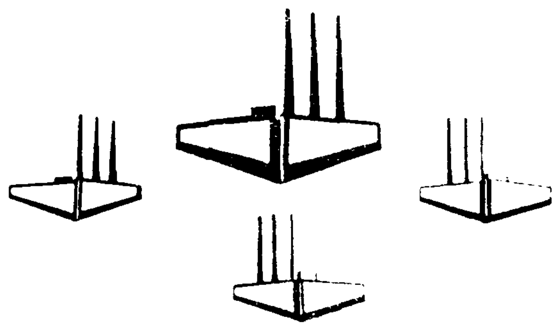
- O DEFINE PROBLEMS AND THEIR SOLUTIONS
- O FACILITATE COMMUNICATION AND ANALYSIS
- O ANSWER QUESTIONS ABOUT MANUFACTURING

"EACH OF THE THREE MODELS INDIVIDUALLY AS WELL AS COLLECTIVELY FORM AN "ARCHITECTURE" WHEN THE ENVIRONMENT OR SYSTEM BEING MODELED IS COMPRISED OF COMPONENT SYSTEMS, ORGANIZATIONS OR TECHNOLOGIES WHICH MUST WORK TOGETHER AS A HIGHER LEVEL SYSTEM, ENVIRONMENT OR ENTERPRISE.

THE SIGNIFICANCE OF THE MODELS BEING REFERRED TO AS ARCHICHTECTURES IS THAT THEY ARE "BLUEPRINTS" WHICH DESCRIBE GRAPHICALLY THE FUNDAMENTAL RELATIONSHIPS - THE FUNCTIONAL INTERFACES, COMMON/SHARED INFORMATION AND DYNAMICS INTERACTION - OF THE CONSTITUENT COMPONENTS OF THE SUBJECT ENVIRONMENT OR THE SYSTEM BEING MODELED."

ICAM

IDEF ⟶ ARCHITECTURE

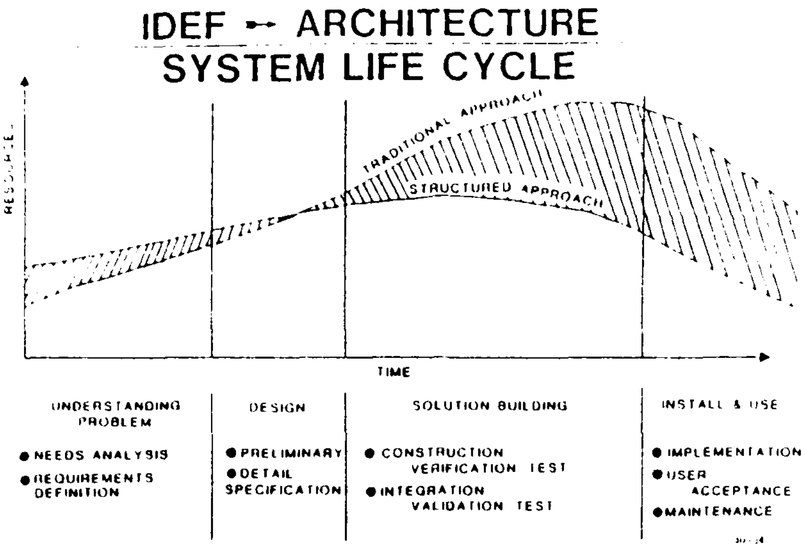


INSTRUCTIONAL OBJECTIVE: To answer the question "What is IDEF"? for executive level management.

NARRATION: "IT IS IMPORTANT TO RECOGNIZE, HOWEVER, THAT THE MODELS ARE IN FACT ARCHITECTURES ONLY WHEN USED AS ARCHITECTURES - THAT IS, TO BETTER UNDERSTAND, COMMUNICATE AND ANALYZE THE SUBJECT ENVIRONMENT OR SYSTEM AND HOW ITS COMPONENTS FIT TOGETHER FOR THE PURPOSE OF IMPROVING <u>OVERALL PRODUCTIVITY</u>.

"THE ICAM ARCHITECTURE, CREATED THROUGH THE USE OF IDEF MODELING TECHNIQUES, REPRESENTS A "<u>COMPOSITE VIEW</u>" OF AEROSPACE MANUFACTURING. THIS "<u>COMPOSITE VIEW</u>" WAS CREATED FROM THE VARIOUS "<u>FACTORY VIEWS</u>" GENERATED BY MEMBERS OF ICAM AEROSPACE INDUSTRY COALITION TEAMS.

"WHAT IS NOT IMMEDIATELY APPARENT IS THAT AN ARCHITECTURE - AS A MEANS TO PRODUCTIVITY IMPROVEMENT - IS IN ESSENCE A "<u>STANDARD FOR COMMUNICATION</u>." AS DISCUSSED EARLIER, ALL THREE IDEF MODELS PROVIDE INSIGHT WHICH IS FACILITATED BY THE REVIEW OF THE MODELS BY THE PEOPLE INVOLVED TO BETTER UNDERSTAND THE SUBJECT ENVIRONMENT OR SYSTEM AND HOW TO IMPROVE IT. INSIGHT VIA COMMUNICATION IS PRIMARILY WHAT AN ARCHITECTURE PROVIDES TO THE PROCESS OF PRODUCTIVITY IMPROVEMENT."



INSTRUCTIONAL OBJECTIVE: To answer the question "What is IDEF"? for executive level management.

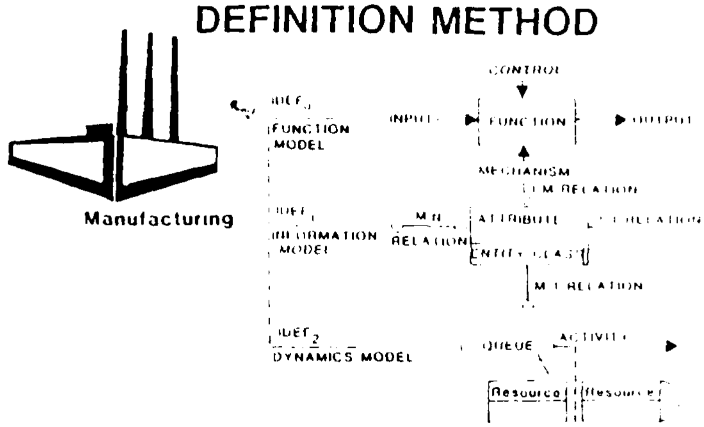
NARRATION: "THIS VIEW OF THE ICAM SYSTEM LIFE CYCLE PORTRAYS THE FACT THAT ADDITIONAL EXPENDITURE OF TIME AND EFFORT EARLY IN THE LIFE CYCLE "UNDERSTANDING THE PROBLEM" AND "DESIGNING THE SOLUTION" WILL RESULT IN SIGNIFICANT COST SAVINGS, AND PERHAPS TIME REDUCTION OVER THE LIFE CYCLE OF THE PROGRAM. WE REFER TO THE USE OF ARCHITECTURE AND IDEF METHODOLOGY AS THE "STRUCTURED APPROACH" VERSUS THE "TRADITIONAL APPROACH" ON THIS GRAPHIC PRESENTATION.

"IN AN ENVIRONMENT SUCH AS MANUFACTURING THERE ARE BASICALLY TWO AREAS OF COMMUNICATION WHICH NEED TO BE FACILITATED FOR PRODUCTIVITY IMPROVEMENT. FIRST AND FOREMOST IS THE NEED TO BETTER COMMUNICATE MANUFACTURING AMONG AND BETWEEN THE CROSS SECTION OF DISCIPLINES INVOLVED. MANUFACTURING IS CARRIED OUT BY MANY DIFFERENT PEOPLE REPRESENTING MANY DIFFERENT VIEWPOINTS, FROM WHICH TO COMMUNICATE, BASED UPON THEIR UNIQUE EXPERIENCE, RESPONSIBILITY AND PURPOSE. THE METHODS USED TO COMMUNICATE TRANSCENDS VIEWPOINT AND PROMOTES A COLLECTIVE, IMPROVED UNDERSTANDING OF MANUFACTURING TAKING ADVANTAGE OF ALL VIEWPOINTS.

"ANOTHER IMPORTANT ADVANTAGE OF USING AN ARCHITECTURE AND MODELING METHODOLOGIES IN THE PROCESS OF PRODUCTIVITY IMPROVEMENT, IS THAT IT SERVES AS A BRIDGE BETWEEN THE MANAGEMENT AND TECHNICAL ENDEAVORS. AN ARCHITECTURE CAN BE USED AS BOTH A MANAGEMENT AND AS A TECHNICAL TOOL. MANAGERS ARE CONCERNED WITH PLANNING, CONTROLLING, AND ORGANIZING AND COORDINATING; WHILE TECHNICAL PEOPLE ARE CONCERNED WITH ANALYZING, INTEGRATING AND DESIGNING PRODUCTIVITY IMPROVEMENTS. ABOVE ALL WHAT IS MOST IMPORTANT IS TO RECOGNIZE THAT THEY MUST WORK TOGETHER TO IMPROVE MANUFACTURING AND COMMUNICATION BY WHATEVER MEANS IS IMPERATIVE.

"SOME BELIEVE THAT THIS CONCEPT AND APPROACH TO SYSTEM LIFE CYCLE MANAGEMENT IS THE AREA WHEREIN JAPANESE INDUSTRY REPEATEDLY OUT PERFORMS MUCH OF U.S. INDUSTRY."

IDEF - A SYSTEM DEFINITION METHOD



INSTRUCTIONAL OBJECTIVE: *To introduced executive management to* the IDEF0 function modeling methodology.

NARRATION: "WHAT IS NEEDED IS A SET OF TOOLS AND METHODOLOGIES WHICH WILL ALLOW THE MANUFACTURING SYSTEM OR DEVELOPER TO:

- O PROVIDE A COMMON BASIS FOR COMMUNICATION.
- O PROVIDE FOR ESTABLISHMENT OF COMPOSITE DEFINITION FROM MANY INDIVIDUAL COMPANIES SPECIFIC DEFINITIONS.
- O PROVIDE A DESCRIPTIVE AND REPRESENTATIVE DOCUMENTATION OF THE OBJECTS OF THE COMPONENT SYSTEMS UTILIZING A COMMON SET OF CHARACTERISTICS.
- O SERVE AS THE INTEGRATION MECHANISM FOR APPLICATION SUPPORT SUBSYSTEMS.
- O SERVE AS THE BASIS FOR SYSTEM DESIGN, CONSTRUCTION, TEST AND IMPLEMENTATION.

- O BE UTILIZED BY MANUFACTURING PERSONNEL IN AN EFFECTIVE MANNER.

- O HAVE A FORMAL BASIS SO THAT AUTOMATED ANALYZERS AND CONSTRUCTION AIDS COULD BE BUILT.

- O BE VALIDATED BY BOTH EXPERT REVIEW AND SIMULATION TECHNIQES.

"THE ICAM PROGRAM DECIDED TO PURSUE THREE MODELING METHODOLOGIES CONSIDERING THE FOLLOWING FACTORS:

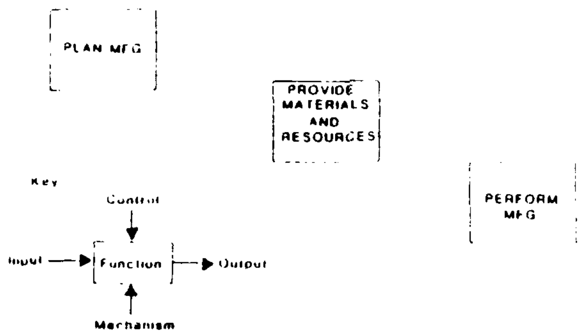
- O INDEPENDENTLY DEVELOPED MODELS, WHICH ARE VALIDATED AGAINST ONE ANOTHER AS AN APPROACH TO INTEGRATION, PROVIDE A GREATER ASSURANCE THAT THE IMPORTANT CHARACTERISTICS WILL BE ISOLATED AND DOCUMENTED BY AT LEAST ONE OF THE MULTIPLE INQUIRIES.

- O SINCE THE PRIMARY MECHANISM FOR VALIDATION IS EXPERT REVIEW, MULTIPLE MODELS ALLOW FOR SIMPLIFICATION OF THE CONCEPTS AND SYNTAX FOR EACH REVIEW AND THEREBY ENHANCE COMMUNICATION.

- O MULTIPLE MODELS ALLOW THE DEFINITION PROCESS TO BE SEGMENTED INTO MANAGEABLE PIECES.

"LET'S FIRST EXAMINE HOW AN IDEF0 FUNCTION MODEL ANSWERS SPECIFIC QUESTIONS RELATIVE TO THE BASIC FUNCTIONAL BREAKDOWN OR DECOMPOSITION OF THE MANUFACTURING ENTERPRISE."

IDEF$_0$ — FUNCTION MODEL



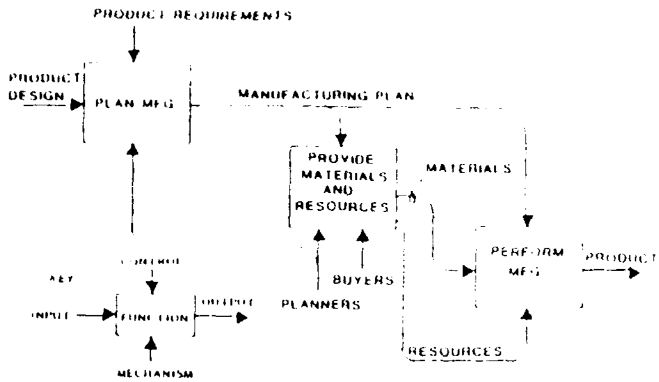
INSTRUCTIONAL OBJECTIVE: To introduced executive management to the IDEFO function modeling methodology.

NARRATION: "LET'S CONSTRUCT A TOP-LEVEL FUNCTION MODEL OF A MANUFACTURING ENTERPRISE'S PROUCTION ACTIVITY:

- O PLAN MANUFACTURING
- O PROVIDE MATERIAL AND RESOURCES
- O PERFORM MANUFACTURING

"PLEASE NOTE THE KEY PROVIDED IN THE LOWER LEFT CORNER TO FACILITATE YOUR UNDERSTANDING THROUGH THE NEXT STEPS IN OUR MODEL CONSTRUCTION."

IDEF$_0$ -- FUNCTION MODEL



INSTRUCTIONAL OBJECTIVE: To introduced executive management to the IDEF0 function modeling methodology.

NARRATION: "WHAT IS BEING TRANSFORMED AND WHAT IS THE RESULT? HERE WE INPUT "PRODUCT DESIGN" IN THE FUNCTION OF "PLAN MANUFACTURING."

"OUR PRODUCT DESIGN "INPUT" IS BEING TRANSFORMED INTO A MANUFACTURING PLAN AND EVENTUALLY INTO A PRODUCT "OUTPUT."

"THE "OUTPUT" OF THE FUNCTION "PROVIDE MATERIAL AND RESOURCES" IS "MATERIALS AND RESOURCES."

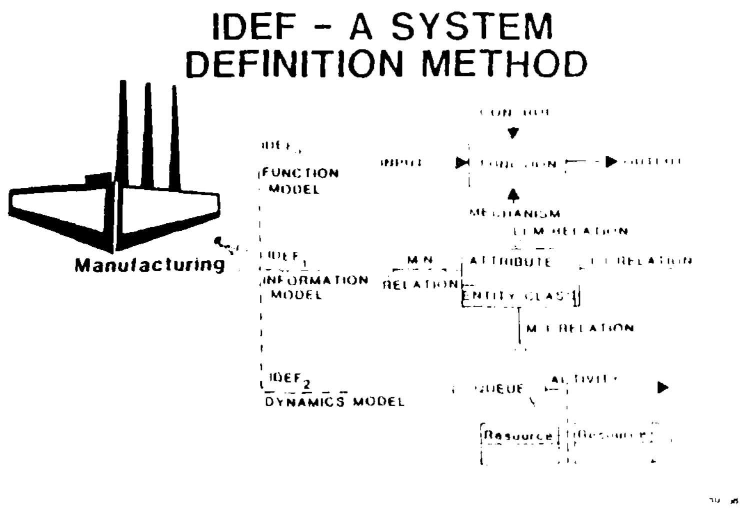
"IN ORDER TO ACCOMPLISH OUR "PERFORM MANUFACTURING" FUNCTION, WE MUST "INPUT" MATERIALS.

"WHAT INFLUENCES THESE FUNCTIONS? "PLAN MANUFACTURING" IS CONTROLLED BY "PRODUCT REQUIREMENTS." "PROVIDE MATERIAL AND RESOURCES" AND "PERFORM MANUFACTURING" ARE CONTROLLED BY THE "MANUFACTURING PLAN."

"WHAT IS NECESSARY TO CARRY OUT THESE FUNCTIONS? "PERFORM MANUFACTURING" REQUIRES THE MECHANISM OF "RESOURCES" SUCH AS EQUIPMENT, TOOLS AND PEOPLE. THE OTHER FUNCTIONS REQUIRE PLANNERS AND BUYERS.

"THIS IDEFO MODEL DIAGRAM ILLUSTRATES THAT:

> IDEF IS USED TO PRODUCE A FUNCTION MODEL PERSPECTIVE, A BLUEPRINT, A STRUCTURED DESCRIPTION OF WHAT IS BEING PERFORMED. WE MAY FURTHER DECOMPOSE EACH OF THESE FUNCTIONS TO PROVIDE A BREAKDOWN TO ANY DESIRED LEVEL OF DETAIL, THEREBY PROVIDING A FUNCTIONAL ARCHITECTURE OR FRAMEWORK OF MANUFACTURING."



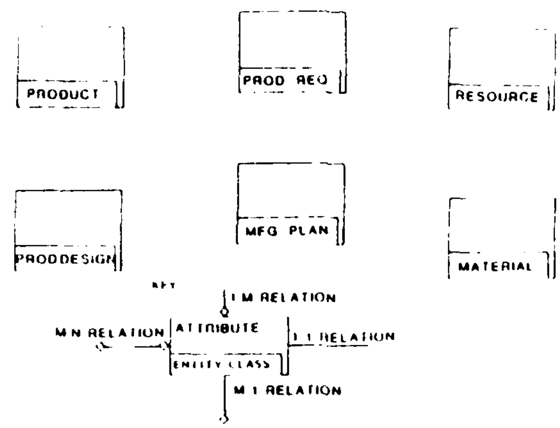
INSTRUCTIONAL OBJECTIVE: To introduce executive management to the IDEF1 information modeling methodology.

NARRATION: "THE IDEF 1 INFORMATION MODEL PROVIDES AND IN-DEPTH DESCRIPTION OF INFORMATION BY FOCUSING ON THE STRUCTURE OF INFORMATION IN SUPPORT OF WHAT IS BEING PERFORMED.

WE FEEL THAT THIS MODELING PERSPECTIVE IS ABSOLUTELY ESSENTIAL FOR THE INTEGRATION OF IDEF0 FUNCTION MODELS AND THE DEVELOPMENT OF AN INTEGRATED DATABASE.

"THE IDEF1 INFORMATION MODELS ARE PROVING TO BE ONE OF ICAM'S KEY SYSTEM INTEGRATION TOOLS."

IDEF$_1$ — INFORMATION MODEL

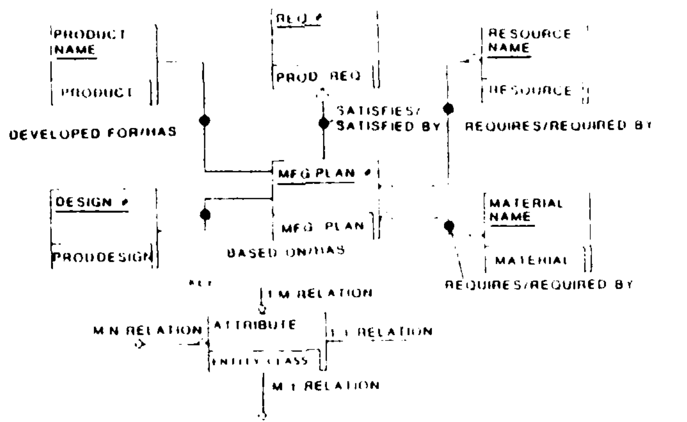


INSTRUCTIONAL OBJECTIVE: To introduce executive management to the IDEF1 information modeling methodology.

NARRATION: "AN IDEF1 INFORMATION MODEL CAN ANSWER SPECIFIC QUESTIONS REGARDING ANY INFORMATION ELEMENT (ENTITY CLASS) - SOMETIMES THE IDEF1 MODEL ANSWERS QUESTIONS NOT DEFINABLE IN IDEFO FUNCTION MODELS.

"PLEASE NOTE THAT WE HAVE AGAIN PROVIDED A MODEL KEY ON EACH OF THESE PRESENTATIONS TO FACILITATE YOUR UNDERSTANDING. THE IDEF1 PRIMITIVES ARE ENTITIES, ATTRIBUTES AND RELATIONS."

IDEF1 -- INFORMATION MODEL



INSTRUCTIONAL OBJECTIVE: To introduce executive management to the IDEF1 information modeling methodology.

NARRATION: "WHAT ARE THE RELATIONS OF ALL OF THE OTHER INFORMATION ENTITIES SHOWN TO THE "MANUFACTURING" ENTITY CLASS?

- O EACH "PRODUCT" HAS A SPECIFIC "MANUFACTURING PLAN"
- O EACH DESIGN HAS A SPECIFIC "MANUFACTURING PLAN"
- O MANY PRODUCT REQUIREMENTS MAY BE SATISFIED BY THE "MANUFACTURING PLAN"
- O MANY "RESOURCES" ARE REQUIRED BY THE "MANUFACTURING PLAN"
- O MANY "MATERIALS" ARE REQUIRED BY THE "MANUFACTURING PLAN"

"FOLLOWING THE SAME ANALY[illegible] TECHNIQUE, WE HAVE PROVIDED THE RELATION DIAGRAMMING FOR THE OTHER ENTITY RELATION CLASSES SHOWN. (INSTRUCTOR MAY REVIEW EACH USING "MANUFACTURING PLAN" AS "CENTER.")

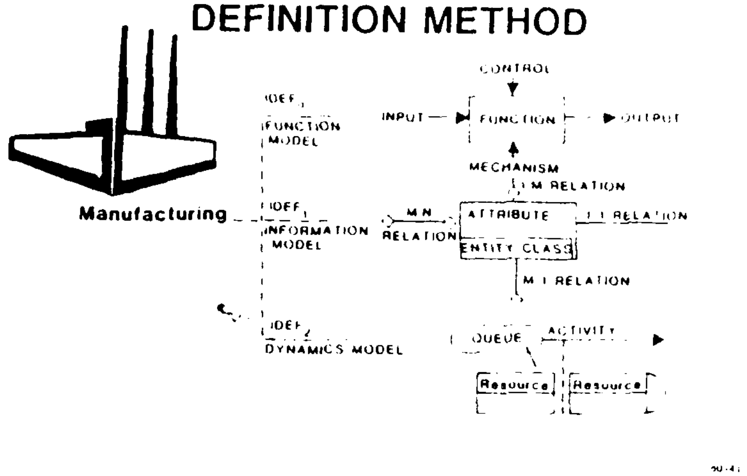
"IDEF1 IS USED TO PRODUCE AN INFORMATION MODEL PERSPECTIVE, A "DATA DICTIONARY" AND A STRUCTURED DESCRIPTION OF THE BASIC INFORMATION ELEMENTS.

"THE MODEL DEFINES, CROSS REFERENCES, RELATES AND CHARACTERIZES INFORMATION TO THE LEVEL OF DETAIL NECESSARY TO SUPPORT AND INTEGRATE THE MANUFACTURING ENVIRONMENT.

"IDEF 1 MODELS ARE <u>ESSENTIAL</u> TO COMMUNICATE THE INTERRELATIONSHIP OF INFORMATION AND TO PLAN INTEGRATED COMPUTER-AIDED MANUFACTURING.

"IDEF 1 MODELS PROVIDE THE BASIS TO ANALYZE THE COMMON, SHARED AND PRIVATE INFORMATION NEEDS OF THE MANUFACTURING ENVIRONMENT."

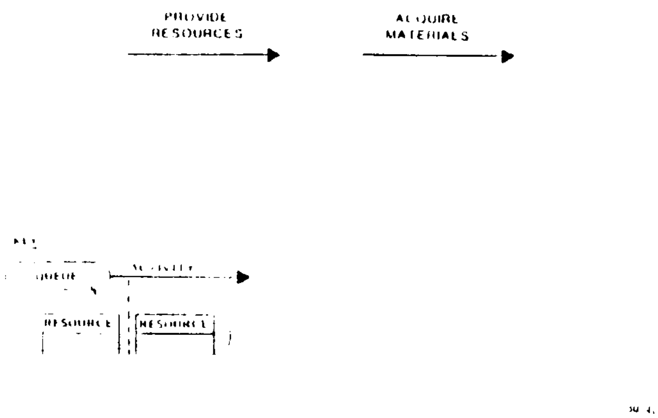
IDEF - A SYSTEM DEFINITION METHOD



INSTRUCTIONAL OBJECTIVE: To introduce the IDEF2 dynamics modeling methodology.

NARRATION: "THE IDEF 2 DYNAMICS MODEL REPRESENTS THE TIME DEPENDENT CHARACTERISTICS OF MANUFACTURING TO DESCRIBE AND ANALYZE THE BEHAVIOR OF FUNCTIONS AND INFORMATION INTERACTING OVER TIME."

IDEF$_2$ -- DYNAMICS MODEL

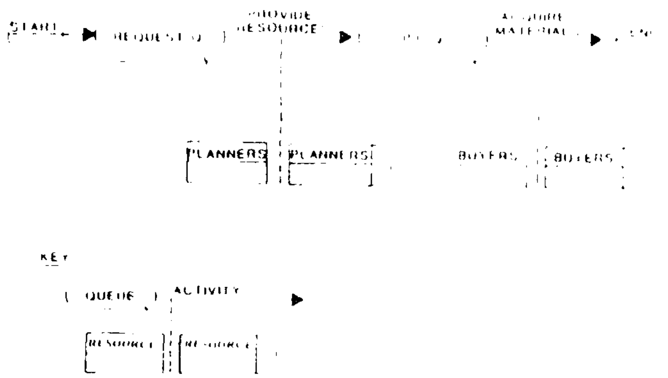


INSTRUCTIONAL OBJECTIVE: To introduce the IDEF2 dynamics modeling methodology.

NARRATION: "THE IDEF2 MODEL ANSWERS SPECIFIC QUESTIONS ABOUT ANY OBJECT OR INFORMATION AS IT PASSES THROUGH THE MANUFACTURING ENVIRONMENT, SUCH AS:

- O WHAT ACTIVITIES CONSUME TIME IN THE PROCESSING OF A MANUFACTURING PLANT?
- O WHAT TIME IS CONSUMED IN WAITING TO BE PROCESSED BY THE ACTIVITIES"?

IDEF$_2$ -- DYNAMICS MODEL



INSTRUCTIONAL OBJECTIVE: To introduce the IDEF2 dynamics modeling methodology.

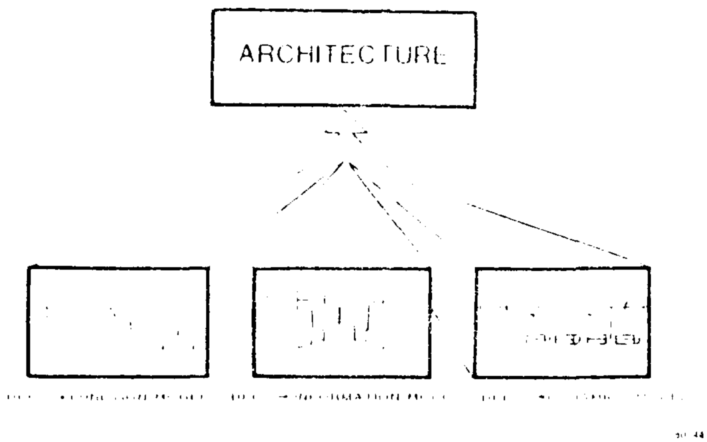
NARRATION: "WHAT RESOURCES ARE ALLOCATED, UTILIZED AND DEALLOCATED BY THE ACTIVITIES?

"ONCE THESE QUESTIONS HAVE BEEN ANSWERED, BECAUSE OF TIME RELATIVE INFORMATION ASSOCIATED WITH EACH QUESTION, FURTHER QUESTIONS MAY BE ANSWERED REGARDING PERFORMANCE OF FLOW - SUCH AS:

> WHAT IS THE TOTAL PROCESSING TIME OF THE MANUFACTURING PLAN? WHAT IS THE TOTAL TIME OF MANUFACTURING PLAN IS WAITING IN QUEUE TO BE PROCESSED? WHAT IS THE UTILIZATION OF RESOURCES AND WHAT STATISTICS ARE ASSOCIATED WITH THESE TIMES?

"IDEF2 THEREFORE, IS USED TO PRODUCE A DYNAMICS MODEL, A "SCENARIO" - A STRUCTURED DESCRIPTION OF THE TIME ORIENTED BEHAVIOR OF FUNCTIONS AND INFORMATION, AND PREVIOUS QUANTITATIVE INFORMATION AS TO THE SEQUENCE, DURATION AND FREQUENCY AT A LEVEL OF DETAIL NECESSARY TO ANALYZE HOW MANUFACTURING IS PERFORMED. (I.E. COMMUNICATION OF FUNCTION/INFORMATION INTER-RELATION - ANALYSIS OF RESOURCE UTILIZATION AND THROUGHPUT TIME COSTS.)"

ARCHITECTURE



INSTRUCTIONAL OBJECTIVE: To provide executive management with an understanding that all three IDEF0, IDEF1, and IDEF2 modeling methodologies constitute the generic manufacturing architecture.

NARRATION: "INDIVIDUALLY AND COLLECTIVELY:

- O IDEF0 FUNCTION MODELS PROVIDE A "BLUEPRINT OF FUNCTIONS"
- O IDEF1 INFORMATION MODELS PROVIDE A "DICTIONARY OF INFORMATION"
- O IDEF2 DYNAMICS MODELS PROVIDE A "SCENARIO OF FUNCTION/INFORMATION INTERACTION."

"ALL THREE MODELING METHODOLOGIES AND THEIR RESPECTIVE ARCHITECTURES FORM THE ICAM ARCHITECTURE.

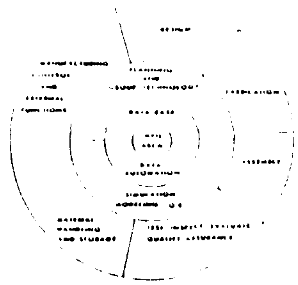
"EACH OF THE MODELS REPRESENT A DISTINCT BUT RELATED VIEW OF MANUFACTURING.

"EACH USES A STRUCTURED IDEA METHOD [illegible] UNDERSTAND, COMMUNICATE AND ANALYZE EXISTING [illegible] FUTURE MANUFACTURING.

"EACH SUPPORTS THE DEVELOPMENT OF STATE-OF-THE-ART MANUFACTURING TECHNOLOGY AND INTEGRATION OF THAT TECHNOLOGY INTO EXISTING MANUFACTURING."

ICAM

INTEGRATED
COMPUTER AIDED MANUFACTURING

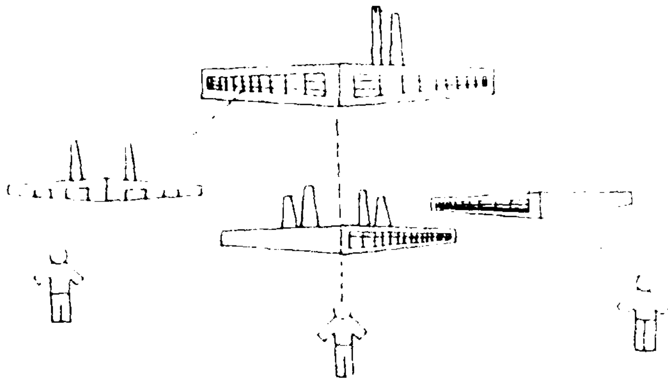


INSTRUCTIONAL OBJECTIVE: To provide executive management with an understanding of the importance of the manufacturing architecture developed via the IDEF methodologies.

NARRATION: "THIS ICAM LOGO ILLUSTRATES THE IMPORTANCE PLACED BY THE AIR FORCE UPON THE MANUFACTURING ARCHITECTURE DEVELOPED BY THE IDEF METHODOLOGIES. IT IS THE CENTER PIECE OF THE ICAM PROGRAM, THE BASIS FOR DEVELOPING INTEGRATED DATABASES AND DATA AUTOMATION.

"THE MANUFACTURING ARCHITECTURE HAS BEEN THE CENTER TARGET OF THE ICAM PROGRAM SINCE THE EARLY DAYS OF ITS INCEPTION. ALL OF THE WORK ACCOMPLISHED TO DATE INDICATES THAT THE SELECTION OF THIS "BULL'S-EYE" WAS FORWARD LOOKING AND AN ACCURATE FORECAST OF THE ICAM PROGRAM'S NEEDS."

ARCHITECTURE
STANDARD FOR COMMUNICATION



INSTRUCTIONAL OBJECTIVE: To provide executive management with an understanding of the importance of the manufacturing architecture developed via the IDEF methodologies.

NARRATION: "THE GENERIC ICAM MANUFACTURING ARCHITECTURE HAS BEEN AND IS BEING DEVELOPED THROUGH THE USE OF COALITIONS OF AEROSPACE CONTRACTORS.

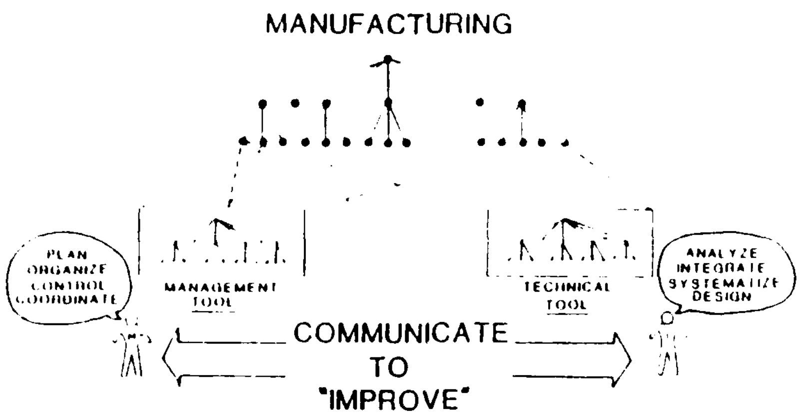
"COALITION PARTICIPANTS FIRST MODELED THEIR OWN "FACTORY VIEW" OF THE ARCHITECTURE.

"THESE INDIVIDUAL "FACTORY VIEWS" WERE THEN COMPOSITED INTO THE GENERIC MANUFACTURING COMPOSITE VIEW "ARCHITECTURE."

"WHEN YOU UTILIZE THE GENERIC ARCHITECTURE AND DEVELOP YOUR OWN MANUFACTURING TECHNOLOGY MODERNIZATION (TECH MOD) PROGRAM, THE PROCESS IS REVERSED.

"THE GENERIC ARCHITECTURE PROVIDES A STANDARD FOR ORGANIZATIONAL COMMUNICATION, UNDERSTANDING AND ANALYSIS."

ARCHITECTURE



INSTRUCTION OBJECTIVE: To provide executive management with an understanding of the importance of the manufacturing architecture developed via the IDEF methodologies.

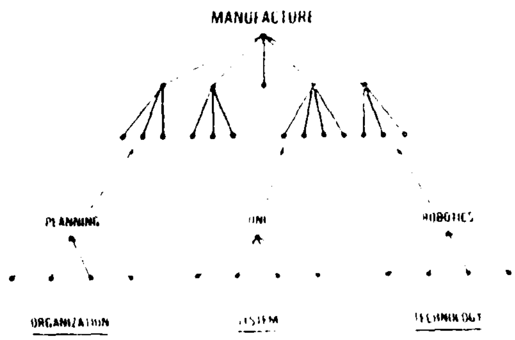
NARRATION: "THE MANUFACTURING ARCHITECTURE PROVIDES BOTH A MANAGEMENT TOOL AND A TECHNICAL TOOL TO IMPROVE UNDERSTANDING AND COMMUNICATION.

"MANAGEMENT CAN USE THE ARCHITECTURE TO PLAN, ORGANIZE AND CONTROL THE INTEGRATION OF NEW MANUFACTURING TECHNOLOGY.

"TECHNICAL PERSONNEL CAN USE THE ARCHITECTURE TO ANALYZE, INTEGRATE, SYSTEMATIZE AND DESIGN OF NEW TECHNOLOGY.

"AND MAYBE MORE IMPORTANT--TO IMPROVE COMMUNICATION BETWEEN EACH OTHER"!!!

STANDARD FOR COMMUNICATION



INSTRUCTIONAL OBJECTIVE: To provide executive management with an understanding of the importance of the manufacturing architecture developed via the IDEF methodologies.

NARRATION: "IN SUMMARY, WE NEED AN "ARCHITECTURE" TO FACILITATE PUTTING VIEWPOINTS INTO PERSPECTIVE AND TO PROVIDE A COMMON BASIS UPON WHICH WE CAN DEAL WITH ALL ASPECTS OF MANUFACTURING. (I.E. ORGANIZATION, SYSTEM, AND TECHNOLOGIES.)

"THIS ARCHITECTURE MUST PROVIDE A FRAMEWORK, A ROAD MAP, A BLUEPRINT, A DICTIONARY FROM WHICH WE CAN DEPART AND REFERENCE BACK TO. THE KEY TO INCREASED MANUFACTURING PRODUCTIVITY IS TO DO IT SMARTER. TO DO IT SMARTER, WE MUST INTEGRATE AND TO INTEGRATE WE MUST BETTER UNDERSTAND HOW ALL THE "PIECES" FIT TOGETHER. WE MUST UNDERSTAND BETTER OUR OWN DOMAIN AND HOW WE FIT INTO THE WHOLE.

"GIVEN THAT OUR OBJECTIVE IS TO IMPROVE MANUFACTURING PRODUCTIVITY, THE TASK WILL REQUIRE US TO INTEGRATE THE MANAGEMENT AND OPERATIONS OF MANUFACTURING. THIS MEANS NOT JUST TO INTEGRATE COMPUTERS TOGETHER BUT INTEGRATE WHAT COMPUTERS WILL ENABLE. (I.E. INTEGRATED ORGANIZATIONS, SYSTEMS, AND TECHNOLOGIES.)

IDEF IS THE METHOD

ARCHITECTURE IS THE MEANS

PRODUCTIVITY IS THE OBJECTIVE

INSTRUCTIONAL OBJECTIVE: To provide executive management with ICAM's understanding of the relationship of IDEF, architecture, and productivity.

NARRATION: "IDEF IS THE METHOD!!

"ARCHITECTURE IS THE MEANS!!

"PRODUCTIVITY IS THE OBJECTIVE!!

"THE ICAM ARCHITECTURE HAS NOW MATURED TO THE POINT WHERE THE AIR FORCE HAS BEEN ABLE TO UTILIZE THE "AS-IS" ARCHITECTURE AS A BASELINE FROM WHICH THE FACTORY OF THE FUTURE CAN BE DEFINED.

"THE VOUGHT CORPORATION HAS BEEN AWARDED A "TO-BE" ARCHITECTURE CONTRACT FOR A "CONCEPTUAL DESIGN FOR COMPUTER INTEGRATED MANUFACTURING (CIM)" FOR THE AEROSPACE FACTORY OF THE FUTURE. (AS A POINT OF INTEREST, THE VOUGHT CORPORATION HAS INDEPENDENTLY DECIDED TO USE THE IDEF MODELING METHODOLOGIES TO COMPLETED MODEL THEIR "AS-IS" BUSINESS STRUCTURE.)

"BESIDES SUPPORT TO THE ICAM PROGRAM, THE ARCHITECTURE ALSO SUPPORTS THE AIR FORCE'S TECHNOLOGY

MODERNIZATION [illegible] AND [illegible] LOGISTIC COMMAND REPAIR PROGRAMS. THESE PROGRAMS MAY ACCELERATE THE MANAGEMENT OF TECHNOLOGY CHANGE BY TAKING ADVANTAGE OF THE ICAM ARCHITECTURE.

"IN ADDITION, THE ARMY HAS RECOGNIZED THE BENEFITS OF THE ICAM ARCHITECTURE AND IS USING IT IN SUPPORT OF THE ELECTRONIC COMPUTER-AIDED MANUFACTURING (ECAM) PROGRAM, A TRI-SERVICE ACTIVITY. THE ECAM PROGRAM, MANAGED BY THE U.S. ARMY MISSILE COMMAND, REDSTONE ARSENAL, ALABAMA, IS THE FIRST MAJOR CAD/CAM PROGRAM OUTSIDE OF THE AIR FORCE TO APPLY THE CONCEPTS PIONEERED BY THE ICAM PROGRAM ON A BROAD SCALE. THE PRIMARY OBJECTIVE OF THE INITIAL PHASE OF THE ECAM EFFORT IS TO ESTABLISH AN ICAM LIKE MASTER PLAN FOR DEVELOPING STRATEGY AND CONCEPTS FOR AUTOMATED SYSTEMS TO BE UTILIZED IN THE DESIGN, MANUFACTURE AND TEST OF ELECTRONIC EQUIPMENT

"NEITHER HAVE THE BENEFITS THAT CAN BE DERIVED FROM THE ARCHITECTURE BEEN MISSED BY COMPANIES THAT HAVE BECOME FAMILIAR WITH IT THROUGH THEIR EXPERIENCE WITH THE ARCHITECTURE. FIVE MAJOR COMPANIES ARE KNOWN TO BE USING IT IN INTERNAL MODERNIZATION PROGRAMS.

"THE CONTINUED MAINTENANCE OF THE ARCHITECTURE IS LIKELY TO IMPROVE ITS APPLICATION FOR INDUSTRY TO A GREATER EXPANSE. THE U.S. HAS RECOGNIZED THE NEED TO IMPROVE THE PRODUCTIVITY AND RESPONSIVENESS OF THE DEFENSE INDUSTRIAL BASE, AND IN PARTICULAR, THROUGH THE MECHANISM OF NATIONAL LEVEL CAD/CAM PROGRAMS. THE ARCHITECTURE OF MANUFACTURING IS NOW A KEY ELEMENT CONTRIBUTING TO MEETING THIS IMPORTANT NATIONAL OBJECTIVE.

"THE AIR FORCE ICAM PROGRAM IS ALSO FORGING AHEAD TO DEMONSTRATE AND VALIDATE THE BENEFITS OF COMPUTER-AIDED INTEGRATION OF MANUFACTURING BY CONSTRUCTING AN INTEGRATED SHEET METAL CENTER (ISMC) IN THE AEROSPACE INDUSTRY. THE FINAL ISMC DESIGN WILL BE COMPLETED BY FY84 AND INITIAL DEMONSTRATION AT THE SITE SELECTED WILL BE CONDUCTED IN FY85.

"THE ICAM SPONSORED ISMC IS INTENDED TO SHOW A CLEAR AND AUDIBLE TRACK OF THE MAGNITUDE AND SOURCE OF PRODUCTIVITY BENEFITS, FROM DESIGN THROUGH FACTORY FLOOR DEMONSTRATION."

ICAM INTEGRATED SHEET METAL CENTER (ISMC)

MACHINE UTILIZATION 44%

NUMBER OF:

- MACHINES 44%
- FLOOR SPACE 39%
- PEOPLE 44%

THROUGHPUT 25%

COST:

- INITIAL 17%
- ANNUAL 24%

INSTRUCTIONAL OBJECTIVE: To orient executive management to ICAM ISMC goals.

NARRATION: "IN SUMMARY, THE ICAM ISMC PROJECT WILL DEMONSTRATE THE TRANSITION OF THE ICAM PROGRAM FROM METHODOLOGY DEVELOPMENT TO ACTUAL APPLICATION.

"THE ISMC EFFORT WILL COVER PLANNING AND CONTROL, ISMC CAPACITY UTILIZATION, AND TECHNOLOGY TRANSFER.

"IN THE AREA OF PLANNING AND CONTROL, WE PLAN TO DEMONSTRATE THE FOLLOWING:

- O THE INTEGRATION OF MANUFACTURING SYSTEMS FROM PRODUCTION SCHEDULE GENERATION AND PROCESS PLANNING DOWN TO THE SHOP FLOOR.
- O COMPUTER-AIDED SHOP FLOOR CONTROL SYSTEM.
- O DECISION SUPPORT CAPABILITIES AT ALL LEVELS.
- O ALL ASSOCIATED PRODUCT ASSURANCE ACTIVITIES.

"IN THE AREA OF CAPACITY UTILIZATION, WE INTEND TO

DEMONSTRATE:

- O A FULL RANGE OF SHEET METAL FABRICATION PROCESSES.
- O FULLY AUTOMATED BLANKING AND STRAIGHT-LINE BENDING CELLS.
- O PART FAMILIES, MATERIALS AND GAUGES REPRESENTING 88% OF AEROSPACE SHEET METAL FABRICATION.
- O APPROXIMATELY 750,000 PARTS PER YEAR CAPABILITY.

"THE END OBJECTIVE IS, OF COURSE, TO ACHIEVE TECHNOLOGY TRANSFER RECOGNIZING:

- O ISMC IS A MAJOR PART OF COMMITTED AEROSPACE PRODUCTION.
- O ISMC IS MODULAR IN DESIGN.
- O ISMC WILL PROVIDE CLEAR, OPEN BENEFITS TRACKING.
- O ISMC WILL BE A LONG-TERM, EXPANDING DEMONSTRATION.

"THERE ARE MANY TANGIBLE ISMC PAYOFFS TO BE DEMONSTRATED:

- O LOWER FABRICATION COSTS.
- O REDUCE WORK IN-PROCESS INVENTORY.
- O IMPROVED DIRECT LABOR PRODUCTIVITY.
- O ENHANCE MACHINE UTILIZATION.
- O SIMPLER, FASTER RESPONSE TO ENGINEERING CHANGES.
- O IMPROVED SHOP FLOOR CONTROL WITH LOWER COSTS.
- O HIGHER MORE CONSISTENT PRODUCT QUALITY.

"IN ADDITION, WE ANTICIPATE SEVERAL INTANGIBLE ISMC PAYOFFS:

- O IMPROVED MANAGEMENT VISIBILITY AND CONTROL OF ALL AREAS, INCLUDING DATA PROCESSING, MORE SATISFYING WORK ENVIRONMENT.
- O MORE SATISFYING WORK ENVIRONMENT.
- O INCREASED RESPONSIVENESS.
- O HIGHER SEARCH CAPABILITY.
- O REDUCED FACILITY AND EQUIPMENT CAPITAL REQUIREMENTS.
- O GREATER PRODUCTIVITY OF "INDIRECT" FUNCTIONS DOING PLANNING AND SCHEDULING.

INTEGRATED STRATEGIC PLANNING AND INFORMATION RESOURCE MANAGEMENT

INSTRUCTIONAL OBJECTIVE: To provide executive management with further understanding of the requirements for "top-down" factory analysis and technology modernization (TECH MOD) management planning.

NARRATION: "STRATEGIC PLANNING IS A PROCESS FOR EXERCISING FAVORABLE INFLUENCE OVER FUTURE EVENTS. IT INVOLVES ACTIVITIES PERFORMED AT A HIGH LEVEL WITHIN THE ORGANIZATION AND IS CRITICAL TO SUCCESS.

"COMPETING IN A WORLD OF RAPIDLY CHANGING TECHNOLOGIES CAN BE LIKENED TO PLAYING A VIDEO GAME. THE TARGET CONSTANTLY MOVES AND NEW OPPONENTS ZOOM IN FROM VARIOUS VECTORS. FOCUSING SOLELY ON ONE TARGET SOMETIMES MEANS LOSING THE GAME TO AN UNEXPECTED FOE THAT HAS BEEN OVERLOOKED IN THE FRAY. TO PLAY THE GAME WELL, A NEW SET OF SKILLS IS REQUIRED; HIGHTENED REFLEXES PLUS THE ABILITY TO ANTICIPATE CHALLENGES AND MAKE FAST, RATIONAL DECISIONS.

"THE SINGLE MOST IMPORTANT CHALLENGE FACING MANUFACTURING EXECUTIVES TODAY MAY WELL BE THE STRATEGIC PLANNING FOR THE INTRODUCTION OF NEW INFORMATION RESOURCE MANAGEMENT AND AUTOMATION TECHNOLOGY. SINCE COMPUTERS ARE AN INTEGRAL PART OF MOST OF THIS TECHNOLOGY, GREAT STRIDES CANNOT BE MADE UNTIL MANAGEMENT GETS COMFORTABLE WITH COMPUTERS AND DEVELOPS A POSITIVE, AGRESSIVE ATTITUDE TOWARD THEIR USE.

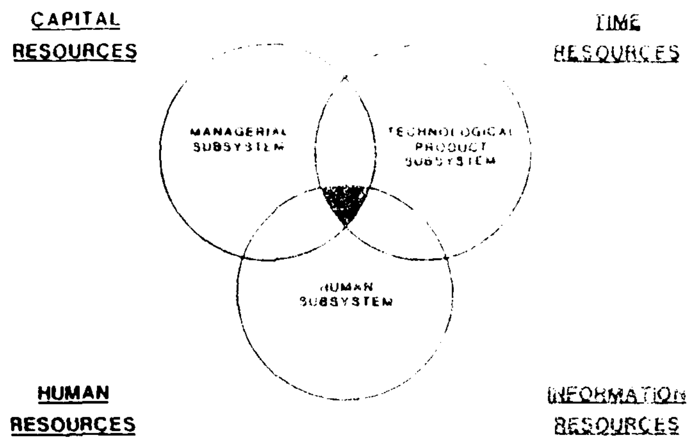
"AUTOMATION MUST BECOME THE FOCUS OF TECHNOLOGY MODERNIZATION, NOT THE BI-PRODUCT OF IT. THIS IS WHAT LIES BEHIND THE EMERGENCE OF COMPUTER INTEGRATED MANUFACTURING (CIM) AS A MAJOR FORCE IN THE PROCESS OF INDUSTRIAL MODERNIZATION.

"NEVER BEFORE HAS THERE BEEN SO MUCH CONFUSION IN TERMINOLOGY, SUCH AN ABUNDANCE OF TECHNOLOGY, SUCH A VARIETY OF ALTERNATIVES, AND SUCH A MULTITUDE OF SUGGESTIONS ON WHICH COURSE TO FOLLOW. UNFORTUNATELY, IT IS APPARENT THAT MANY ORGANIZATIONS ARE MOVING RIGHT AHEAD IN THE APPLICATION OF NEW TECHNOLOGY, WITHOUT MUCH, IF ANY CONCERN ON HOW THESE MOVES WILL AFFECT OR ANSWER THE REAL INFORMATION NEEDS OF THE ENTERPRISE.

"JOE FERREIRA OF THE DIEBOLD GROUP STATED; 'WHAT IS IMPORTANT IS TO GAIN A CONCEPTUAL UNDERSTANDING OF WHAT IS TAKING PLACE, TO UNDERSTAND YOUR NEED FOR INFORMATION, TO KNOW WHERE IT IS AND WHAT YOUR INFORMATION RESOURCES ARE. INFORMATION IS COMING INTO ITS OWN AS A CORPORATE RESOURCE, AND ORGANIZATIONS HAVE A NEW OPPORTUNITY TO DO WHAT THEY SHOULD HAVE BEEN DOING ALL ALONG - GET BACK TO FUNDAMENTALS AND DETERMINE HOW THEY USE INFORMATION.'

"THE AIR FORCE'S ICAM FACTORY OF THE FUTURE PROJECT IS DEVELOPING A STRATEGY TO ACHIEVE A COMPUTER INTEGRATED MANUFACTURING FRAMEWORK THAT INTEGRATES, INTERFACES, AND INTERACTS ALL MAJOR MANUFACTURING ENTERPRISE ACTIVITIES AND SYSTEMS. SCOPING AND NEEDS ANALYSIS WORK TO DATE INDICATES THAT THE ICAM ANALYTICAL/PLANNING TOOLS DISCUSSED THUS FAR IN OUR PRESENTATION WILL ALSO BE VERY PRODUCTIVE IN THIS MANAGEMENT AREA."

RESOURCE MANAGEMENT



INSTRUCTIONAL OBJECTIVE: To provide executive management with an understanding of the socio-technical model and resource management.

NARRATION: "WORK ACCOMPLISHED BY THE ICAM MANUFACTURING CONTROL - MATERIAL MANAGEMENT (MCMM) DEMONSTRATION PROJECT AT THE NORTHROP CORPORATION PROVIDED US WITH A SOCIO-TECHNICAL MODEL VIEWPOINT OF ENTERPRISE MANAGEMENT.

"THIS VIEWPOINT PORTRAYS THE INTERRELATIONSHIP OF THREE MAJOR SUBSYSTEMS FOR CONSIDERATION:

"<u>TECHNOLOGICAL PRODUCT SUBSYSTEM</u> - THIS SUB-SYSTEM INCLUDES THE TECHNOLOGICAL REQUIREMENTS DEFINITION AND PLANNING ACTIVITIES OF THE MANUFACTURING ENTERPRISE. GENERALLY SPEAKING, MANUFACTURING BEGINS WITH DESIGN - THE FIRST STEP AND PROCEEDS THROUGH VARIOUS PLANNING STEPS TO PREPARE FOR PRODUCTION. AS AN EXAMPLE, THE FUNCTIONS OF DESIGN, PROCESS PLANNING, MAKE OR BUY DECISIONS, MANUFACTURING PLANNING, ETC. OCCUR HERE. (THIS IS A KEY AREA FOR ACHIEVING CIM REWARDS IN THAT THE INTEGRATION/INTERFACING/INTERACTING OF THESE INFORMATIONAL ACTIVITIES APPEAR TO OFFER A SIGNIFICANT REDUCTION IN MANUFACTURING LEAD TIME AND IMPROVEMENT IN QUALITY.)"

"MANAGERIAL SUBSYSTEM - THIS SUBSYSTEM INTEGRATES THE VARIOUS ACTIVITIES WITHIN THE FACTORY AND THE INFORMATION ASSOCIATED WITH THOSE ACTIVITIES. IT IS WITHIN THIS SUBSYSTEM THAT MANAGEMENT'S POLICIES, BUDGETS, AND PLANS ARE CONVERTED INTO THE DIRECTIVES, OPERATIONAL PLANS AND SCHEDULES REQUIRED TO PRODUCE THE PRODUCT.

"HUMAN SUBSYSTEM - THIS SUBSYSTEM INCLUDES THE OVERALL ORGANIZATION CLIMATE, WILLINGNESS TO ACCEPT CHANGE, WORK GROUP FACTORS AT ALL LEVELS, HUMAN RESOURCES DEVELOPMENT, AND JOB SATISFACTION. MUCH EFFORT HAS GONE INTO IMPROVING THE ABILITY OF A DRILL TO PENETRATE METAL, BUT MUCH LESS TIME HAS BEEN COMMITTED TO THE OPERATOR THAT IS INVOLVED. ENERGY GOES INTO IMPROVING CAD SYSTEMS BUT LESS INTO THE ROLE OF THE DESIGNER WHO MUST WORK IN FRONT OF THAT CAD SYSTEM. WORKER'S DISSATISFACTION WITH THEIR ENVIRONMENT, THEIR LACK OF LOYALTY TO A CORPORATION, ARE ONLY SYMPTOMS OF SHORTCOMINGS IN THE MANAGEMENT/WORKER RELATIONSHIP. (THE TERM WORKERS, IN THIS CASE, REFERS TO ALL PEOPLE FROM THE FACTORY FLOOR TO THE EXECUTIVE SUITE.)

"EXECUTIVE LEVEL MANAGEMENT FUNCTIONS WITHIN THIS COMPLEX THREE-SUBSYSTEM ENVIRONMENT WHILE MANAGING THE FOUR KEY RESOURCES AT ITS DISPOSAL:

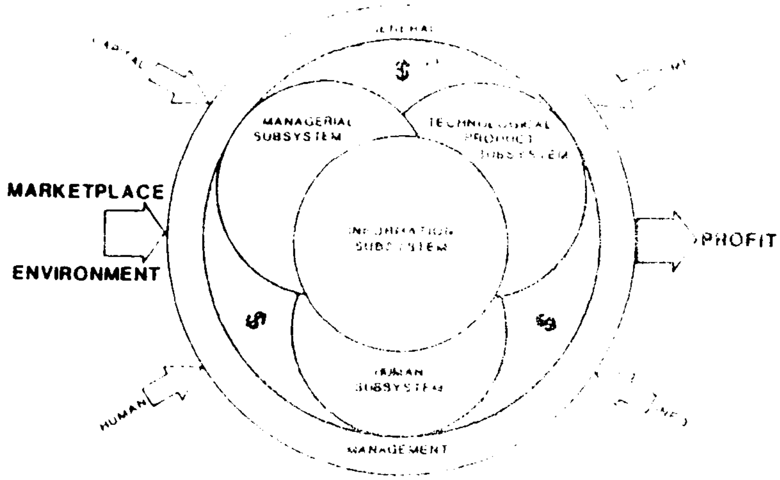
"CAPITAL RESOURCES - THE COMPLEX WORLD OF AVAILABLE FINANCING, HIGH INTEREST RATES, CASH FLOW, AND THE IMPACT UPON INTERNAL OPERATIONAL PLANS AND BUDGETS.

"TIME RESOURCES - THE IRREPLACEABLE EXPENDITURE OF 24 HOURS IN EACH DAY AND 365 DAYS IN EACH CALENDAR YEAR.

"HUMAN RESOURCES - PERHAPS THE MOST CRITICAL OF THE RESOURCES, THE AREA WHEREIN AN ORGANIZATION RETAINS ITS MARKETPLACE AND PRODUCT KNOWLEDGE, EXPERIENCE AND CREATIVITY.

"INFORMATION RESOURCES - THE ENTERPRISE'S BUSINESS AND PRODUCT KNOWLEDGE IS DESCRIBED AND RETAINED IN ITS INTERNAL INFORMATION STRUCTURE. CLEARLY, THE HEART OF THE INTEGRATED MODERN FACTORY IS ITS ABILITY TO EFFICIENTLY AND EFFECTIVELY HANDLE INFORMATION. NO ONE EXCEPT DIRECT 'TOUCH LABOR' DOES ANYTHING EXCEPT GENERATE, STORE, RETRIEVE AND MANIPULATE INFORMATION.

INFORMATION RESOURCE MANAGEMENT



INSTRUCTIONAL OBJECTIVE: To orient executive management relative to the importance of information resource management in preparation for further emphasis on the ICAM analytical/planning tools

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NARRATION: "THIS INFORMATION RESOURCE MANAGEMENT (IRM) MODEL BUILDS UPON THE PRIOR SOCIO-TECHNICAL MODEL IN THAT IT HIGHLIGHTS THE RELATIONSHIP OF THE MANAGEMENT INFORMATION SUBSYSTEM TO THE PREVIOUSLY DESCRIBED SUBSYSTEMS.

"IN ADDITION, IT RECOGNIZES THAT GENERAL MANAGEMENT (I.E. THE GENERAL MANAGER AND HIS TOP FUNCTIONAL STAFF) MUST CONSTANTLY FOCUS UPON THE EXTERNAL MARKETPLACE AND ENVIRONMENT WITH THE END OBJECTIVE OF PRODUCING A SATISFACTORY PROFIT FOR THE ENTERPRISE.

"GENERAL MANAGEMENT CONTROLS THE ALLOCATION AND EXPENDITURE OF CAPITAL, TIME, HUMAN AND INFORMATION RESOURCES PRIMARILY THROUGH THE TOOLS OF FINANCIAL CONTROL AND EXCHANGE OF INFORMATION BETWEEN THE ACTIVITIES AND FUNCTIONS OF THE ORGANIZATION.

"AS TECHNOLOGY MODERNIZATION OPPORTUNTIES ARE ANALYZED AND SELECTED FOR IMPLEMENTATION, IT IS THIS EXCHANGE OF MANAGEMENT INFORMATION BETWEEN THE ORGANIZATIONAL ACTIVITIES THAT WILL UNITE AND INTEGRATE THE INDIVIDUAL "ISLAND OF TECHNOLOGY" PROJECTS."

INFORMATION RESOURCE MANAGEMENT (IRM)

"INFORMATION IS THE MANAGER'S MAIN TOOL. INDEED THE MANAGER'S 'CAPITAL' AND IT IS HE WHO MUST DECIDE WHAT INFORMATION HE NEEDS AND HOW TO USE IT."

PETER DRUCKER "MANAGING THE INFORMATION [illegible]"

INSTRUCTIONAL OBJECTIVE: To orient [illegible] management [illegible] relationship [illegible] Information Resource Management and the ICAM [illegible] methodologies and architecture.

NARRATION: "THE PRECEDING MATERIAL BRINGS US TO THE CONCLUSION THAT PETER DRUCKER STATED IN HIS ARTICLE 'MANAGING THE INFORMATION EXPLOSION':

> 'INFORMATION IS THE MANAGER'S MAIN TOOL. INDEED THE MANAGER'S 'CAPITAL' AND IT IS HE WHO MUST DECIDE WHAT INFORMATION HE NEEDS AND HOW TO USE IT.'

"WE BELIEVE THAT THE ICAM IDEF METHODOLOGIES AND ARCHITECTURE PROVIDE YOU WITH ADDITIONAL MANAGEMENT ANALYTICAL AND PLANNING TOOLS FOR LINKING YOUR STRATEGIC BUSINESS PLANNING [illegible] WITH THE DAY-TO-DAY OPERATIONAL ASPECTS OF YOUR BUSINESS."

INTEGRATED STRATEGIC PLANNING AND IRM

- "ONLY 19% OF THE COMPANIES SURVEYED HAVE INTEGRATED THEIR STRATEGIC PLANNING AND INFORMATION RESOURCE MANAGEMENT (IRM) SYSTEMS"
- "THE COMPANIES THAT DID SO OUTPERFORMED THE REST OF THE SAMPLE BY ABOUT 300% OVER FIVE YEARS ON SUCH MEASURES AS :
    - AVERAGE RETURN ON EQUITY
    - RETURN ON TOTAL CAPITAL
    - NEW PROFIT MARGINS"

(REF A.T. KEARNEY INC MANAGEMENT CONSULTANT SURVEY OF 40 OF 500 LARGEST U.S. INDUSTRIAL AND FINANCIAL INSTITUTIONS)

INSTRUCTIONAL OBJECTIVE: To provide executive management with an example of the results of Integrated Strategic Planning and Information Resource Management.

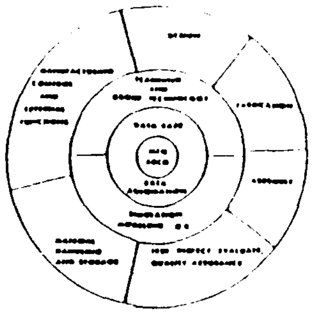
NARRATION: "A RECENT RESEARCH PROJECT WAS PERFORMED BY A. T. KEARNEY ON HOW WELL COMPANIES EFFECTIVELY MANAGE THEIR INFORMATION RESOURCES.

"THE STUDY DISCLOSED THAT THE ORGANIZATIONS THAT HAVE USED FORMAL STRUCTURED BUSINESS AND SYSTEMS PLANNING TO ORGANIZE, MONITOR AND CONTROL THEIR INFORMATION RESOURCES, OUT PERFORM THE REST OF THE SAMPLE BY ABOUT 300% IN TERMS OF AN AVERAGE RETURN ON EQUITY, RETURN ON TOTAL CAPITAL AND NET PROFIT MARGINS OVER A FIVE YEAR PERIOD.

"THIS OFFERS PROOF THAT AN EFFECTIVE INTEGRATED INFORMATION RESOURCE MANAGEMENT SYSTEM HAS A SUBSTANTIAL POSITIVE AFFECT ON BOTTOM-LINE RESULTS."

ICAM

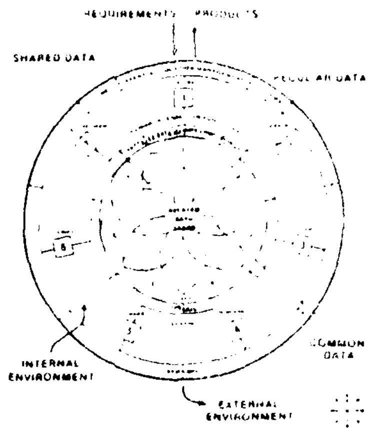
INTEGRATED
COMPUTER-AIDED MANUFACTURING



INSTRUCTIONAL OBJECTIVE: To provide executive management with an example of the results of Integrated Strategic Planning and Information Resource Management.

NARRATION: "AGAIN, IT INDICATES THAT THE ICAM PROGRAM CORRECTLY FOCUSED ON AN INTEGRATED MANUFACTURING SYSTEMS ARCHITECTURE, COUPLED WITH DATABASE DESIGN AND DATA AUTOMATION. THIS ARCHITECTURE CAN BECOME THE FOCAL POINT FOR PLANNING AND CONTROLLING THE FUNCTIONS AND ACTIVITIES OF TOMORROW'S MANUFACTURING ENTERPRISE."

DYNAMIC HUMAN DIRECTED
COMPUTER-AIDED ACTIVITY MODEL

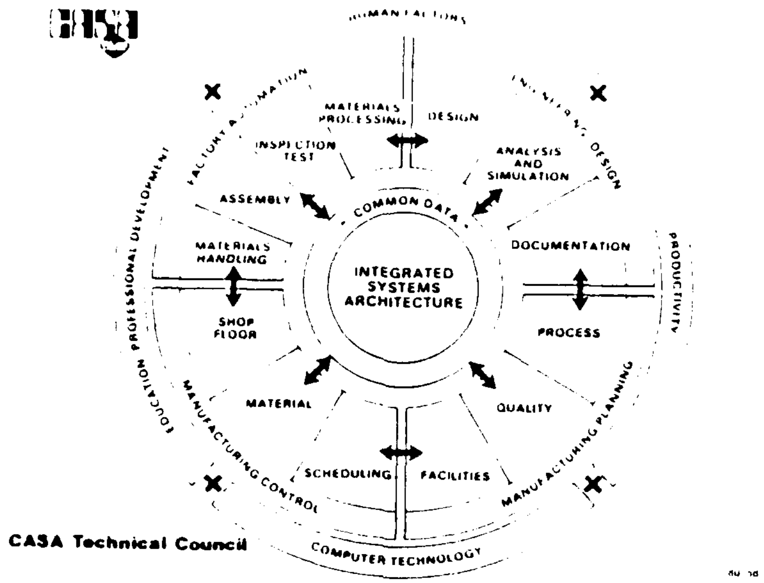


CAM-i

INSTRUCTIONAL OBJECTIVE: To familiarize executive management with other major U.S. activities concurring with ICAM's center focus on integrated system architecture and databases.

NARRATION: "COMPUTER-AIDED MANUFACTURING - INTERNATIONAL (CAM-I) IS A NON-PROFIT RESEARCH ORGANIZATION HEADQUARTERED IN ARLINGTON, TEXAS. CAM-I IS CONSTITUTED BY A LARGE NUMBER OF INSTITUTIONS FROM INDUSTRY AND ACADEMIA ON A WORLD-WIDE BASIS.

"THIS CAM-I "DYNAMIC HUMAN DIRECTED COMPUTER-AIDED ACTIVITY MODEL" WAS DEVELOPED INDEPENDENTLY FROM THE ICAM PROGRAM'S ACTIVITIES. PLEASE NOTE, HOWEVER, THAT THE CENTRAL FOCUS OF THE CAM-I LOGO IS ALSO 'RELATED DATABASES'."



INSTRUCTIONAL OBJECTIVE: To familiarize executive management with other major U.S. activities concurring with ICAM's center focus on integrated system architecture and integrated databases.

NARRATION: "THE SOCIETY OF MANUFACTURING ENGINEER'S COMPUTER AND AUTOMATED SYSTEMS ASSOCIATION (SME CASA) RECENTLY PUBLISHED THIS LOGO DEVELOPED BY ITS TECHNICAL COUNCIL AND APPROVED BY ITS BOARD OF DIRECTORS.

"THE PURPOSE OF THE LOGO WAS TO ASSIST IN PLANNING COMPUTER INTEGRATED MANUFACTURING (CIM) PROGRAMS.

"PLEASE NOTE THAT, LIKE ICAM, SME CASA ALSO SEES INTEGRATED SYSTEMS ARCHITECTURE AND COMMON DATABASES AS THE CENTRAL FOCUS REQUIRED FOR FUTURE FACTORY INTEGRATION."

COMMON TERMINOLOGY

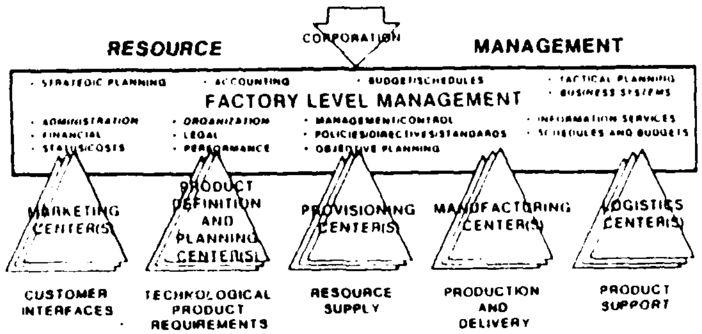
- **FRAMEWORK**
- **ARCHITECTURE**
- **STRUCTURE**
- **"BLUE PRINT"**
- **"ROAD MAP"**

INSTRUCTIONAL OBJECTIVE: To familiarize executive level management with the commonly used terminology relative to "frameworks" and "architectures."

NARRATION: "IN SUMMARY, ICAM, CAM-I, AND SME CASA HAVE ALL ARRIVED AT THE SAME CONCLUSION ---- AN INTEGRATED MANUFACTURING SYSTEM ARCHITECTURE, COUPLED WITH INTEGRATED DATABASES, IS THE CENTER FOCUS OF EXECUTIVE MANAGEMENT'S "TOP-DOWN" PLANNING AND CONTROL NEEDS.

"EFFORTS SUCH AS THESE ARE NOW GENERATING A MORE COMMON UNDERSTANDING RELATIVE TO THE USE OF FRAMEWORKS AND ARCHITECTURES."

FACTORY OF THE FUTURE FRAMEWORK



INSTRUCTIONAL OBJECTIVE: To orient executive level management to the scope of the Air Force's Factory of the Future Framework Project.

NARRATION: "THE ICAM PROGRAM'S FACTORY OF THE FUTURE PROJECT IS DIRECTED SPECIFICALLY AT DEVELOPING AN OVERALL CONCEPTUAL FRAMEWORK TARGETTED AT THE 1985 - 1990 TIME FRAME. THIS ICAM FRAMEWORK PROJECT TASK HAS TWO MAJOR OBJECTIVES:

- O TO ESTABLISH AN OVERALL CONCEPTUAL FRAMEWORK FOR THE AEROSPACE FACTORY OF THE FUTURE WHICH INCLUDES MULTI-PURPOSE PRODUCTION CENTERS (I.E., MACHINING, COMPOSITES, SHEET METAL, ELECTRONICS AND ASSEMBLY.

- O TO DEVELOP AND DEFINE A STRATEGY FOR ACHIEVING A COMPUTER INTEGRATED MANUFACTURING (CIM) FRAMEWORK THAT INTEGRATES, INTERFACES AND INTERACTS ALL MAJOR ACTIVITIES AND SYSTEMS.

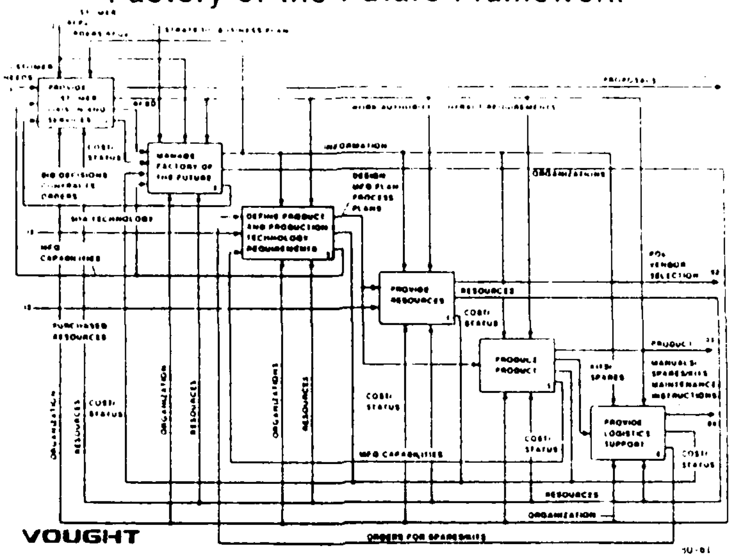
"THE ICAM FACTORY OF THE FUTURE FRAMEWORK, BEING DEVELOPED BY THE VOUGHT CORPORATION AND A SUPPORTING COALITION OF COMPANIES, INCORPORATED THIS PICTORIAL VIEW OF RESOURCE MANAGEMENT INTO THE APPROVED PROJECT SCOPING DOCUMENT.

"OTHER CURRENT AIR FORCE PROGRAMS ARE ADDRESSING THE DESIGN AND DEMONSTRATION OF INTEGRATED FACTORY FLOOR CENTERS. THESE CENTERS WILL BECOME A PART OF THE FACTORY OF THE FUTURE FRAMEWORK.

"THE FACTORY OF THE FUTURE FRAMEWORK WILL ALSO ADDRESS MARKETING, DESIGN AND MANUFACTURING ENGINEERING, ACQUISITION AND CONTROL OF RESOURCES AND LOGISTICS SUPPORT. THESE FUNCTIONS CAN ALSO BE VIEWED AS CENTER-CELL-STATION STRUCTURES THAT ARE INTEGRATED WITH THE PRODUCTION CENTERS THROUGH A FACTORY LEVEL MANAGEMENT SYSTEM STRUCTURE."

(CONDUCT A BRIEF WALKTHROUGH REVIEW OF THE DATA CONTAINED ON THE CHART.)

Factory of the Future Framework



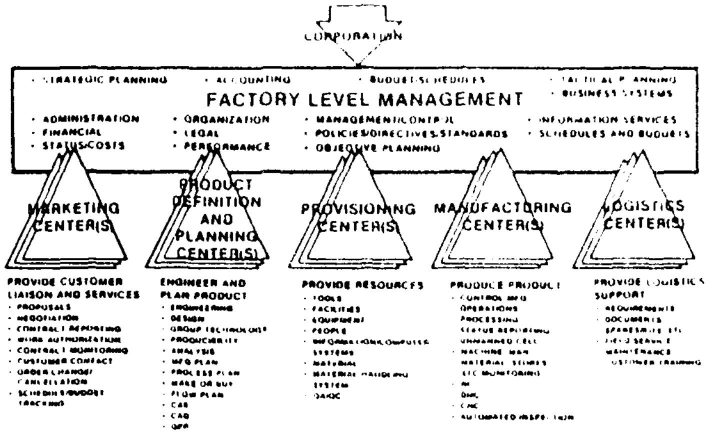
INSTRUCTIONAL OBJECTIVE: To orient executive level management relative to the use of ICAM IDEF methodologies on the Factory Of The Future contract.

NARRATION: "THIS IDEF$_0$ DIAGRAM DEVELOPED BY THE VOUGHT COALITION PORTRAYS THE SIX BASIC FUNCTIONS WE REVIEWED ON THE LAST CHART. OUR INTENT TODAY IS NOT TO COMPLETELY REVIEW ALL OF THE DETAILS SHOWN, BUT TO ILLUSTRATE A HIGHER ORGANIZATIONAL LEVEL USE OF THEIR ICAM PLANNING AND ANALYTICAL TOOLS.

"PLEASE NOTE THAT THE MANAGEMENT OF RESOURCES, DENOTED HERE AS "MANAGE FACTORY OF THE FUTURE," IS CONTROLLED BY BOTH THE ENTERPRISE'S STRATEGIC BUSINESS PLAN AND CUSTOMER REQUIREMENTS SUCH AS: REQUESTS FOR PROPOSALS (RFP), ORDERS AND REQUESTS FOR QUOTATIONS (RFQ). THE TWO OUTPUTS OF THIS MANAGEMENT FUNCTION ARE ORGANIZATIONS AND INFORMATION.

"FURTHER DECOMPOSITION OF EACH OF THESE FUNCTIONAL ACTIVITIES WILL HELP PROVIDE A "STANDARD FOR COMMUNICATION" IN PLANNING FOR FUTURE TECHNOLOGY MODERNIZATION ACTIVITIES."

**FACTORY OF THE
FUTURE FRAMEWORK**



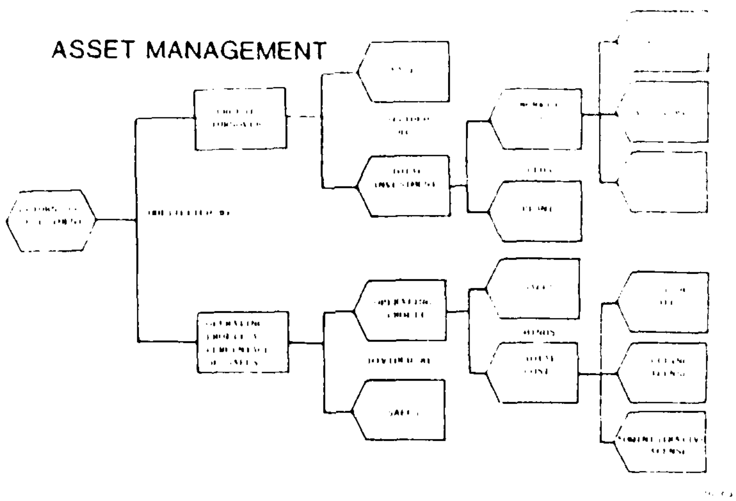
INSTRUCTIONAL OBJECTIVE: To orient executive management relative to further planned decomposition of the Factory Of The Future Framework.

NARRATION: "LISTED BELOW EACH OF THE TOP-LEVEL FUNCTIONS WE JUST ON THE IDEF$_0$ DIAGRAM, WE FIND THE DECOMPOSITION OF MANY OTHER BUSINESS FUNCTIONS AND ACTIVITIES.

"AGAIN, OUR PURPOSE TODAY IS JUST TO ORIENT YOU TO THIS FUTURE POTENTIAL APPLICATION OF ICAM PLANNING AND ANALYTICAL TOOLS."

(BRIEFLY REVIEW THE MAJOR FUNCTIONS AND ACTIVITIES SHOWN ON THE CHART.)

CAPITAL vs. RETURN ON INVESTMENT (ROI)



INSTRUCTIONAL OBJECTIVE: To further orient executive management that the ICAM planning/analytical tools can be focused on asset management.

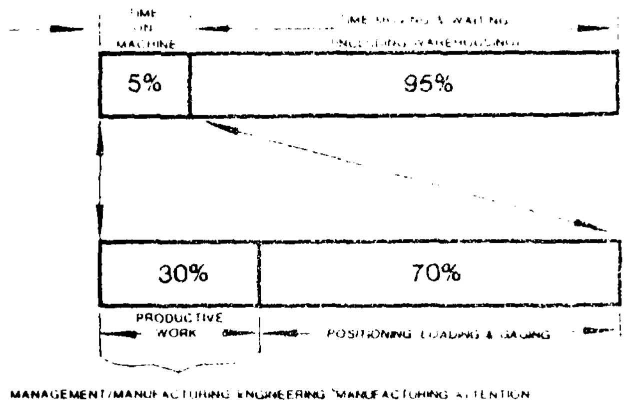
NARRATION: "THE FACTORY OF THE FUTURE CONTRACT IS ALSO MAINTAINING A FOCUS ON THE FACT THAT EXECUTIVE MANAGEMENT'S PRIMARY MOTIVATION IS AND SHOULD BE THE EFFICIENT USE OF CAPITAL.

"THIS ASSET MANAGEMENT RETURN ON INVESTMENT (ROI) FORMULA IS BEING USED AS A PLANNING TOOL BY THE COALITION. THIS EMPHASIS IS DIRECTLY RELATED TO THE 1980 DEPARTMENT OF DEFENSE DoD "STATEMENT OF PRINCIPLES FOR THE DoD MANUFACTURING TECHNOLOGY PROGRAM."

"THIS STATEMENT OF PRINCIPLES, APPROVED AND ISSUED TO ALL DEFENSE AGENCIES, STATES THE FOLLOWING RELATIVE TO "ROI CONSCIOUSNESS":

> "A DEEPER AND MORE EXPLICIT CONSCIOUSNESS OF RETURN ON INVESTMENT MUST BE DEVELOPED AND USED BY ALL LEVELS OF MANAGEMENT OF THE MANUFACTURING TECHNOLOGY PROGRAM. WE MUST ASSURE THE HIGH LEVERAGE RETURN ON INVESTMENT POTENTIAL OF THE DoD MANUFACTURING TECHNOLOGY PROGRAM IS REALIZED."

INVENTORY "TIME IN SHOP"



INSTRUCTIONAL OBJECTIVE: To further orient executive management that the ICAM planning/analytical tools are focused on asset management.

NARRATION: "FOR EXAMPLE, LET'S BRIEFLY FOCUS ON THE SUBJECT OF INVENTORY MANGEMENT."

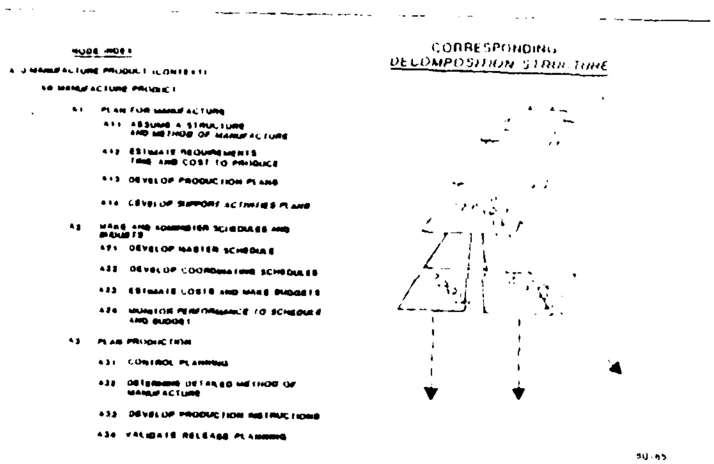
"LOOKING AT THE PROBLEM FROM THE VIEWPOINT OF THE INVENTORY MATERIAL, THE TIME ACTUALLY SPENT ON A MACHINE (OR BEING ASSEMBLED) IS ACTUALLY FIVE PERCENT OF THE TIME BETWEEN THE RECEIVING DOCK AND PRODUCT SHIPMENT.

"A CLOSER EXAMINATION SHOWS THAT ONLY 30% OF THE FIVE PERCENT IS ACTUALLY IN PRODUCTIVE WORK. THE REMAINING 70 PERCENT IS POSITIONING, LOADING AND/OR GAUGING.

"THIS MEANS THAT APPROXIMATELY ONE AND ONE-HALF PERCENT OF THE MATERIALS "TIME IN SHOP" IS ACTUALLY SPENT IN PRODUCTIVE WORK. IN THE PAST, HOWEVER, WE HAVE TENDED TO FOCUS OUR ATTENTION ENTIRELY ON "PROCESS TEHNOLOGY" AND THAT HAS RESULTED IN "ISLANDS OF PROCESS TECHNOLOGY.

"AS STATED EARLY IN OUR PRESENTATION, WE BELIEVE WE MUST CHANGE THE FOCUS OF OUR RESOURCE EXPENDITURES WHILE STILL PURSUING IMPROVEMENTS IN 'PROCESS TECHNOLOGY'."

TIME MANAGEMENT



INSTRUCTIONAL OBJECTIVE: To further orient executive management that the ICAM planning/analytical tools can be focused on asset management.

NARRATION: "THE ICAM PROGRAM'S "INTEGRATED PLANNING AND SCHEDULING (IPS) PROJECT" HAS EFFICIENT TIME MANAGEMENT AS ONE OF ITS OBJECTIVES.

"THIS CHART SHOWS THE "AS-IS" NODE INDEX FROM THE GENERIC MANUFACTURING ARCHITECTURE THAT IS THE FOCUS OF THE IPS PROJECT. IPS IS DEVELOPING AND WILL PROVIDE AN IMPROVED TIME MANAGEMENT SYSTEM FOR THE AEROSPACE FACTORY OF THE FUTURE."

INFORMATION RESOURCE AND HUMAN
RESOURCE MANAGEMENT

- THE PRODUCT OF ANY EMPLOYEE THAT DOES NOT LAY HANDS ON THE HARDWARE PRODUCT IS DATA AND OR DECISIONS
- EMPLOYEE "PARTICIPATION" IS DEPENDENT UPON KNOWLEDGE OF THEIR SURROUNDING ENVIRONMENT AND CONTRIBUTION OF THEIR DATA
- TEAM MANAGEMENT TECHNIQUES OFFER AN EXPLOSIVE IMPACT ON PRODUCTIVITY
- TMT STRUCTURED METHODOLOGIES CHANNEL THIS ENERGY TOWARD "TOP DOWN" PLANNING GOALS

INSTRUCTIONAL OBJECTIVE: To further emphasize to executive management that use of the ICAM planning and analytical tools will be beneficial to their organization.

NARRATION: "THE LINKAGE OF INFORMATION RESOURCE MANAGEMENT AND HUMAN RESOURCE MANAGEMENT IS JUST BEGINNING TO BE UNDERSTOOD. YOU WILL PROBABLY THEREFORE, AGREE WITH THE FIRST TWO OBSERVATIONS ON THIS CHART:

> "THE PRODUCT OF ANY EMPLOYEE THAT DOES NOT LAY HANDS ON THE HARDWARE PRODUCT IS DATA AND/OR DECISIONS.
>
> "EMPLOYEE "PARTICIPATION" IS DEPENDENT UPON KNOWLEDGE OF THEIR SURROUNDING ENVIRONMENT AND CONTRIBUTION OF THEIR DATA.

"SUCCESSFUL "QUALITY CIRCLE" PROGRAMS IN THE UNITED STATES HAVE HIGHLIGHTED THE ABOVE ASSERTIONS.

"IN ADDITION, EXPERIENCE BY SUCCESSFUL IDEF METHODOLOGY MODELING TEAMS HAVE DEMONSTRATED THE LAST TWO ASSERTIONS:

> "TEAM MANAGEMENT TECHNIQUES OFFER AN EXPLOSIVE IMPACT ON PRODUCTIVITY.
>
> "TMT STRUCTURED METHODOLOGIES CHANNEL THIS ENERGY TOWARD "TOP-DOWN" PLANNING GOALS."

TEAM MANAGEMENT TECHNIQUES (TMT)

- PROJECT DEFINITION
- ASSIGN PROJECT TEAMS
- SELECT TEAM MEMBERS
- MANAGE TEAM MEETINGS
- STRUCTURED ANALYTICAL INTEGRATION TOOLS
  - $IDEF_0$ FUNCTION/ACTIVITY MODELS
  - $IDEF_1$ INFORMATION MODELS
  - $IDEF_2$ DYNAMICS MODELS
  - COST DRIVER ANALYSIS (COST MODELS)
- ANTICIPATE FUTURE PROBLEMS

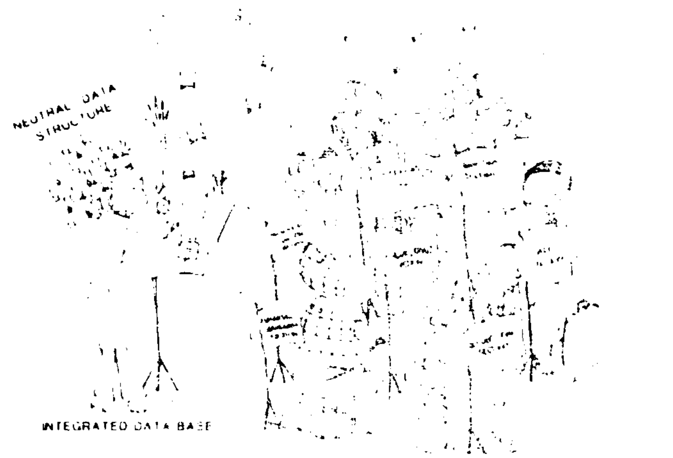
INSTRUCTIONAL OBJECTIVE: To further emphasize to executive management that use of the ICAM planning and analytical tools will be beneficial to their organization.

NARRATION: "THESE IDEF MODELING TEAMS, LIKE ALL OTHER GROUP DYNAMICS, ACTIVITIES, ARE VERY DEPENDENT UPON CAREFUL PROJECT DEFINITION, ASSIGNMENT OF TEAM MEMBERS ON A VERY SELECTIVE BASIS, THE ABILITY OF THE PROJECT MANAGER TO MANAGE TEAMS, AND THE PROPER USE OF THE ICAM DEVELOPED STRUCTURED IDEF ANALYTICAL INTEGRATION TOOLS.

"WHEN APPLIED TO TECHNOLOGY MODERNIZATION PROJECTS, IT IS ALSO RECOMMENDED THAT SOME TRAINING BE PROVIDED TO THE PROJECT TEAM RELATIVE TO COST DRIVER ANALYSIS TECHNIQUES IN ORDER TO DEVELOP COST PERFORMANCE MODELS THAT CORRESPOND WITH THE OTHER IDEF MODELS.

"FREQUENTLY THE FUNCTIONING OF THESE TEAMS WILL IDENTIFY ANITICIPATED FUTURE PROBLEMS THEREBY AVOIDING COSTLY IMPACTS."

INFORMATION RESOURCE MANAGEMENT (IRM)



INSTRUCTIONAL OBJECTIVE: To further emphasize to executive management that use of the ICAM planning and analytical tools will be beneficial to their organization.

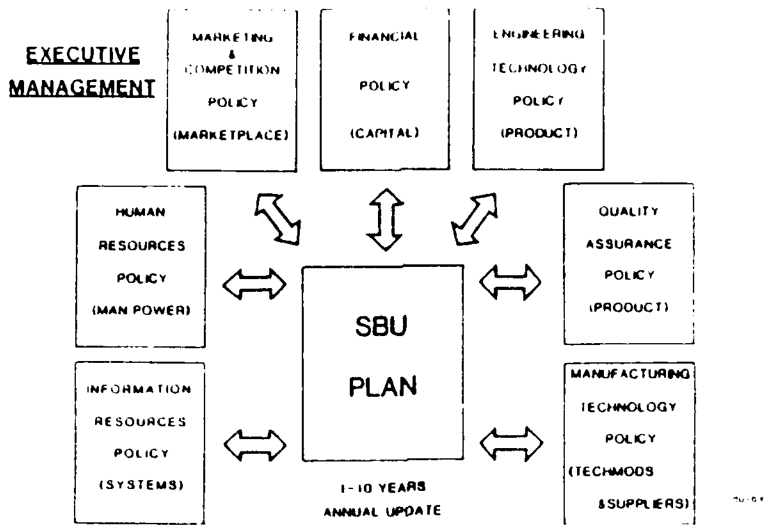
NARRATION: "THIS INFORMATION RESOURCE MANAGEMENT "ORCHESTRATOR" CARTOON ILLUSTRATES OUR MANAGEMENT PREMISE FOR THE FACTORY OF THE FUTURE.

"THE SHEET MUSIC BEING READ BY THE 'COMPUTER BASED INFORMATION SYSTEM (CBIS) CONDUCTOR' IS COMPOSED OF $IDEF_0$ FUNCTION MODEL DIAGRAMS. THE $IDEF_1$ INFORMATION MODEL DATA STRUCTURE PERFORMS AS THE CONDUCTOR'S "INTEGRATION TOOL" TO ORCHESTRATE THE ACTIVITIES OF ALL OF THE VARIOUS ORGANIZATIONAL FUNCTIONS PORTRAYED.

"FUNCTIONS AND ACTIVITIES CONTROLLED BY MANAGEMENT INFORMATION WILL CONSTITUTE THE FACTORY OF THE FUTURE'S INTEGRATED DATABASE.

"LET'S BRIEFLY WALKTHROUGH A HYPOTHETICAL "TOP-DOWN" APPLICATION OF THIS PHILOSOPHY."

STRATEGIC BUSINESS UNIT PLAN



INSTRUCTIONAL OBJECTIVE: To orient executive level management relative to the potential application of ICAM planning and analytical tools to everyday business requirements.

NARRATION: "LET'S ASSUME THAT OUR HYPOTHETICAL ORGANIZATION HAS IN PLACE A STRATEGIC BUSINESS PLANNING SYSTEM. LET'S ALSO ASSUME THAT ALL OF THE POLICIES ILLUSTRATED HERE ARE CLEARLY DELINEATED IN THIS STRATEGIC BUSINESS PLAN OUTLINING THE ORGANIZATION'S PLANNED DIRECTION FOR THE NEXT FIVE TO TEN YEARS.

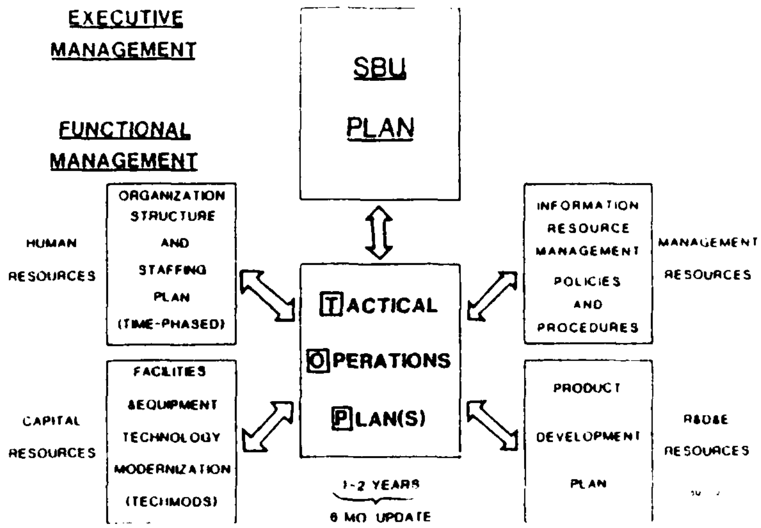
"UP UNTIL VERY RECENTLY, OUR HYPOTHETICAL ORGANIZATION PROBABLY FOCUSED ITS STRATEGIC PLANNING ONLY ON THE POLICY AREAS OF THE MARKETPLACE, FINANCIAL POLICY, AND TECHNOLOGY AS IT RELATED TO THE ORGANIZATION'S PRODUCTS. MORE RECENTLY, HOWEVER, EXTERNAL AND INTERNAL ENVIRONMENTAL PRESSURES HAVE FOCUSED THE GENERAL MANAGER'S AND HIS TOP FUNCTIONAL STAFF'S ATTENTION ON THE OTHER FOUR AREAS REQUIRING POLICY DEFINITION (I.E., HUMAN RESOURCES, QUALITY ASSURANCE, MANUFACTURING TECHNOLOGY AND INFORMATION RESOURCES.

"LET'S ALSO ASSUME THAT THE PROGRESSIVE MANAGEMENT OF OUR HYPOTHETICAL ORGANIZATION RECOGNIZES THAT BETWEEN FORTY AND SIXTY PERCENT OF ITS PRODUCT COST IS

GENERATED BY ITS SUPPLIERS AND CONTRACTORS. THE ORGANIZATION MUST, THEREFORE, ESTABLISH AND MAINTAIN A MANUFACTURING TECHNOLOGY POLICY RELATIVE TO ITS MAJOR SUPPLIERS.

"PLEASE NOTE THAT THE TWO-WAY ARROWS INDICATE AN ITERATIVE PROCESS DURING PLAN DEVELOPMENT AND MAINTENANCE."

TACTICAL OPERATIONS PLAN(S)



INSTRUCTIONAL OBJECTIVE: To orient executive level management relative to the potential application of ICAM planning and analytical tools to everyday business requirements.

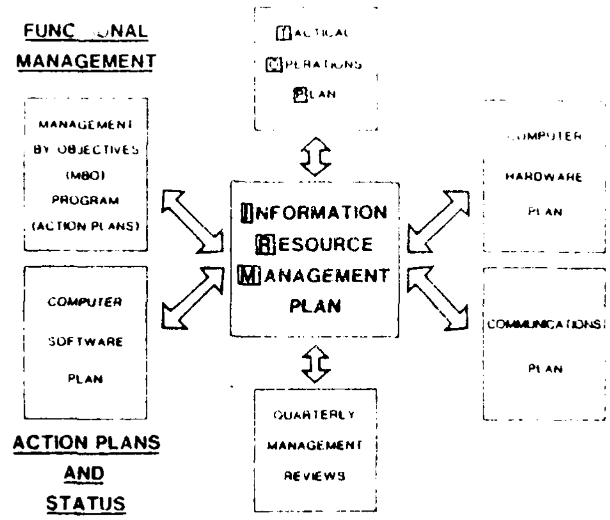
NARRATION: "ONCE OUR HYPOTHETICAL ORGANIZATION HAS APPROVED ITS SBU PLAN, EACH INDIVIDUAL FUNCTIONAL TOP MANAGER IS EXPECTED TO WORK TOGETHER WITH HIS PEERS TO DEVELOP TACTICAL OPERATIONS PLANS FOR THEIR RESPECTIVE ORGANIZATIONS.

"OUR TACTICAL OPERATIONS PLAN IS FOCUSED ON A MUCH SHORTER TIME SPAN THAT THE SBU PLAN, PERHAPS ONLY ONE TO TWO YEARS.

"AT THIS LEVEL OF OUR PLANNING, WE ARE, HOWEVER, PUTTING FORCES INTO MOTION TO EXPEND THE PRECIOUS RESOURCES OF CAPITAL, TIME, HUMAN RESOURCES AND INFORMATION.

"IT IS AT THIS STAGE THAT OUR REQUIREMENTS ANALYSIS AND PLANNING MUST TAKE ON EVEN A MORE STRUCTURED APPROACH TO ASSURE COMMUNICATION AND CONTROL. AT THIS LEVEL, WE ARE MAKING THE SHORTER RANGE DECISIONS THAT WILL IMPACT OVERALL ORGANIZATIONAL PERFORMANCE IN THE NEAR TERM."

INFORMATION RESOURCE MANAGEMENT PLAN



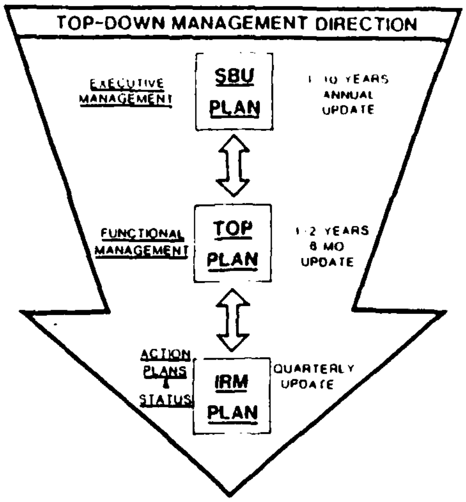
INSTRUCTIONAL OBJECTIVE: To orient executive level management relative to the potential application of ICAM planning and analytical tools to everyday business requirements.

NARRATION: "AT THIS LEVEL OF OUR HYPOTHETICAL ORGANIZATION'S PLANNING, WE ARE DEALING WITH THE "NOW" NEEDS OF OUR OPERATIONAL ENVIRONMENT.

"THE MANAGEMENT OBJECTIVES AND ACTION PLANS ESTABLISHED DURING THE TACTICAL PLANNING PHASE ARE ACTUALLY AT THE STAGE OF IMPLEMENTATION. THERE ARE PROBABLY SENIOR EXECUTIVE QUARTERLY MANAGEMENT REVIEWS BEING CONDUCTED TO ENSURE ADHERENCE TO PLAN AND TO IDENTIFY ANY REQUIRED CORRECTIVE ACTIONS.

"THIS IS THE LEVEL IN OUR FACTORY OF THE FUTURE WHEREIN COMPUTER HARDWARE, SOFTWARE AND COMMUNICATIONS MUST PROVIDE EFFICIENT MANAGEMENT TOOLS FOR MANAGING DAY-TO-DAY COMPUTER INTEGRATION MANUFACTURING (CIM) OPERATIONS."

INFORMATION RESOURCE MANAGEMENT PROGRAM



INSTRUCTIONAL OBJECTIVE: To orient executive level management relative to the potential application of ICAM planning and analytical tools to everyday business requirements.

NARRATION: "IN SUMMARY, OUR HYPOTHETICAL ORGANIZATION HAS INSTALLED A PROVISION FOR CONTINUOUS ITERATIVE "TOP-DOWN" MANAGEMENT DIRECTION AT ALL LEVELS OF OUR FACTORY OF THE FUTURE.

"NOW LET'S TAKE ANOTHER VIEW OF OUR EARLIER DISCUSSION RELATIVE TO A TECHNOLOGY MODERNIZATION (TECH MOD) FRAMEWORK."

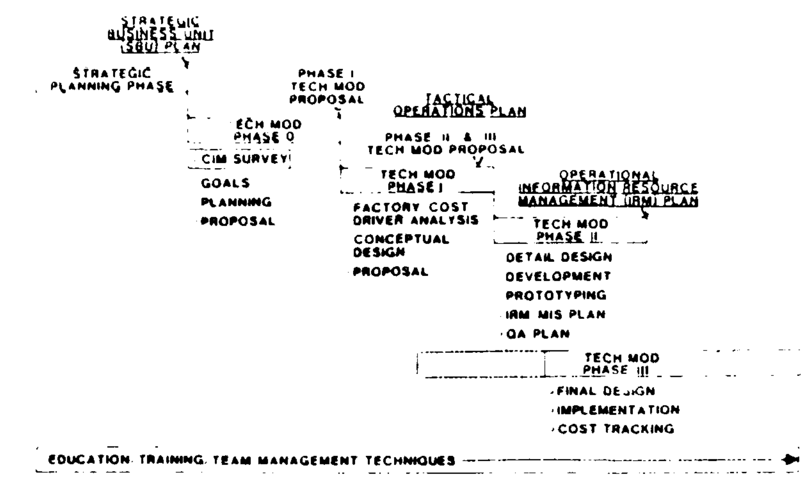
"PROCESSING THESE PROGRAM MANAGEMENT CHANGES [illegible] OUR PRIOR PHASE I PLANNING COULD IMPACT OUR TACTICAL OPERATIONS PLAN AND INDIVIDUAL TECH MOD PROJECTS.

"CERTAINLY ANY SUCH PHASE I IMPACTS WOULD AFFECT OUR OVERALL OPERATIONAL INFORMATION RESOURCE MANAGEMENT PLAN.

"IT ALMOST GOES WITHOUT SAYING, THAT WE NOW RECOGNIZE THAT WE MUST PLACE SIGNIFICANTLY MORE HUMAN RESOURCE MANAGEMENT EMPHASIS ON EDUCATION, TRAINING AND THE USE OF TEAM MANAGEMENT TECHNIQUES.

"LET'S TAKE ANOTHER GRAPHIC VIEW OF WHAT WE ARE SAYING."

TECHNOLOGY MODERNIZATION FRAMEWORK



"TOP-DOWN" PROGRAM MANAGEMENT/"BOTTOM-UP" PROJECT IMPLEMENTION

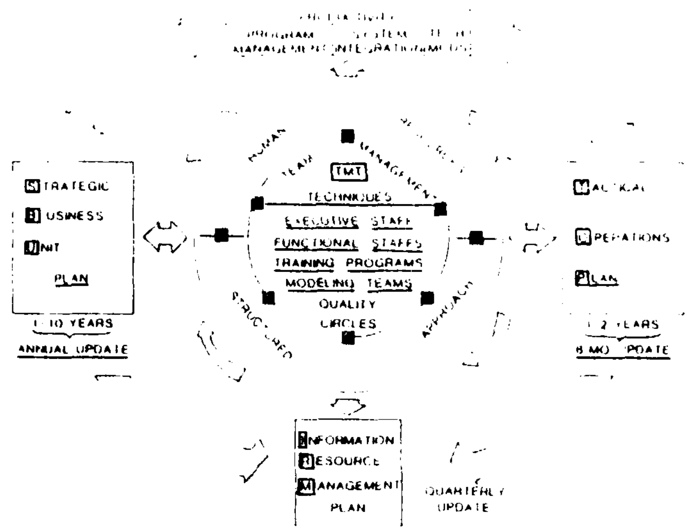
INSTRUCTIONAL OBJECTIVE: To orient executive level management relative to the relationship of structured business planning, structured technology modernization planning, and the use of the structured ICAM planning/analytical tools.

NARRATION: "THE ONLY CHANGES WE HAVE MADE HERE FROM OUR EARLIER "TECHNOLOGY MODERNIZATION FRAMEWORK" DISCUSSION ARE AS FOLLOWS:

"WE RECOGNIZE THE NEED TO INSTITUTE "TOP-DOWN" PROGRAM MANAGEMENT TECHNIQUES WHILE IMPLEMENTING OUR "BOTTOM-UP" TECHNOLOGY MODERNIZATION PROJECTS. THIS "TOP-DOWN" PROGRAM MANAGEMENT MUST BE PERIODICALLY REASSESSED AS THE EXECUTIVE LEVEL BUSINESS PLANS ARE ITERATED.

"WE MUST ALSO RECOGNIZE, IN OUR FACTORY OF THE FUTURE PLANNING, THAT EACH ANNUAL SBU PLAN MAY REVISE PRIOR OUTPUTS OF THE STRATEGIC PLANNING PHASE. THESE CHANGES, COUPLED WITH AN UPDATED COMPUTER INTEGRATED MANUFACTURING (CIM) TECHNOLOGY SURVEY, COULD CAUSE REVISION TO OUR PRIOR TECH MOD PROGRAM PLANNING."

IRM=" TOP DOWN " PRODUCTIVITY ENGINEERING



INSTRUCTIONAL OBJECTIVE: To orient executive level management relative to the relationship of structured business planning, structured technology modernization planning, and the use of the structured ICAM planning/analytical tools.

NARRATION: "INFORMATION RESOURCE MANAGEMENT IS KEY TO "TOP-DOWN" PRODUCTIVITY ENGINEERING.

"OUR PRODUCTIVITY PROGRAMS, CONSISTING OF PROGRAM MANAGEMENT, SYSTEM INTEGRATION AND INDIVIDUAL TECH MOD PROJECTS, MUST BE CLOSELY LINKED WITH OUR OVERALL "TOP-DOWN" BUSINESS PLANNING ACTIVITIES.

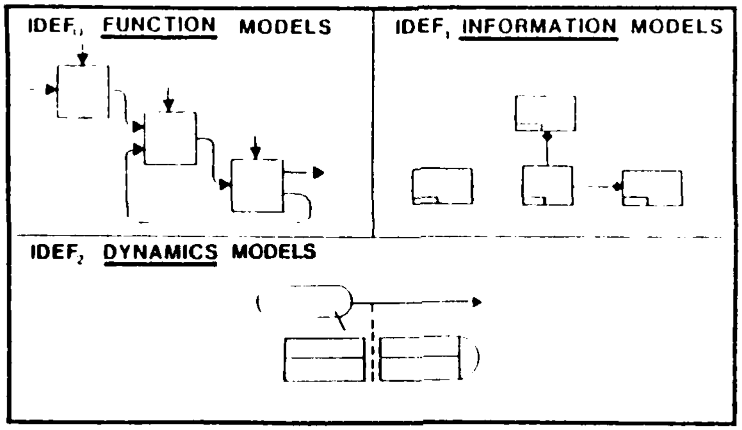
"THIS ITERATIVE PROCESS IS TOTALLY DEPENDENT UPON EFFICIENT INTEGRATION AND UTILIZATION OF OUR HUMAN RESOURCES.

"WE SUBMIT THAT A STRUCTURED BUSINESS PLANNING APPROACH, COUPLED WITH THE STRUCTURED ICAM PLANNING AND ANALYTICAL TOOLS, WILL MATERIALLY ASSIST YOU IN THIS PROCESS.

"AS WE STATED EARLIER, WE RECOGNIZE THAT THIS TEAM MANAGEMENT APPROACH AT ALL LEVELS OF THE ORGANIZATION WILL SOMEWHAT INCREASE "FRONT-END" COSTS AND IMPACT SHORT-TERM COST PERFORMANCE. WE STRONGLY BELIEVE, HOWEVER, THAT THESE NEAR-TERM COSTS WILL BE PAID BACK MANY TIMES OVER IN THE LONG TERM BY MUCH IMPROVED RETURN OF INVESTMENT (ROI)."

ICAM DEFINITION -- IDEF

SYSTEMATIC APPLICATION of COMPUTER TECHNOLOGY



INSTRUCTIONAL OBJECTIVE: To summarize and gain executive management acceptance of ICAM IDEF planning and analytical tools.

NARRATION: "AS A RESULT OF HIS ORGANIZATION'S CIM SURVEY, THE GENERAL MANAGER OF THE FACTORY OF THE FUTURE SHOULD FIND A CATALOG OF PRODUCT AND PROCESS TECHNOLOGIES IN HIS "MODERNIZATION KIT" THAT WILL BE AVAILABLE IN THE 1985 - 1990 TIME FRAME.

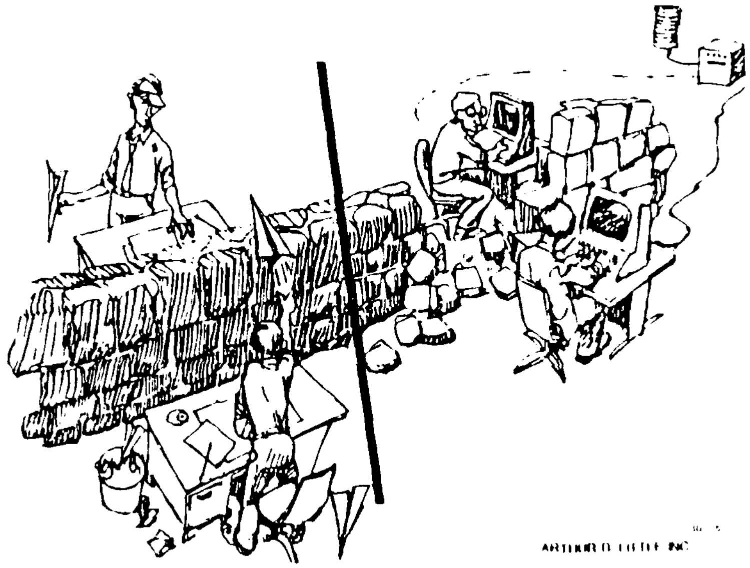
"THESE TECHNOLOGIES MAY INVOLVE EXOTIC PROCESSES AND HIGH-SPEED INTEGRATED CIRCUITS, NEW METALS AND COMPOSITES, MOST OF THEM PROBABLY UTILIZING SOPHISTICATED COMPUTER CONTROL DEVICES.

"AN ABUNDANCE OF TECHNOLOGIES ARE AVAILABLE TODAY IN THE LABORATORY THAT HAVE NOT YET BEEN ASSIMILATED INTO MANUFACTURING. THESE LEADING-EDGE CAPABILITIES ARE EASIER TO CONCEIVE AND DESIGN THAN TO IMPLEMENT IN THE FACTORY OF THE FUTURE.

"THE STRATEGIC PLANNING THAT DESCRIBES THE MARKETPLACE AND THE MARKET NEEDS WILL DETERMINE THE REQUIREMENTS FOR IMPLEMENTING SPECIFIC NEW TECHNOLOGIES. CONSIDERATION OF HUMAN RESOURCE MANAGEMENT REQUIREMENTS WILL AID US IN IMPLEMENTING THESE TECHNOLOGIES.

"AGAIN, IT IS THE OPINION OF THE ICAM PROGRAM THAT THE SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY UTILIZING THE ICAM IDEF PLANNING AND ANALYTICAL TOOLS WILL FACILITATE THIS DIFFICULT TRANSITION.

THE OLD WAY   THE NEW WAY



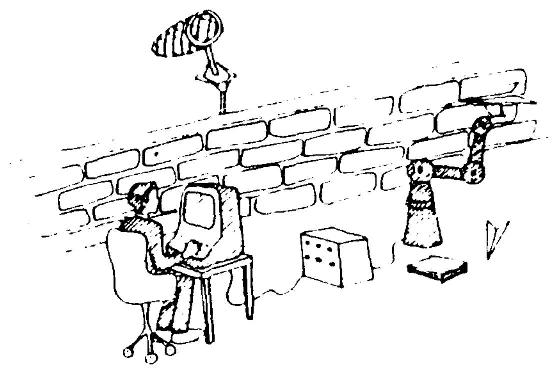
INSTRUCTIONAL OBJECTIVE: To orient executive management relative to the need to exercise caution in implementing new technology.

NARRATION: "IN CLOSING, WE BORROWED THIS CARTOON FROM ARTHUR D. LITTLE TO EXPRESS A BIT OF OPTIMISM RELATIVE TO OUR INDUSTRIAL FUTURE.

"COMPUTER TECHNOLOGY, SYSTEMATICALLY IMPLEMENTED UTILIZING A WELL DEFINED STRUCTURED APPROACH, CAN PROVIDE INTEGRATED DATABASES WHICH WILL TEAR DOWN THE TRADITIONAL ORGANIZATIONAL WALLS IN OUR ORGANIZATIONS.

"WE MUST, HOWEVER, EXERCISE CAUTION ---"

THE WRONG WAY



INSTRUCTIONAL OBJECTIVE: To orient executive management relative to the need to exercise caution in implementing new technology.

NARRATION: "UNLESS EXECUTIVE LEVEL MANAGEMENT BECOMES INVOLVED AND PROVIDES SPECIFIC "TOP-DOWN" INTEGRATION DIRECTION DURING MANUFACTURING TECHNOLOGY MODERNIZATION PROJECT PLANNING ---- THIS MAY BE OUR END RESULT.

SUMMARY

- THE PROBLEM
  - U.S. PRODUCTIVITY PERFORMANCE
  - U.S. INDUSTRY AUTOMATION TECHNOLOGY
- THE SOLUTION
  - INTEGRATED COMPUTER AIDED MANUFACTURING/TECH MODS
  - ICAM ANALYTICAL/PLANNING TOOLS
  - INTEGRATED STRATEGIC PLANNING & INFORMATION RESOURCE MANAGEMENT (IRM)

INSTRUCTIONAL OBJECTIVE: To summarize the Executive Overview presentation.

NARRATION: "IN SUMMARY, WE HAVE DISCUSSED THE PROBLEM WITH U.S. PRODUCTIVITY PERFORMANCE AND THE DANGER OF UNINTEGRATED IMPLEMENTATION OF AVAILABLE TECHNOLOGY.

"WE HOPE THAT YOU WILL AGREE WITH US THAT THE SOLUTION MAY WELL BE INTEGRATED COMPUTER-AIDED MANUFACTURING BASED UPON WELL PLANNED TECHNOLOGY MODERNIZATION PROGRAMS.

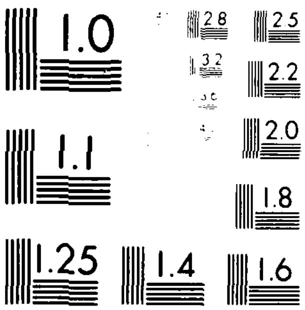
"IT IS ALSO HOPED THAT YOU WILL ALSO CONCUR THAT THE ICAM PROGRAM'S ANALYTICAL AND PLANNING TOOLS WILL BE OF BENEFIT TO YOUR ORGANIZATION AND TO OTHERS THROUGHOUT INDUSTRY. WE BLIEVE THE USE OF ICAM IDEF METHODOLOGIES AND THE RESULTING ARCHITECTURES WILL FACILITATE MANY OF YOUR COMMUNICATION PROBLEMS.

"WE ALSO HOPE THAT OUR LOOK-AHEAD TO THE FACTORY OF THE FUTURE WILL PROVIDE YOU FOR FOOD FOR THOUGHT RELATIVE TO YOUR OWN OPERATION. PERHAPS THE LINKING OF STRATEGIC PLANNING AND INFORMATION RESOURCE MANAGEMENT UTILIZING A "TOP-DOWN" STRUCTURED APPROACH WILL HELP US TURN U.S. INDUSTRY AROUND.

"WE THANK YOU FOR YOUR TIME AND CONSIDERATE ATTENTION DURING THIS PRESENTATION. ARE THERE ANY FURTHER QUESTIONS"?

AD-A144 732 INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM) ARCHITECTURE PART 3 VOLUME..(U) SOFTECH INC WALTHAM MA A W SNODGRASS SEP 83 1080-37 3/6

UNCLASSIFIED AFWAL-TR-82-4063-PT-3-VOL-8 F/G 13/8 NL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1.25
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2.3 Technology Transfer Practitioner's Presentation Manual

FOREWORD

This Presentation Manual is provided to help teach an overview of the U.S. Air Force's Modernization (TECH MOD) Program's use of related IDEF applications, concepts, procedures. It also covers the use of the resulting architecture and planning in controlling these Technology Modernization Programs to upgrade the U.S. industrial base.

This Presentation Manual provides the instructor with the presentation materials required to actually conduct the course. The instructor also will have received a "Train the Trainers" Manual which provides a step-by-step process, section-by-section, dealing with the concepts and procedures of IDEFØ function modeling, including reading, authoring, commenting on, and iterating IDEFØ function models.

2.3.1 Introduction

This is an instructor's Presentation Manual intended to aid those teaching an overview of the Air Force Manufacturing Technology Modernization (TECH MOD) Program's use of related ICAM IDEF) Function Modeling Methodology. The instructor's Practitioner's "Train the Trainers" Manual provides the elements and an order of presentation needed in teaching. The developing of style is left to the individual instructor.

This instructor's Presentation Manual consist of a guide for conducting and presenting a practitioner's level briefing. The instructor's Practitioner's "Train the Trainers" Manual provides a step-by-step text, containing the objectives and procedures to be covered, concepts, and a suggested narration.

The course materials are presented in a standardized format, divided into four sections. Each page is composed of a copy of the foil, the instructional objective that must be covered with that foil, and a suggested naration that may be followed until individual styles can be developed.

It must be made clear from the start that the ICAM Definition Language (IDEF) requires that both functions and data necessary to carry out a process be modeled.

The IDEFØ Function Modeling Methodology concerns itself with the modeling of functions along with the data those functions employ.

The IDEFØ Function Model is composed of diagrams, text, and glossary.

Both Authoring and Commenting roles and responsibilities of IDEFØ Function Models are required for full development of each Function Model, because of the iterative nature of the IDEFØ methodology. This IDEFØ Training Course discusses Authoring Concepts and Procedures as well as Commenting Concepts and Procedures, respectively.

Overall planning for and conducting of actual training sessions is almost as critical to accomplishing participant learning objectives as the course presentation material. Attention must be given to planning for presentation set-up, pre-presentation, presentation, and post-presentation activities.

2.3.1.1 Presentation Set-Up

2.3.1.1.1 Audio/Visual Equipment:

a) Overhead vue foil projector

b) 35mm projector (if slides are used)

2.3.1.1.2 Audio/Visual Aids:

a) Overhead transparencies

b) 35mm color transparencies (when slides are used)

c) Training materials (handouts and/or manuals)

2.3.1.1.3 Room Set-up:

Everyone must be in hearing and seeing distance of the presentation.

REMEMBER: The best instructional program is no good if you can't hear and see it!

2.3.1.2 Pre-Presentation

- Review all training materials beforehand and be familiar with them.

- Make sure room, equipment, and materials are all in order and ready to go when you are.

  REMEMBER: Prior planning prevents poor performance!

- Set up audio/visual equipment.

- Get audio/visual aids ready for presentation.

a) Make sure all overhead transparencies are in their order of presentation.

c) Make sure all 35mm color transparencies (when slides are used) are in their order of presentation and that they are all placed in carousel right-reading, (a slide in backwards or upside down can throw your whole presentation off kilter).

- Handout training materials:

  a) IDEF0 Function Modeling Manual (Vol. IV - AFWAL-TR-81-4023)

  b) Composite Function Model of "Manufacture Product" (MFG0 - Vol. VII - AFWAL-TR-81-4023)

  c) MFG0 Node Tree

  d) DES0 Node Tree

  e) IDEF Kit Cover Sheet

  f) IDEF Forms

  g) IDEF Templates

  h) Copies of Presentation Materials (Handed out section by section as applicable)

2.3.1.3 Presentation

- Give introduction

  a) Include purpose and viewpoint of presentation.

  b) Set atmosphere conducive to learning.

- Go through training materials step-by-step.

- Use peer cross-referencing method to check for understanding.

  PEER CROSS-REFERENCING METHOD

  a) Ask who understands the point you've just presented.

  b) Ask who isn't clear about it.

  c) Ask if anyone who understands the point can explain it to those who don't.

NOTE: If you don't get any takers, you must explain it over again, if possible, in different terms.

- REMEMBER:

  Just because you've presented the material doesn't mean that everyone has understood it.

2.3.1.4 Post Presentation

- Try not to leave any question unanswered. If you don't know, find out, and write or call with the answer.

- At some time, a sheet could be filled out with the name, organization, department, phone number, etc. of those attending. Get sheet typed and make copies to give to everyone. Use for:

  - historical record

  - contact sheet.

2.3.2 ICAM IDEF/Architecture

FTR110410000
8 September 1983

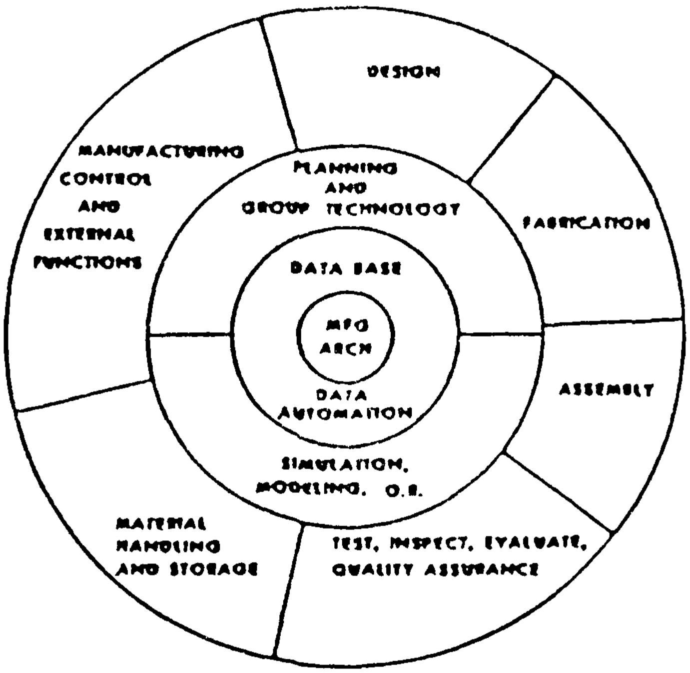
USAF MANUFACTURING TECHNOLOGY PROGRAM

A MANUFACTURING TECHNOLOGY MODERNIZATION

PROGRAM CONCEPT FOR

INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM)

IDEF/ARCHITECTURE METHODOLOGY



PRACTITIONER'S PRESENTATION MANUAL

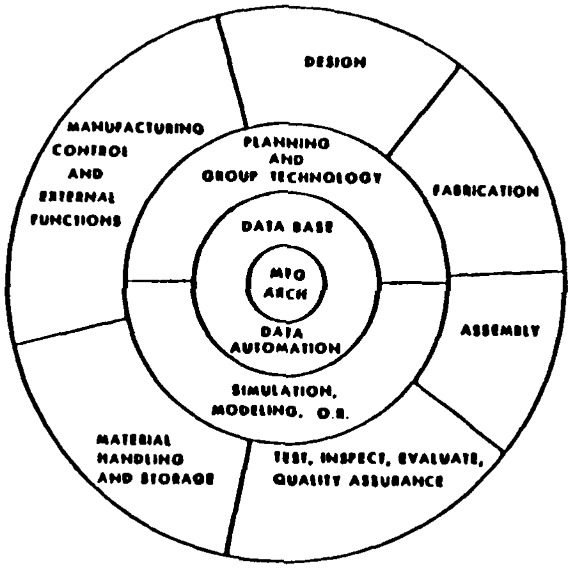
IDEF → ARCHITECTURE

- *WHAT IS ICAM ?*
- *WHAT IS IDEF ?*
- *HOW DOES IDEF RELATE TO ARCHITECTURE ?*

WHAT IS ICAM?

ICAM

INTEGRATED COMPUTER-AIDED MANUFACTURING



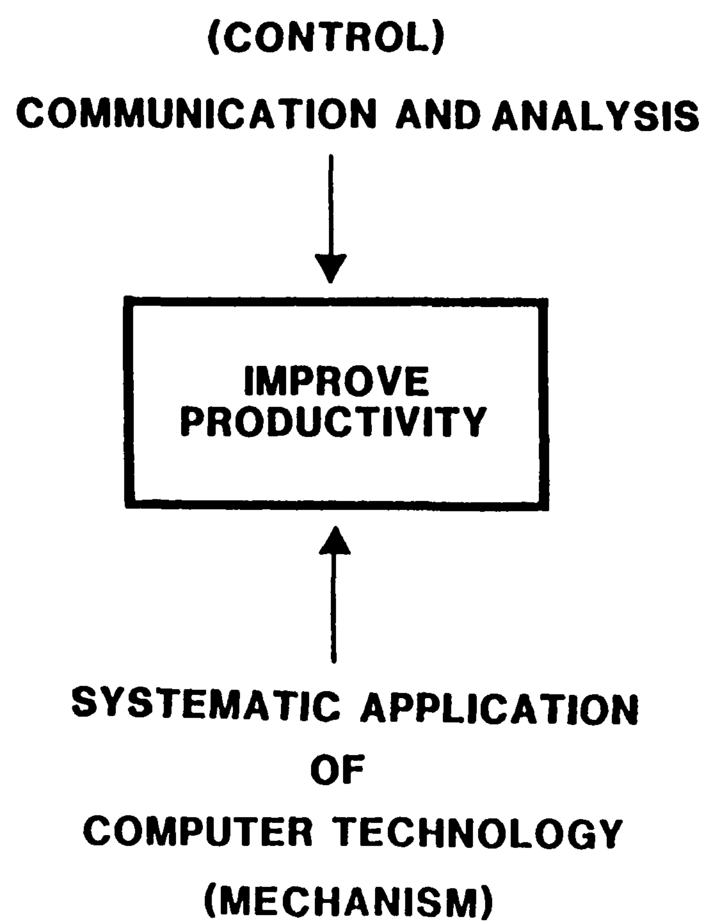
PURPOSE OF ICAM

IMPROVE PRODUCTIVITY

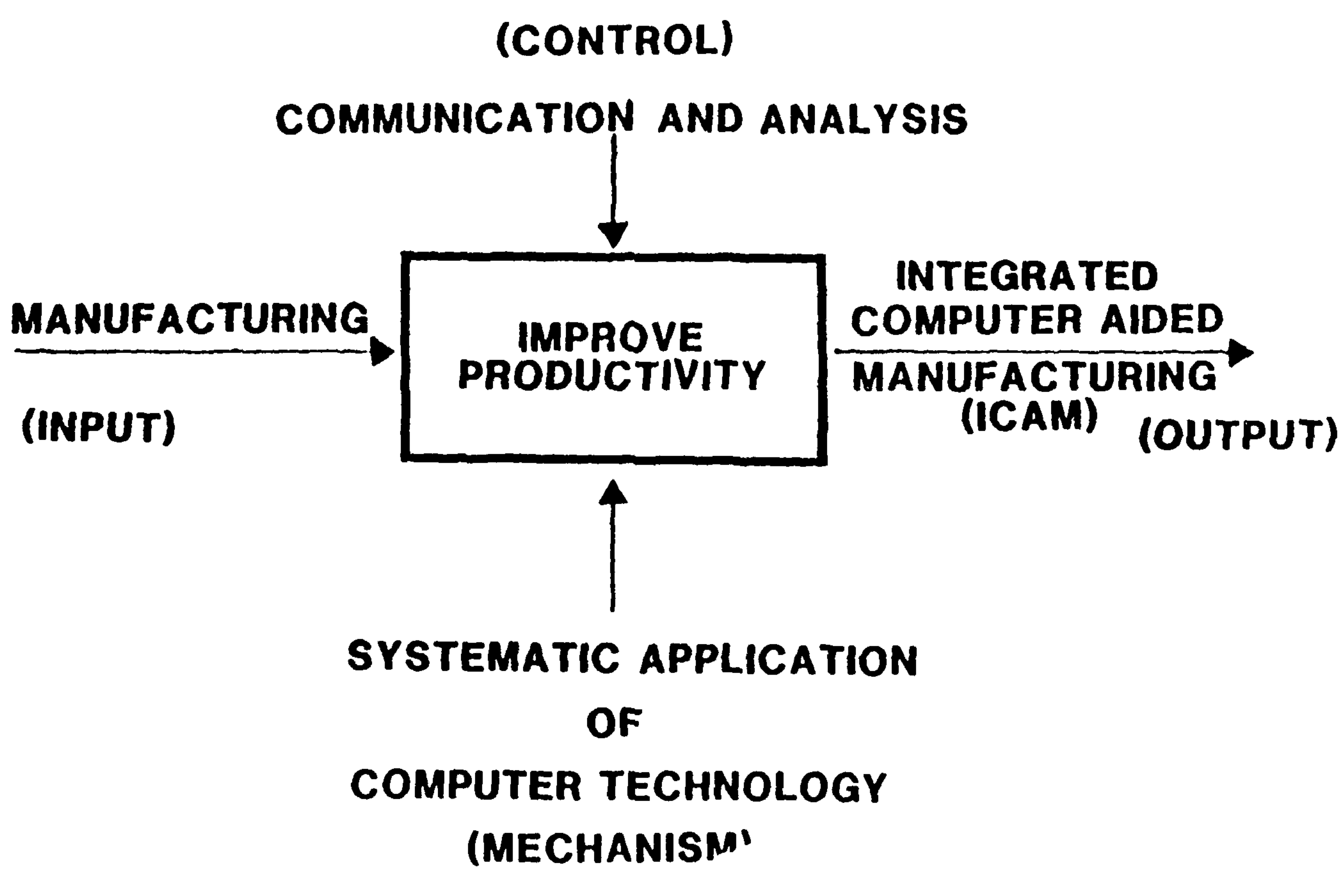
↑

SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY (MECHANISM)

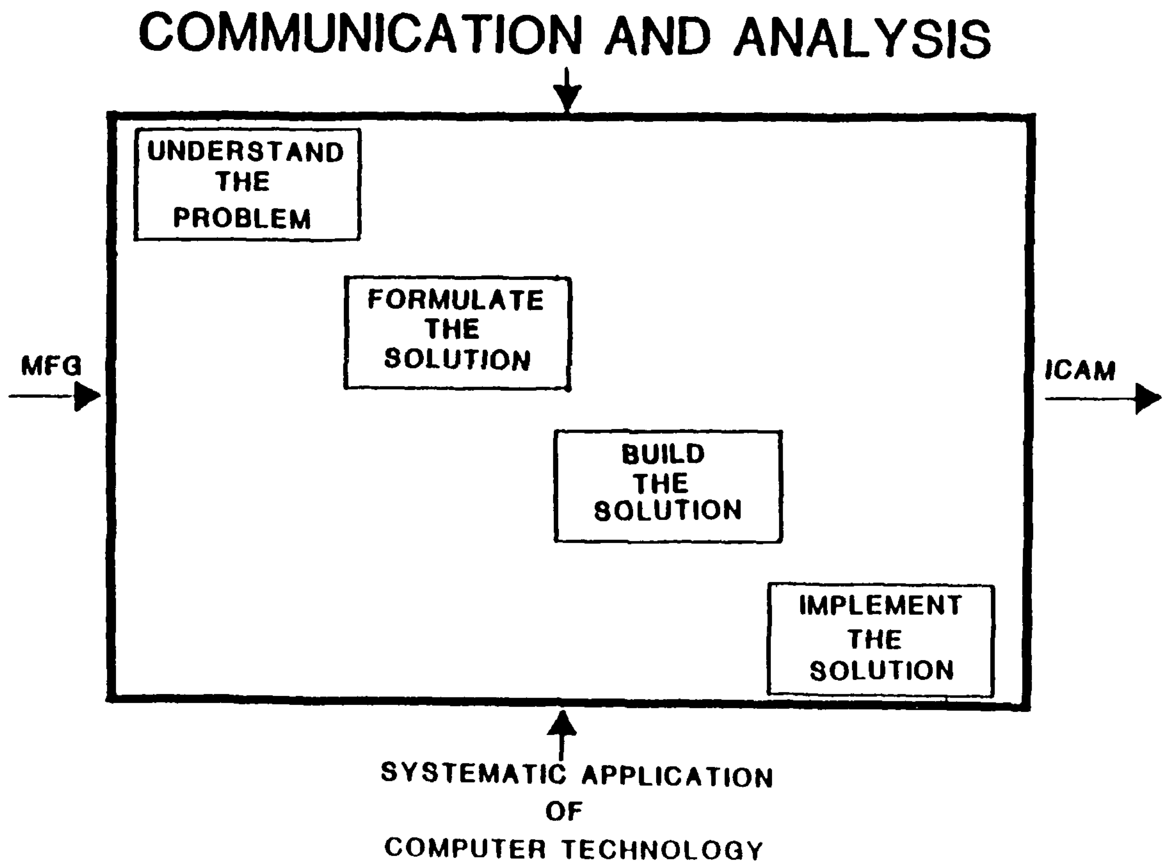
ICAM APPROACH



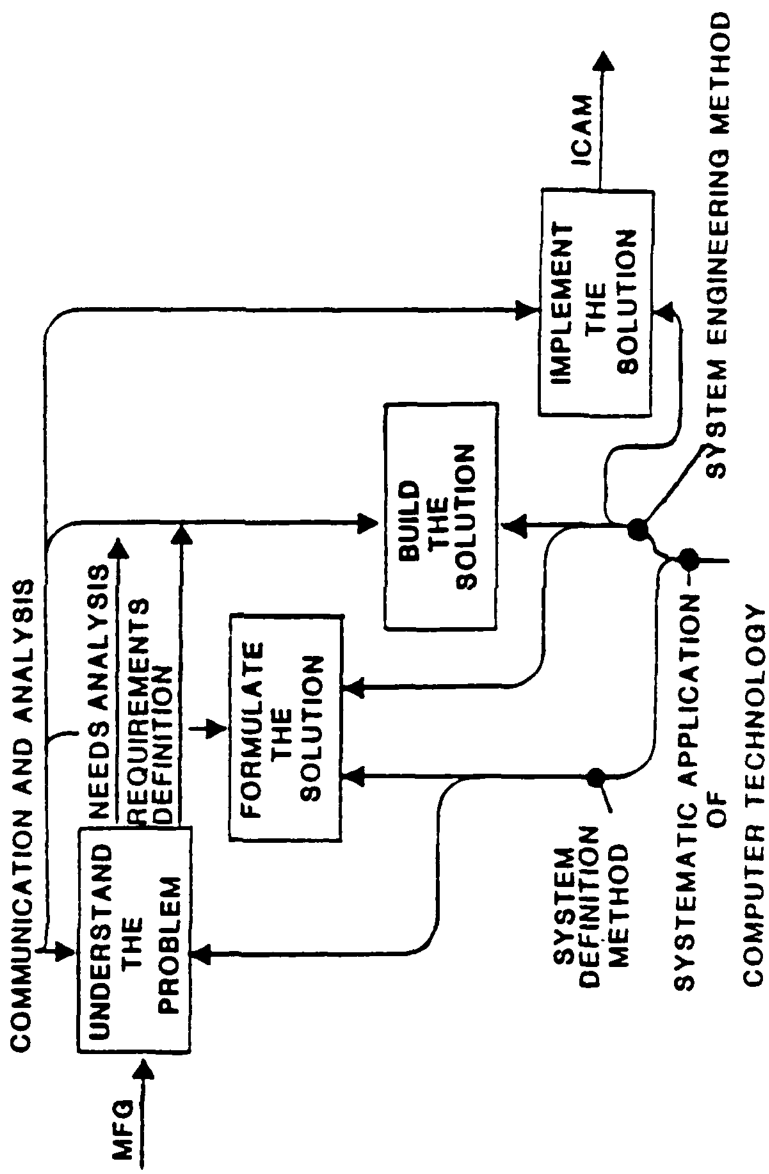
OBJECTIVE OF ICAM



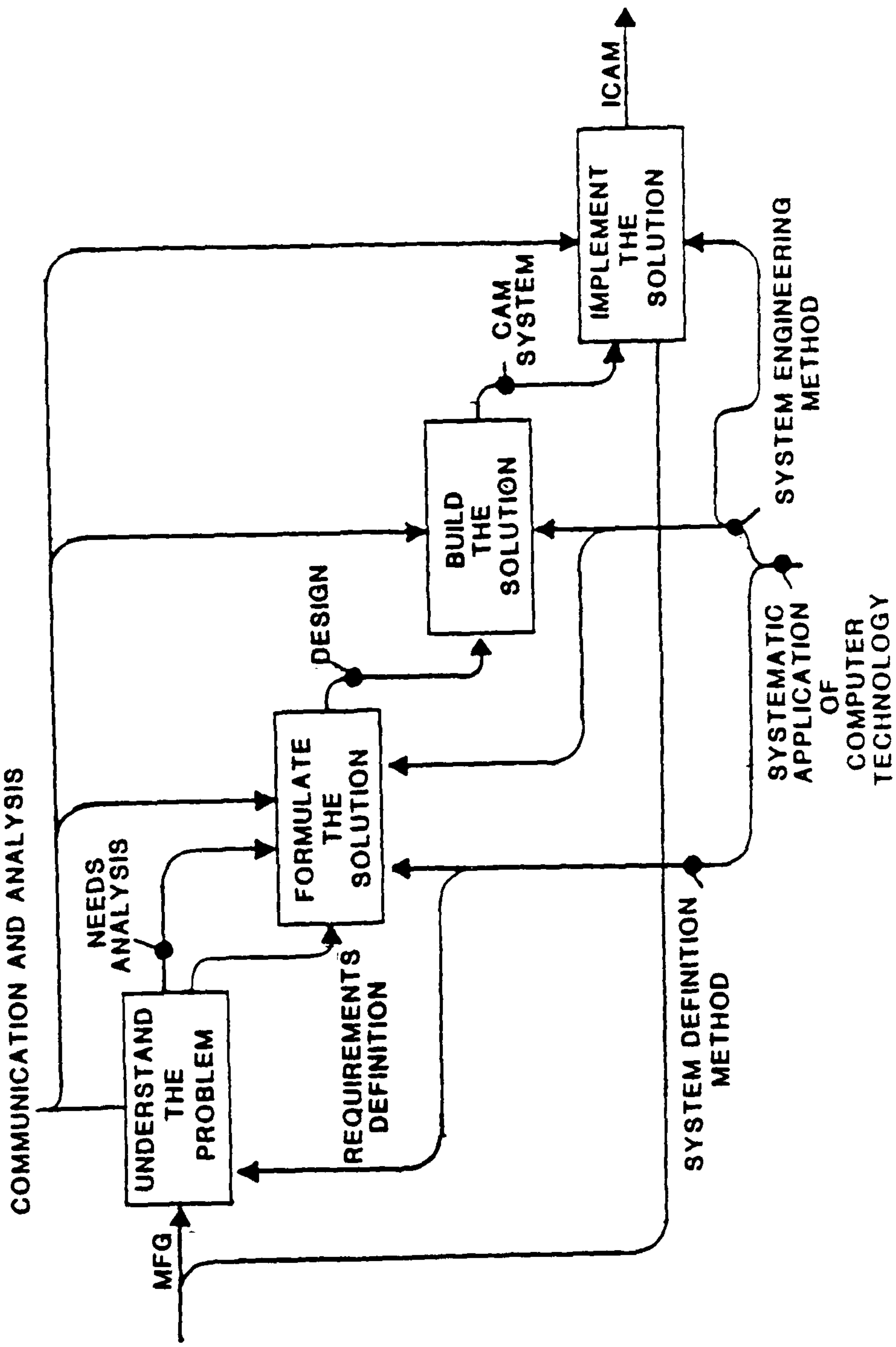
IMPROVE PRODUCTIVITY



IMPROVE PRODUCTIVITY



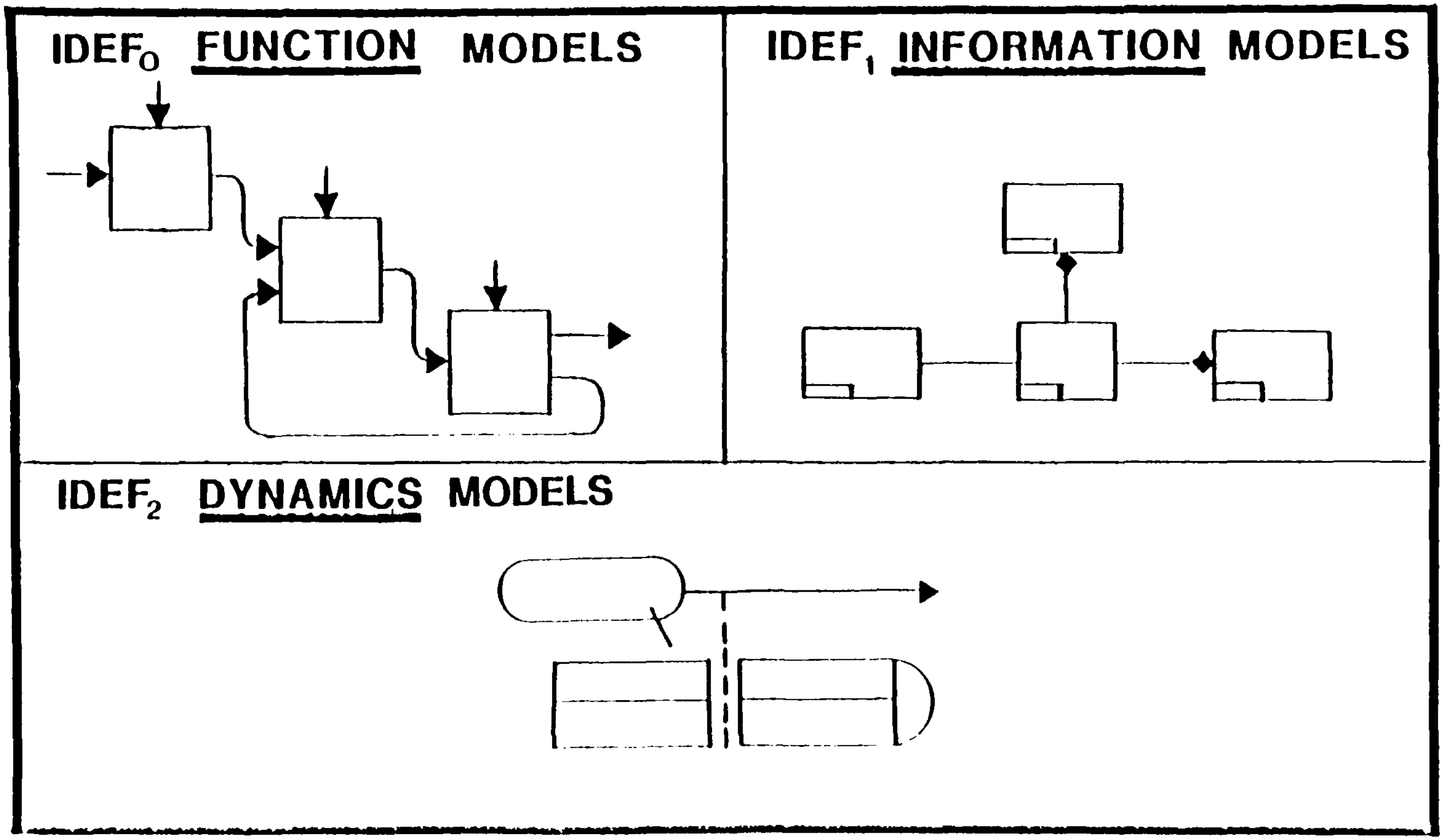
IMPROVE PRODUCTIVITY

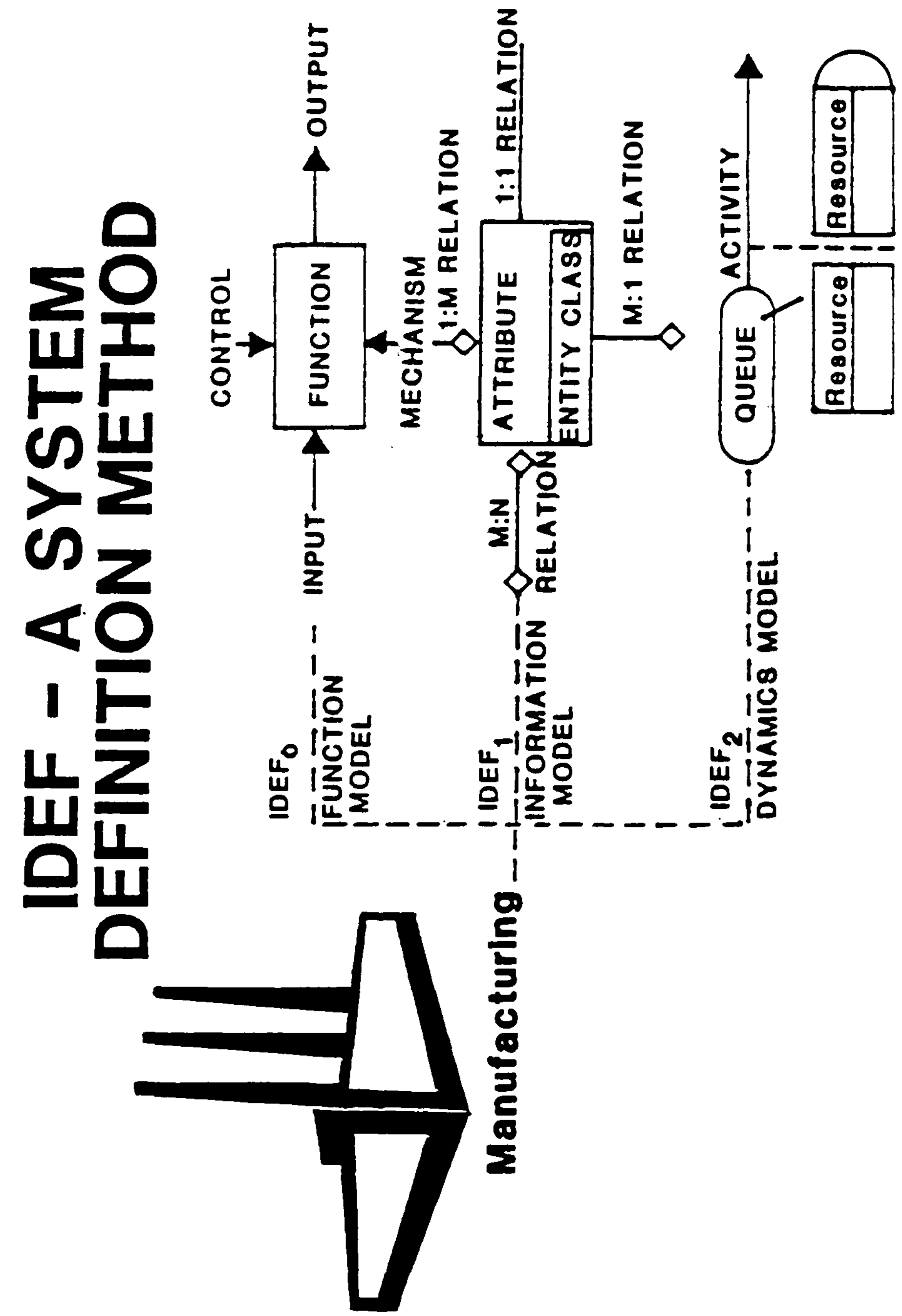


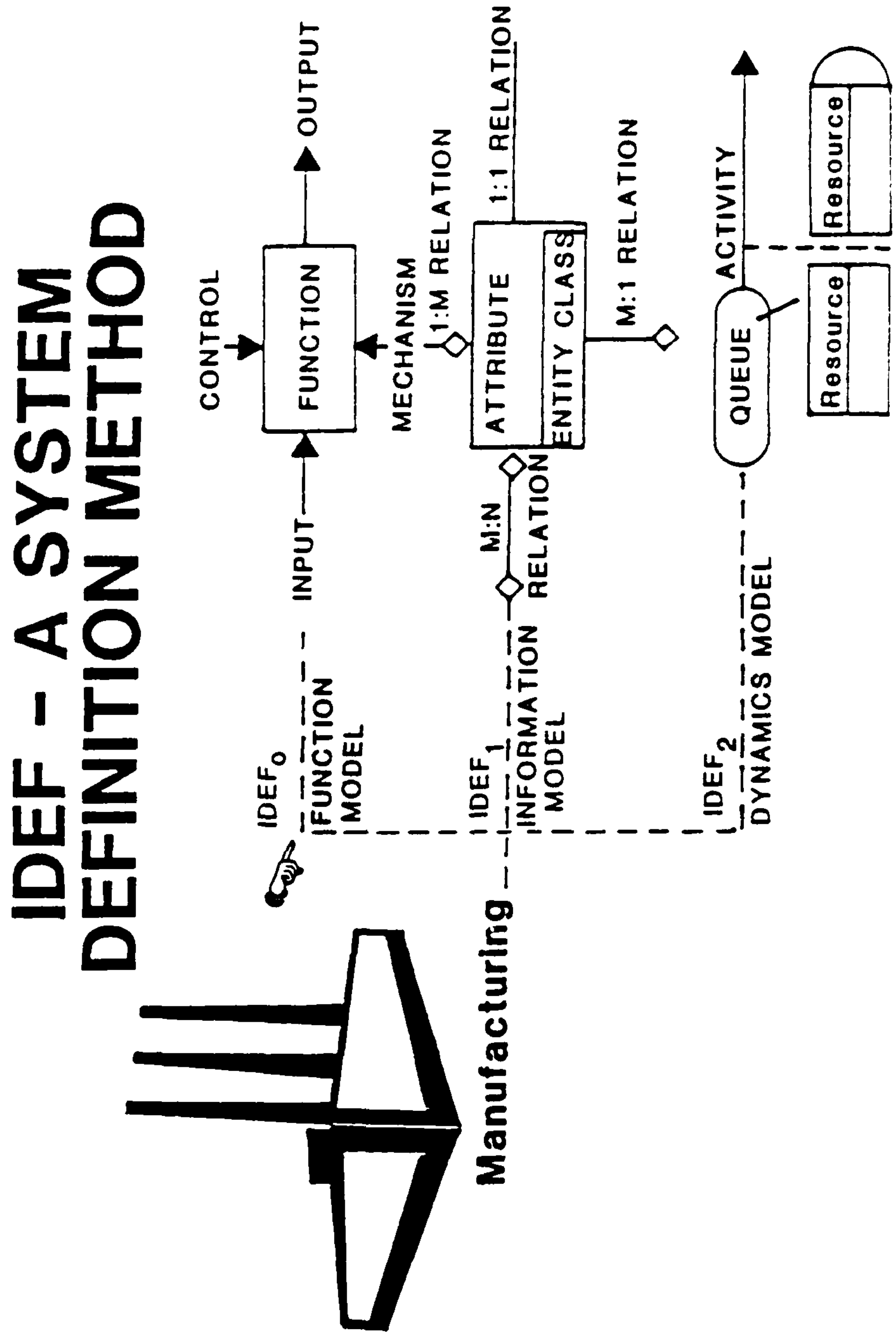
WHAT IS IDEF?

ICAM DEFINITION → IDEF

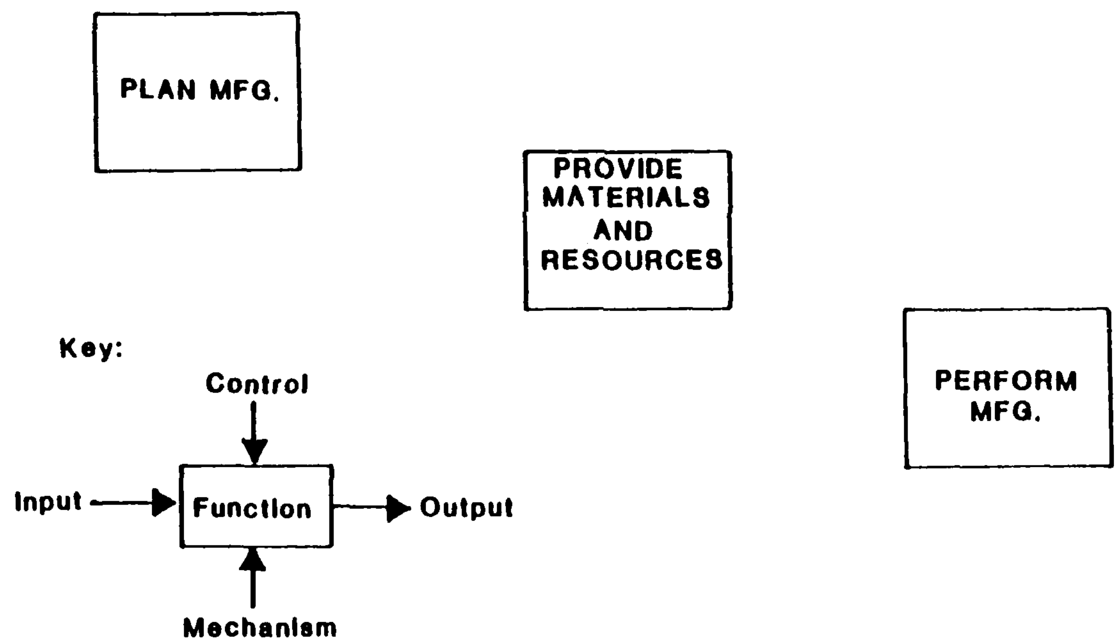
SYSTEMATIC APPLICATION of COMPUTER TECHNOLOGY



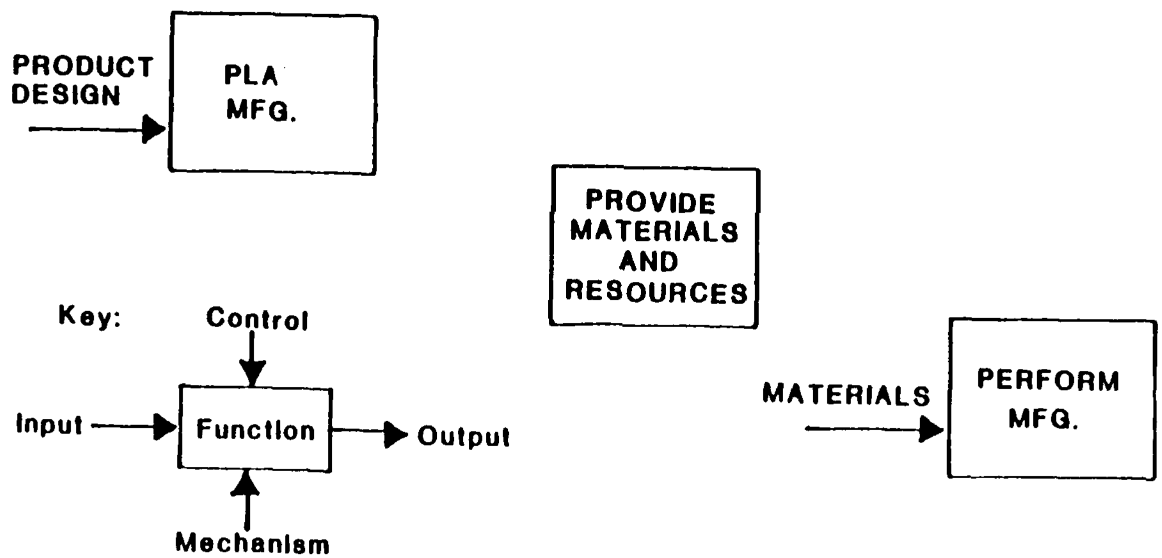

IDEF - A SYSTEM DEFINITION METHOD
Manufacturing
IDEF0
FUNCTION MODEL
INPUT
CONTROL
FUNCTION
MECHANISM
OUTPUT
IDEF1
INFORMATION MODEL
M:N RELATION
1:M RELATION
ATTRIBUTE
ENTITY CLASS
1:1 RELATION
M:1 RELATION
IDEF2
DYNAMICS MODEL
QUEUE
ACTIVITY
Resource
Resource

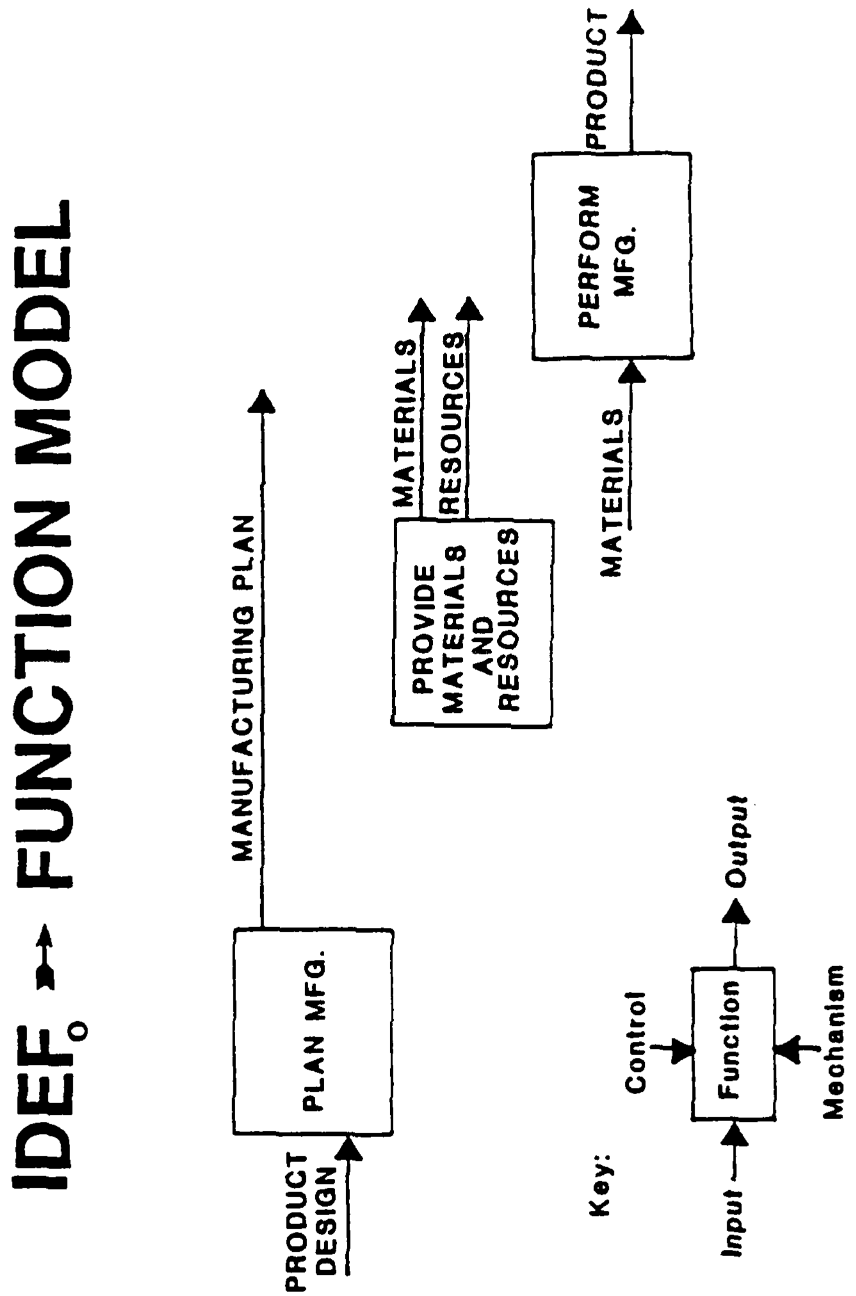

IDEF - A SYSTEM DEFINITION METHOD
Manufacturing
IDEF$_0$
FUNCTION MODEL
INPUT
CONTROL
FUNCTION
MECHANISM
OUTPUT
IDEF$_1$
INFORMATION MODEL
M:N RELATION
1:M RELATION
ATTRIBUTE
ENTITY CLASS
1:1 RELATION
M:1 RELATION
IDEF$_2$
DYNAMICS MODEL
QUEUE
ACTIVITY
Resource
Resource

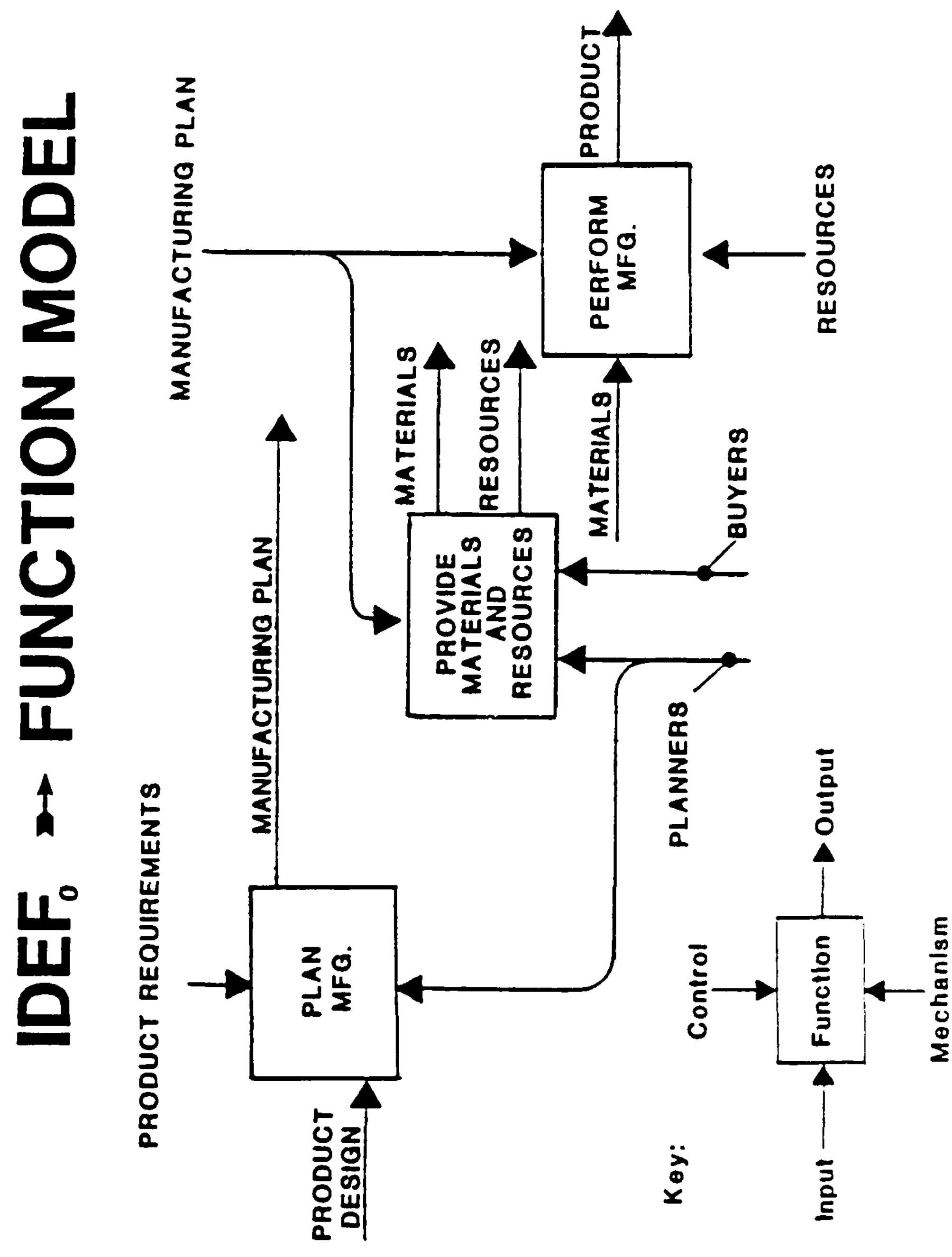
IDEF$_0$ → FUNCTION MODEL



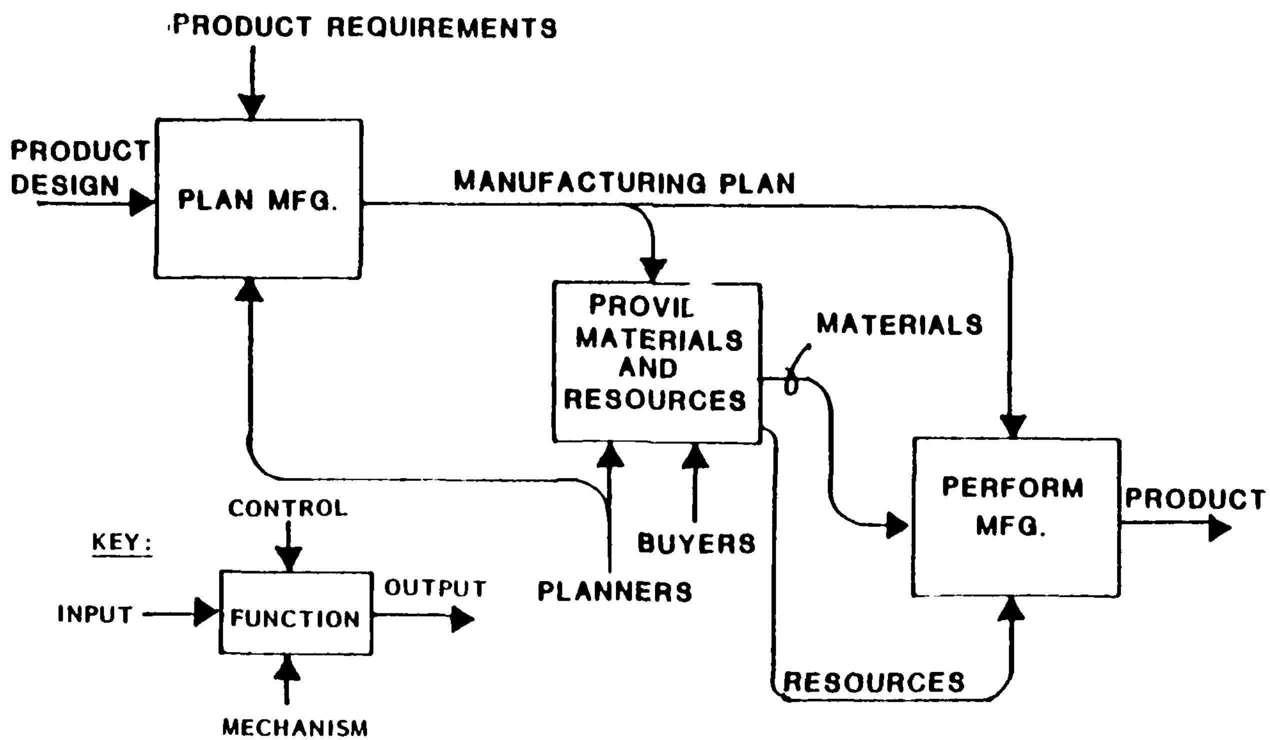
IDEF$_0$ ➛ FUNCTION MODEL



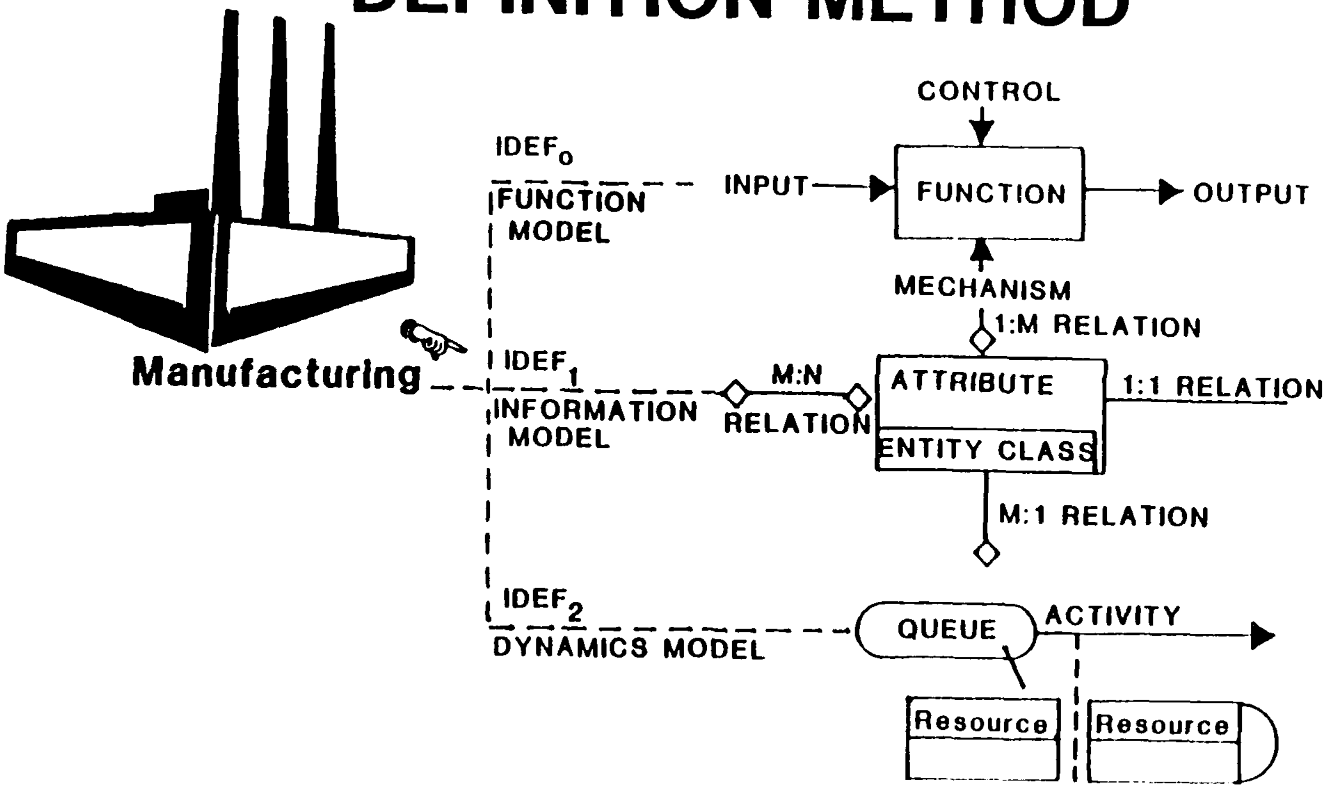

IDEF0 → FUNCTION MODEL
PRODUCT DESIGN
PLAN MFG.
MANUFACTURING PLAN
PROVIDE MATERIALS AND RESOURCES
MATERIALS
RESOURCES
MATERIALS
PERFORM MFG.
PRODUCT
Key:
Input
Control
Function
Mechanism
Output


IDEF$_0$ → FUNCTION MODEL
PRODUCT REQUIREMENTS
PLAN MFG.
PRODUCT DESIGN
MANUFACTURING PLAN
PROVIDE MATERIALS AND RESOURCES
MANUFACTURING PLAN
MATERIALS
RESOURCES
PERFORM MFG.
PRODUCT
MATERIALS
BUYERS
PLANNERS
RESOURCES
Key:
Control
Input
Function
Output
Mechanism

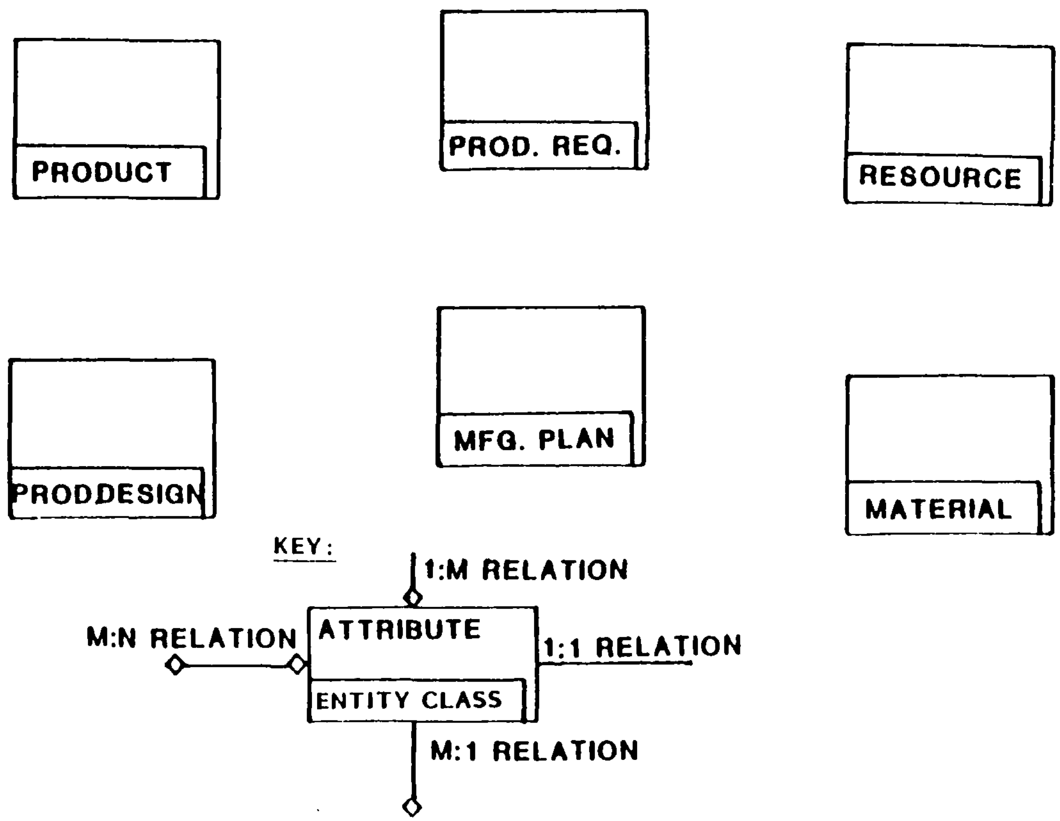
IDEF$_0$ → FUNCTION MODEL

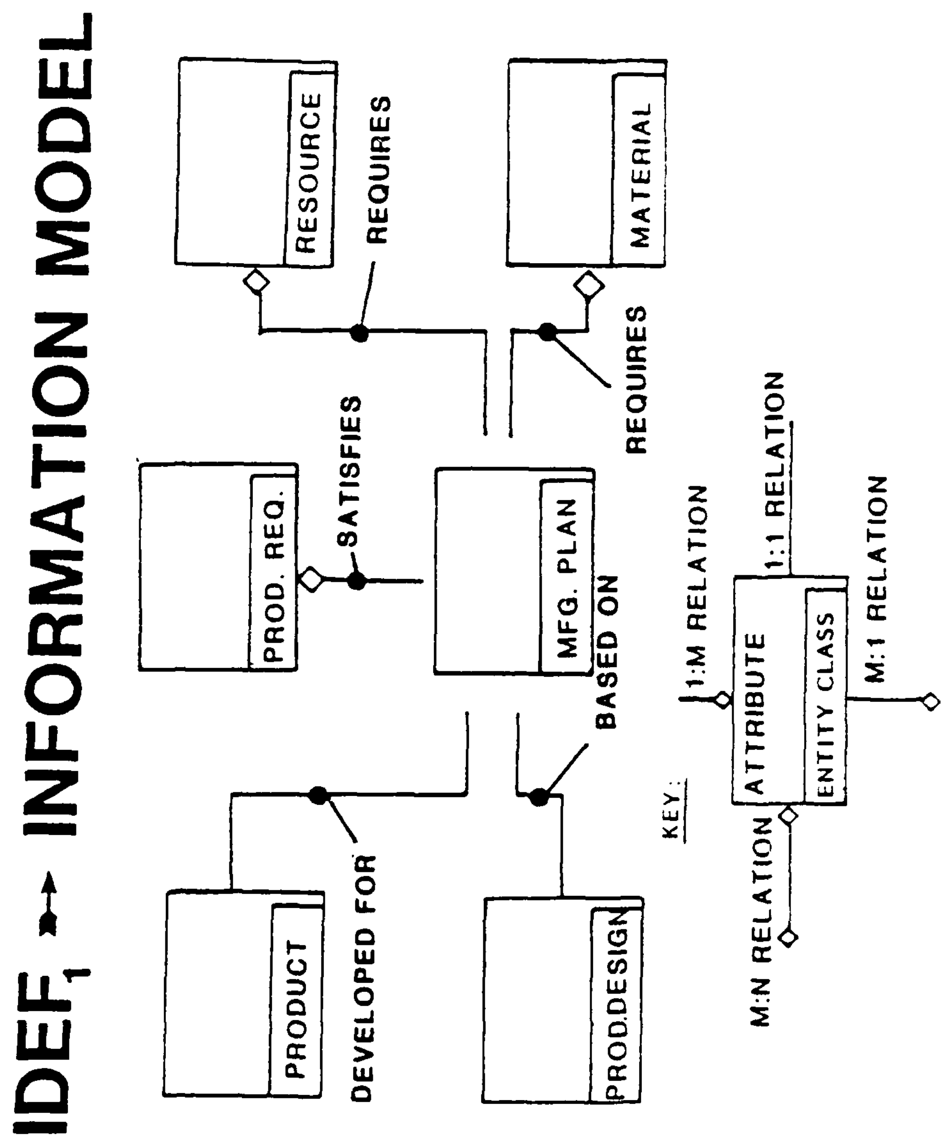


IDEF - A SYSTEM DEFINITION METHOD

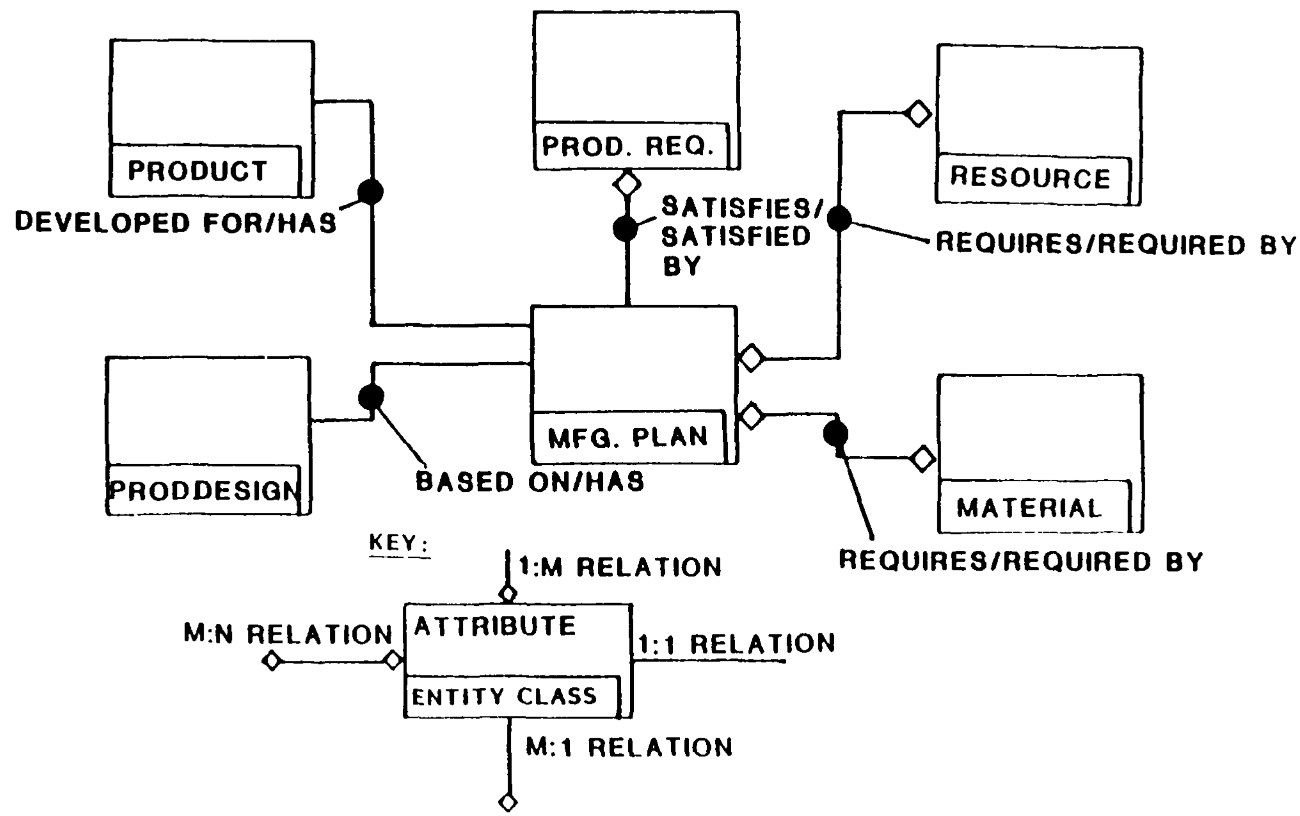


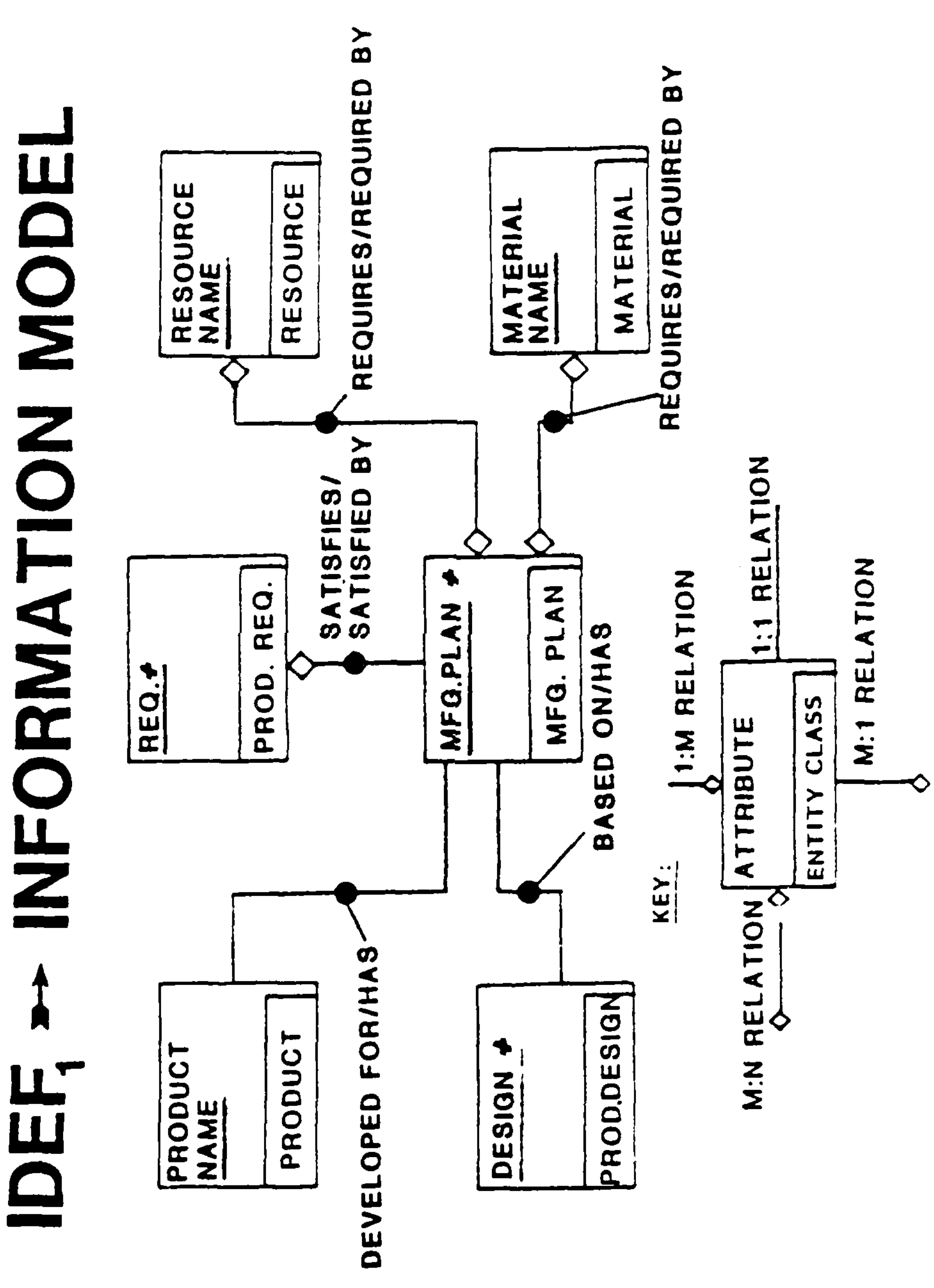
$IDEF_1$ → INFORMATION MODEL




IDEF1 → INFORMATION MODEL
RESOURCE
REQUIRES
MATERIAL
REQUIRES
PROD. REQ.
SATISFIES
MFG. PLAN
BASED ON
PRODUCT
DEVELOPED FOR
PROD.DESIGN
KEY:
1:M RELATION
1:1 RELATION
ATTRIBUTE
ENTITY CLASS
M:1 RELATION
M:N RELATION

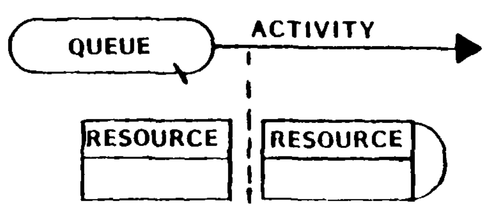
IDEF$_1$ ➛ INFORMATION MODEL



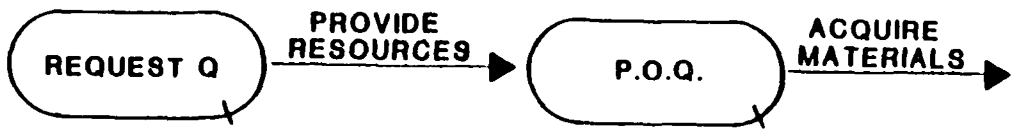

IDEF1 → INFORMATION MODEL
PRODUCT NAME
PRODUCT
DEVELOPED FOR/HAS
DESIGN
PROD.DESIGN
BASED ON/HAS
REQ.
PROD. REQ.
SATISFIES/ SATISFIED BY
MFG.PLAN
MFG. PLAN
RESOURCE NAME
RESOURCE
REQUIRES/REQUIRED BY
MATERIAL NAME
MATERIAL
REQUIRES/REQUIRED BY
KEY:
ATTRIBUTE
ENTITY CLASS
M:N RELATION
1:M RELATION
1:1 RELATION
M:1 RELATION

$IDEF_2$ ➛ DYNAMICS MODEL

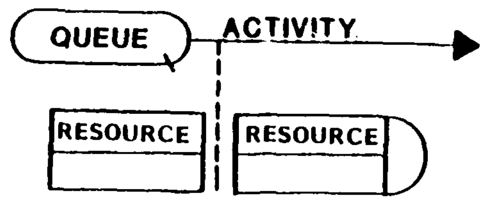
KEY



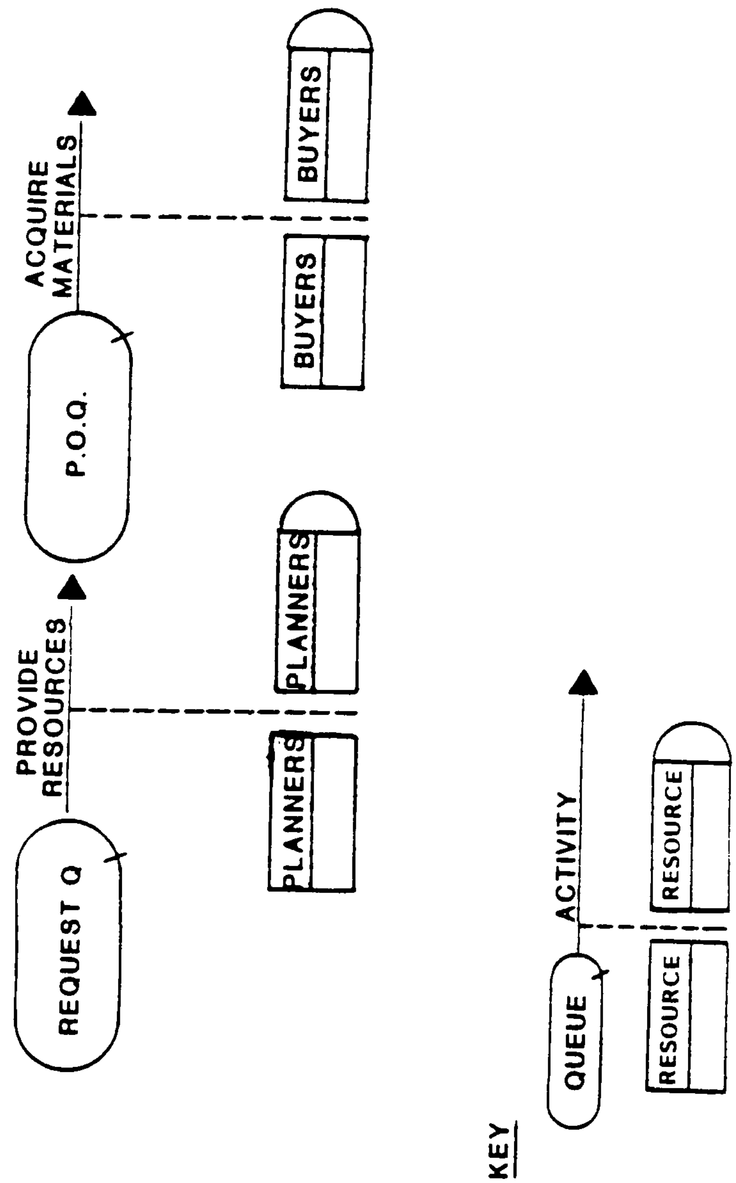
IDEF$_2$ ➛ DYNAMICS MODEL



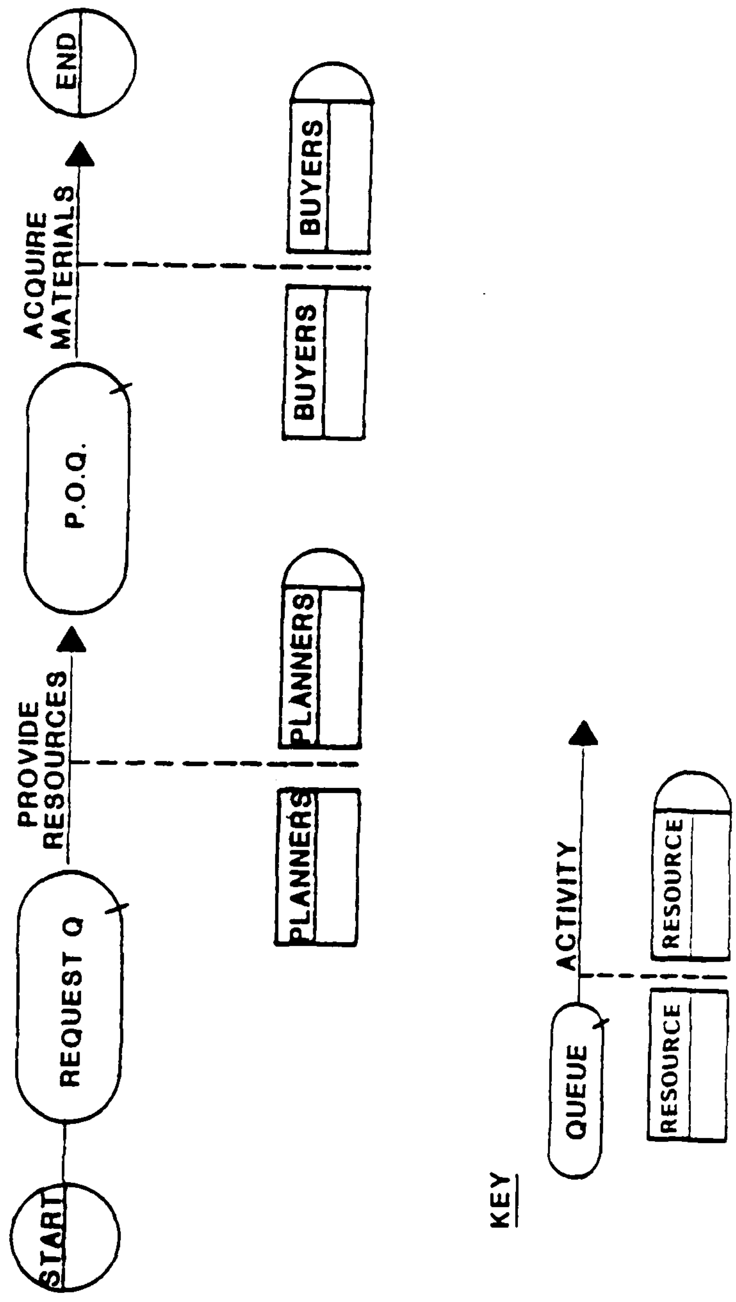
KEY



IDEF$_2$ → DYNAMICS MODEL



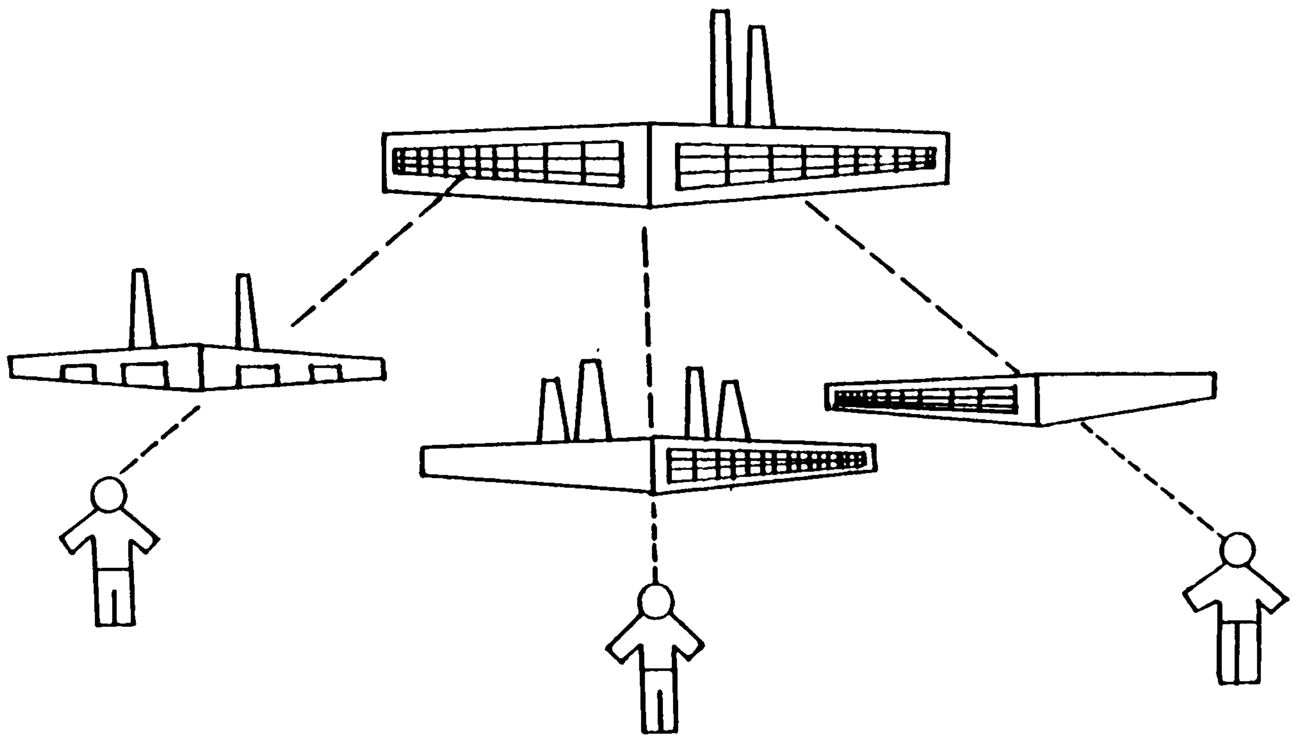
IDEF$_2$ → DYNAMICS MODEL



HOW DOES IDEF RELATE TO ARCHITECTURE ?

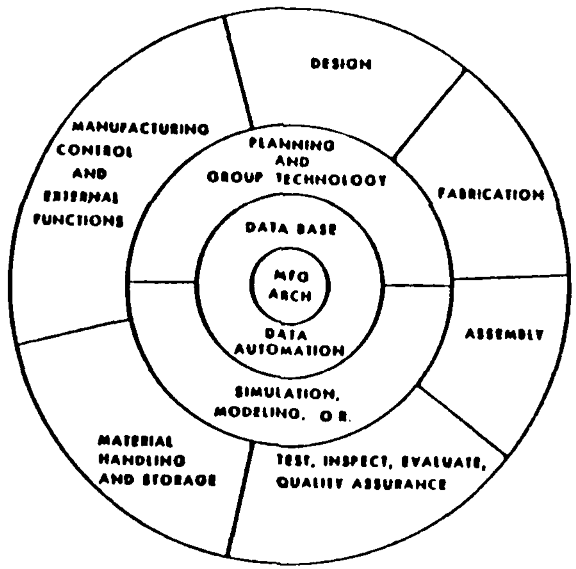
ARCHITECTURE

STANDARD FOR COMMUNICATION

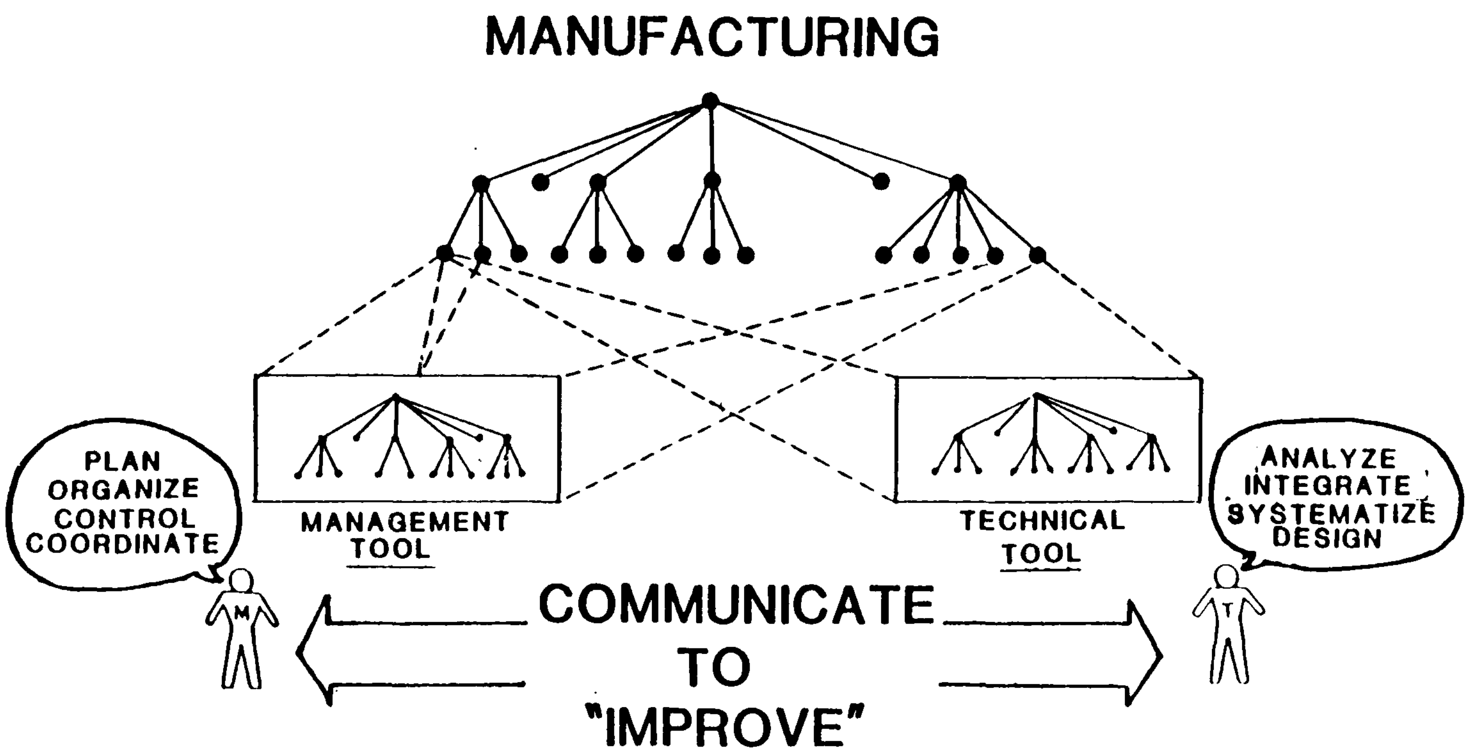


ICAM

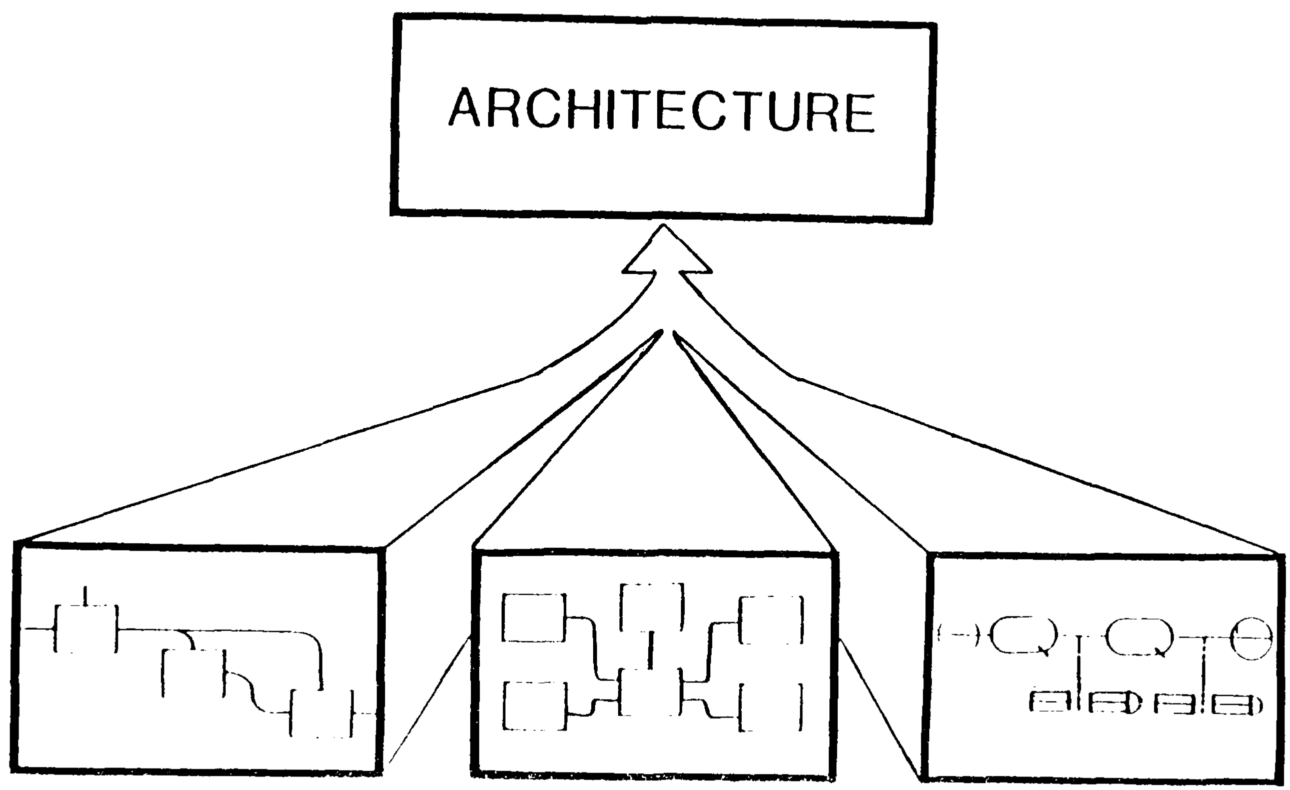
INTEGRATED COMPUTER-AIDED MANUFACTURING



ARCHITECTURE



ARCHITECTURE



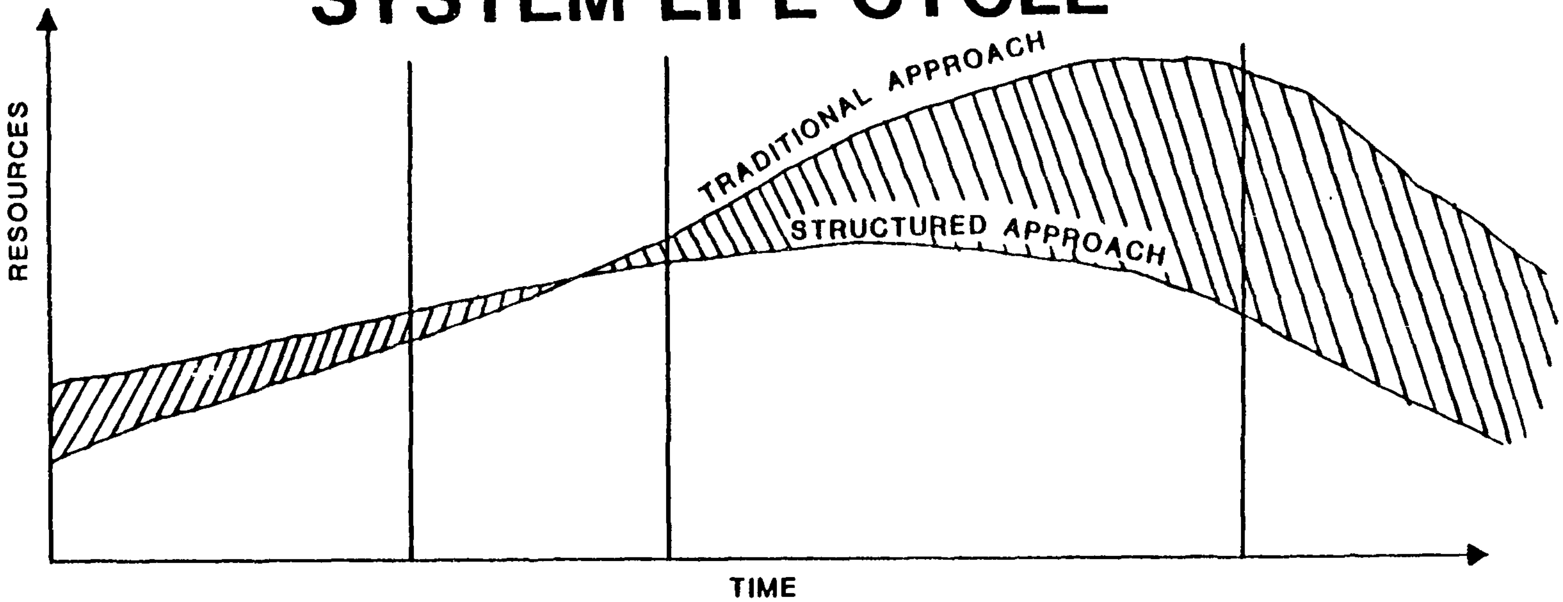
IDEF$_0$ → FUNCTION MODEL   IDEF$_1$ → INFORMATION MODEL   IDEF$_2$ → DYNAMICS MODEL

ICAM OBJECTIVE

IDEF AND ARCHITECTURE ARE TOOLS ....

NOT OBJECTIVES

IDEF ➞ ARCHITECTURE
SYSTEM LIFE CYCLE



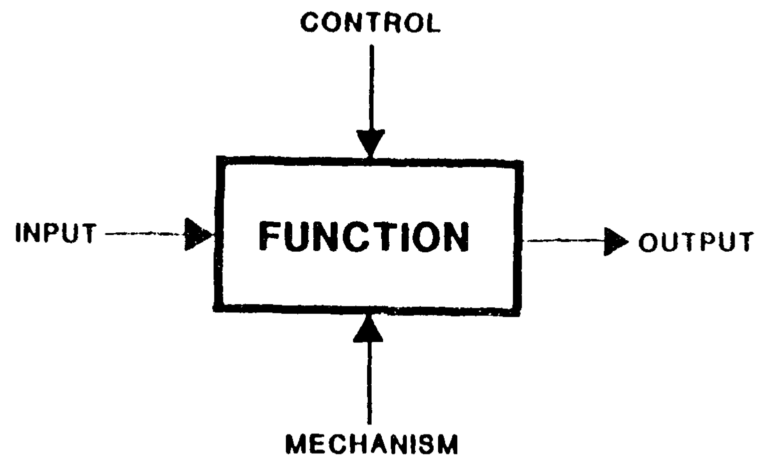
UNDERSTANDING PROBLEM	DESIGN	SOLUTION BUILDING	INSTALL & USE
• NEEDS ANALYSIS • REQUIREMENTS DEFINITION	• PRELIMINARY • DETAIL SPECIFICATION	• CONSTRUCTION, VERIFICATION, TEST • INTEGRATION, VALIDATION, TEST	• IMPLEMENTATION • USER ACCEPTANCE • MAINTENANCE

IDEF IS THE **METHOD**

ARCHITECTURE IS THE **MEANS**

PRODUCTIVITY IS THE **OBJECTIVE**

IDEF$_0$



<u>AUTHORING</u>
CONCEPTS AND PROCEDURES

AUTHORING CONCEPTS AND PROCEDURES

LEARNING OBJECTIVES

1. UNDERSTAND $IDEF_0$ (FUNCTION MODEL) GRAPHIC SYNTAX, I.E. SYMBOLS

2. UNDERSTAND THE BASIC CONCEPTS OF $IDEF_0$

3. UNDERSTAND THE DIFFERENT USES THAT DATA CAN PLAY IN FUNCTION MODELING WITH $IDEF_0$:
   - a. INPUTS
   - b. CONTROLS
   - c. OUTPUTS
   - d. MECHANISMS

4. UNDERSTAND $IDEF_0$ (FUNCTION MODEL) DIAGRAM DECOMPOSITION

5. UNDERSTAND AUTHORING AND REFINING $IDEF_0$ (FUNCTION MODEL) DIAGRAMS.

AUTHORING CONCEPTS | DEFINITIONS AND EXAMPLES

DEFINITIONS	EXAMPLES IN $IDEF_0$
SYNTAX I.E. SYMBOLS: • STRUCTURAL COMPONENTS OR "SYMBOLS" • RULES THAT DEFINE RELATIONS AMONG THE COMPONENTS	SYMBOLS: • BOXES • ARROWS RULES: • "USE ONLY 3-6 BOXES IN A DIAGRAM LAYOUT"
SEMANTICS I.E. CONCEPTS: • MEANING OF SYNTACTIC COMPONENTS • INTERPRETATION OF SYNTACTIC RULES	CONCEPTS: • FUNCTIONS . . . BOXES • INTERFACE-CONSTRAINTS . . . ARROWS • "USE ONLY 3-6 BOXES IN A DIAGRAM LAYOUT" • LESS THAN 3 BOXES -NOT ENOUGH DETAIL • MORE THAN 6 BOXES -CLUTTERS AND DETRACTS FROM READABILITY

AUTHORING CONCEPTS | FUNCTION

"FUNCTION"

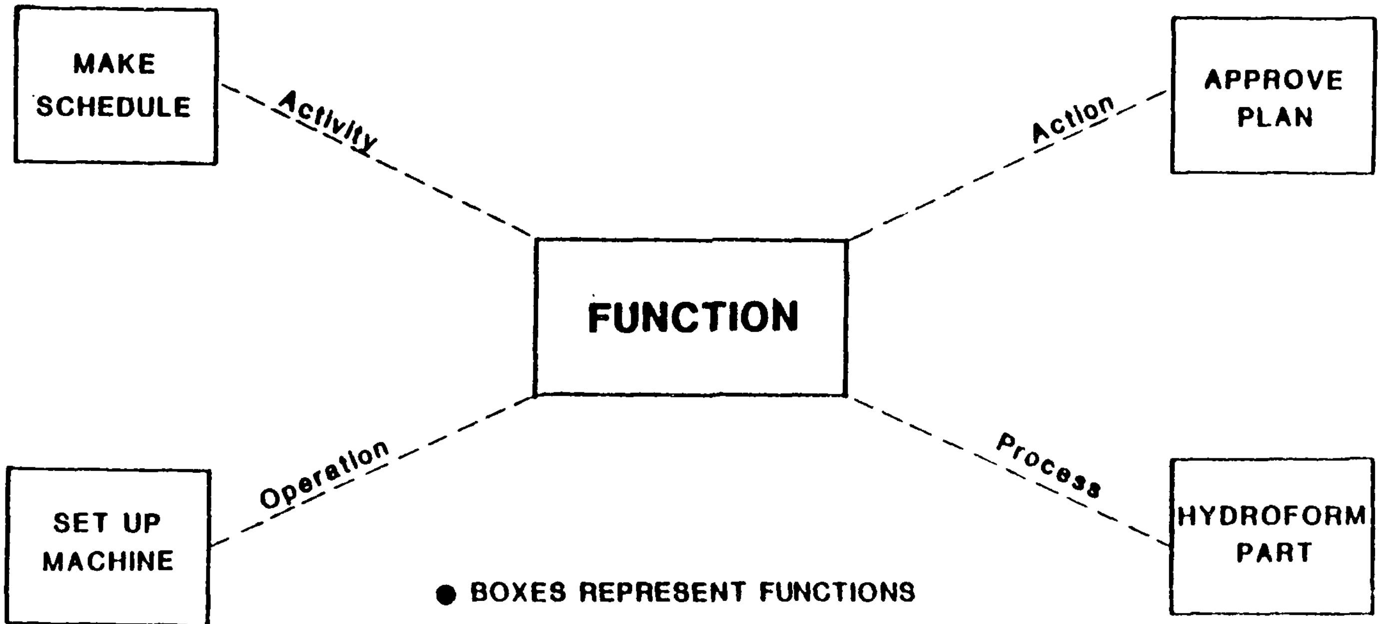
DEFINITION:

- *AN ACTIVITY, ACTION, PROCESS, OPERATION.*
- A DESCRIPTION OF "WHAT HAPPENS" IN A PARTICULAR ENVIRONMENT – WHAT IT MEANS TO DO SOMETHING.
- FUNCTIONS THAT ARE DONE BY PEOPLE, MACHINES, COMPUTERS, ETC.

CHARACTERISTICS:

- ACTIVE VERB OR VERB PHRASE
- OCCURS OVER TIME
- RECOGNIZABLE RESULTS

AUTHORING CONCEPTS | SYNTACTIC COMPONENTS: BOXES



- BOXES REPRESENT FUNCTIONS
- FUNCTION SYNTAX IS A BOX

AUTHORING CONCEPTS | DATA

DEFINITION:

- INFORMATION / PHYSICAL OBJECTS

CHARACTERISTICS:

- NOUN OR NOUN PHRASE

RELATIONSHIP TO FUNCTION:

- UNDERGO CHANGES BY FUNCTION
- DETERMINE OR AFFECT FUNCTION
- RESULT FROM FUNCTION
- CARRY OUT FUNCTION

AUTHORING CONCEPTS | DATA: PRIOR TO/RESULTING FROM ACTIVATION OF FUNCTION

DATA PRIOR TO ACTIVATION OF FUNCTION	FUNCTION	DATA RESULTING FROM ACTIVATION OF FUNCTION
• PRODUCT MANUFACTURING REQUIREMENTS	• PLAN FOR MANUFACTURE	• MANUFACTURING PLAN
• PRODUCT SPECIFICATIONS	• PRODUCE PRODUCT	• PRODUCT
• RAW MATERIALS • BLUEPRINTS • WORK ORDERS • INSTRUCTIONS	• MAKE PART	• FABRICATED PARTS • SCRAP

AUTHORING CONCEPTS | USES OF DATA: INPUTS, CONTROLS, OUTPUTS AND MECHANISMS

INPUT: DATA WHICH UNDERGOES A CHANGE
AND IS TRANSFORMED

CONTROL: DATA WHICH INFLUENCES OR DETERMINES
THE FUNCTION OUTPUT (S)

OUTPUT: DATA WHICH RESULTS FROM A FUNCTION:
DATA CREATED BY A FUNCTION

MECHANISM: DATA WHICH CARRIES OUT A FUNCTION

AUTHORING CONCEPTS | DATA ROLES IN IDEF$_0$

INPUT(S)	CONTROL(S)	FUNCTION	OUTPUT(S)
• PROCURABLE ITEMS	• PRODUCT DESIGN	• MANUFACTURE PRODUCT	• PRODUCT
• RAW MATERIALS	• BLUEPRINT • WORKORDER • INSTRUCTIONS	• MAKE PART	• FABRICATED PART • SCRAP
• EXPERIENCE & CAPABILITY INFORMATION	• RESOURCE REQUIREMENTS	• ESTIMATE RESOURCE NEEDS	• RESOURCE PLANS

"INPUT" DATA

"OUTPUT" DATA

AUTHORING CONCEPTS | MECHANISM

DEFINITION:

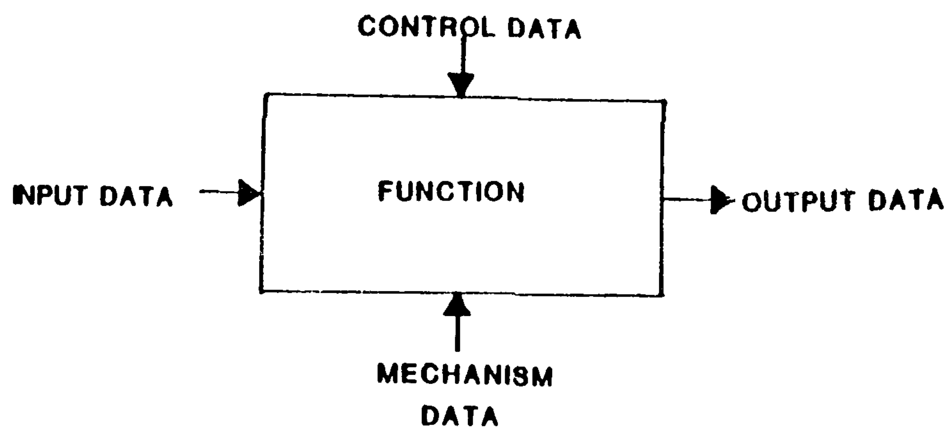
- THE MEANS BY WHICH A FUNCTION IS DONE
- THE ORIGIN, SOURCE, OR AGENT THAT ENABLES A FUNCTION TO BE ACCOMPLISHED

CHARACTERISTICS:

- NOUN OR NOUN PHRASE
- TYPICALLY A PERSON, MACHINE, OR COMPUTER

AUTHORING CONCEPTS | SYNTACTIC COMPONENTS: ARROWS

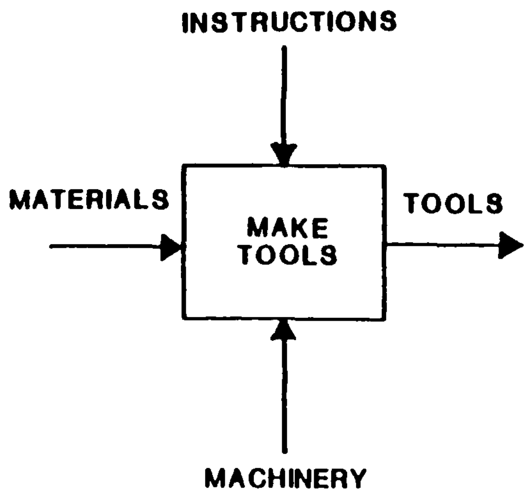
- ARROWS REPRESENT DATA
- ARROWS ALWAYS CONNECT TO A BOX



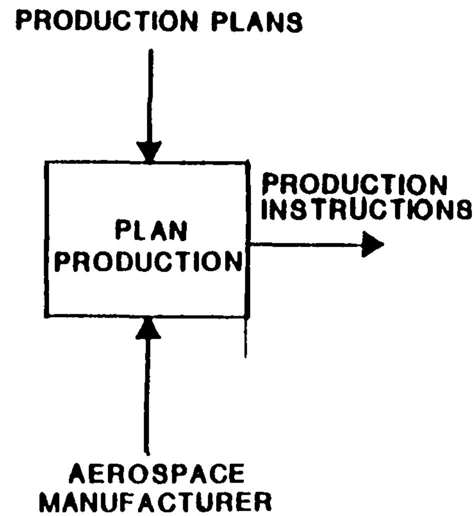
- DATA SYNTAX IS AN ARROW

AUTHORING CONCEPTS | FUNCTIONS AND DATA

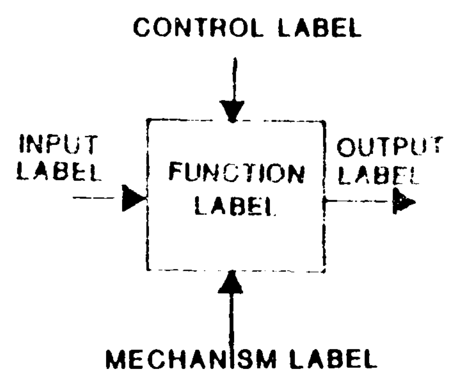
"TRANSFORMATION TYPE FUNCTION"



"NON TRANSFORMATION TYPE FUNCTION"



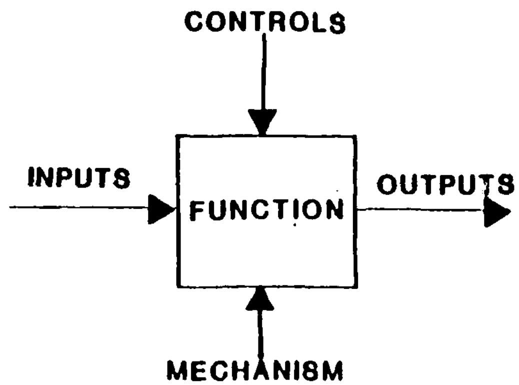
AUTHORING CONCEPTS | LABELS



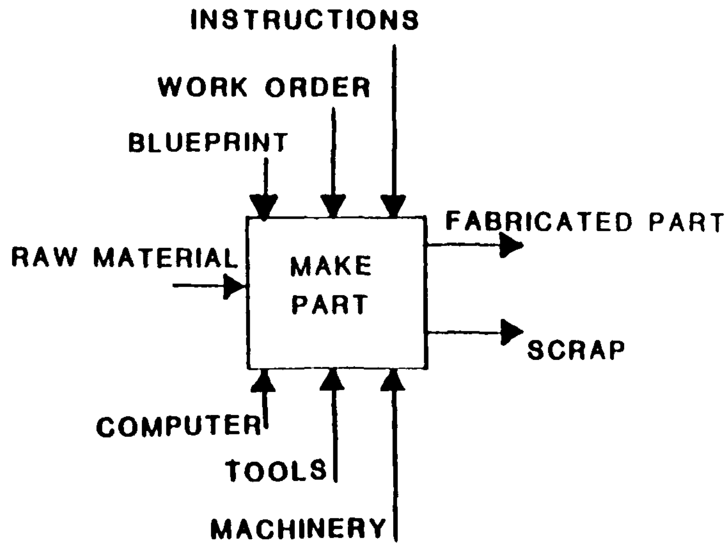
- LABELS ARE WORDS THAT NAME FUNCTIONS AND DATA
- FUNCTION LABELS ARE VERBS OR VERB PHRASES AND ARE PUT IN THE CENTER OF THE FUNCTION BOX
- DATA LABELS ARE NOUNS OR NOUN PHRASES
- DATA LABELS ARE ASSOCIATED WITH INPUT, CONTROL, OUTPUT, AND MECHANISM ARROWS
- DATA LABELS ARE PLACED AS NEAR TO THEIR RESPECTIVE ARROWS AS POSSIBLE

THE CHOICE OF WORDS IN NAMING LABELS IS CRITICAL!

AUTHORING CONCEPTS | FUNCTIONS, DATA AND LABELS



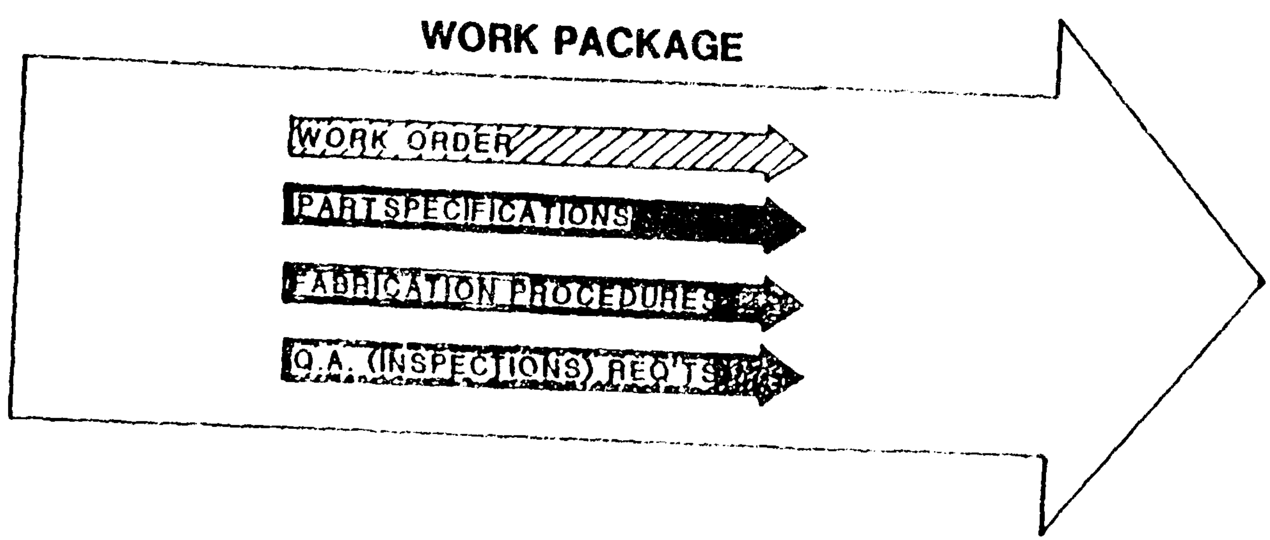
EXAMPLE:



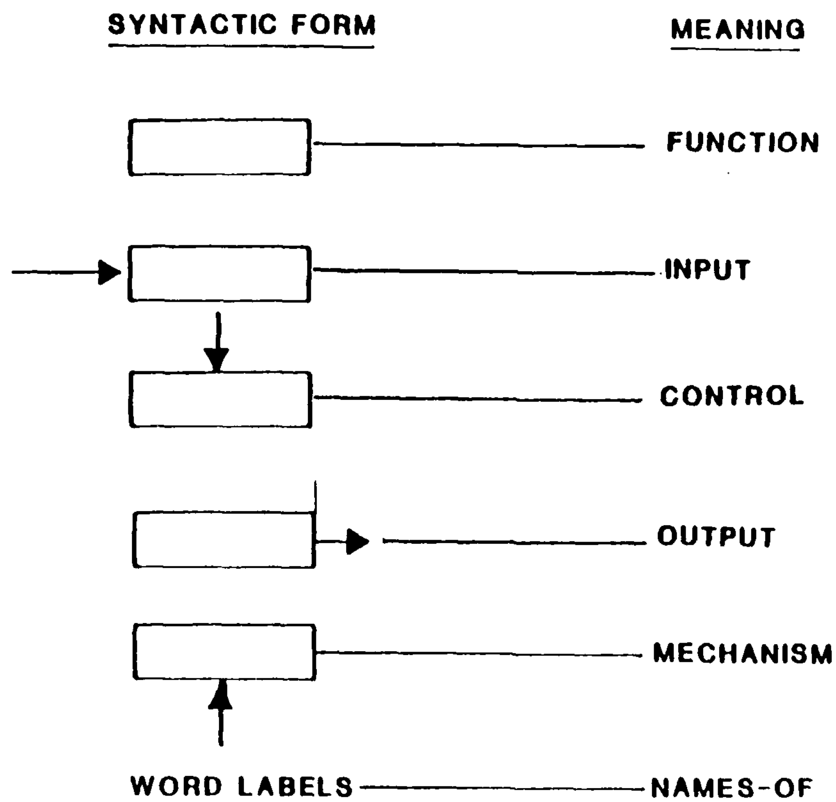
AUTHORING CONCEPTS | DATA ARROWS: "PIPELINES"

INPUT, OUTPUT, AND CONTROL ARROWS REPRESENT "CLASSES" OR "CATEGORIES" OF DATA.

ANALOGY
- PIPE LINES
- COAXIAL CABLES



AUTHORING CONCEPTS | SYNTAX COMPONENTS: REVIEW



AUTHORING CONCEPTS | EXERCISE

INSTRUCTIONS: BASED ON THE NARRATIVE, IDENTIFY TERMS WHICH DESCRIBE FUNCTIONS, INPUTS, CONTROLS, OUTPUTS, AND MECHANISMS. LIST THE TERMS IN THE APPROPRIATE SPACES BELOW.

NARRATIVE: BUILD A MODEL AIRPLANE, GIVEN A KIT WHICH CONTAINS MATERIALS AND INSTRUCTIONS. THE KIT INCLUDES THE FOLLOWING ITEMS:

- PRINTED PAMPHLET WITH STEP-BY-STEP INSTRUCTIONS
- GLUE
- RUBBER BAND (FOR PROPULSION)
- BALSA WOOD
- PAINT
- DECAL
- APPLICATORS FOR PAINT AND GLUE

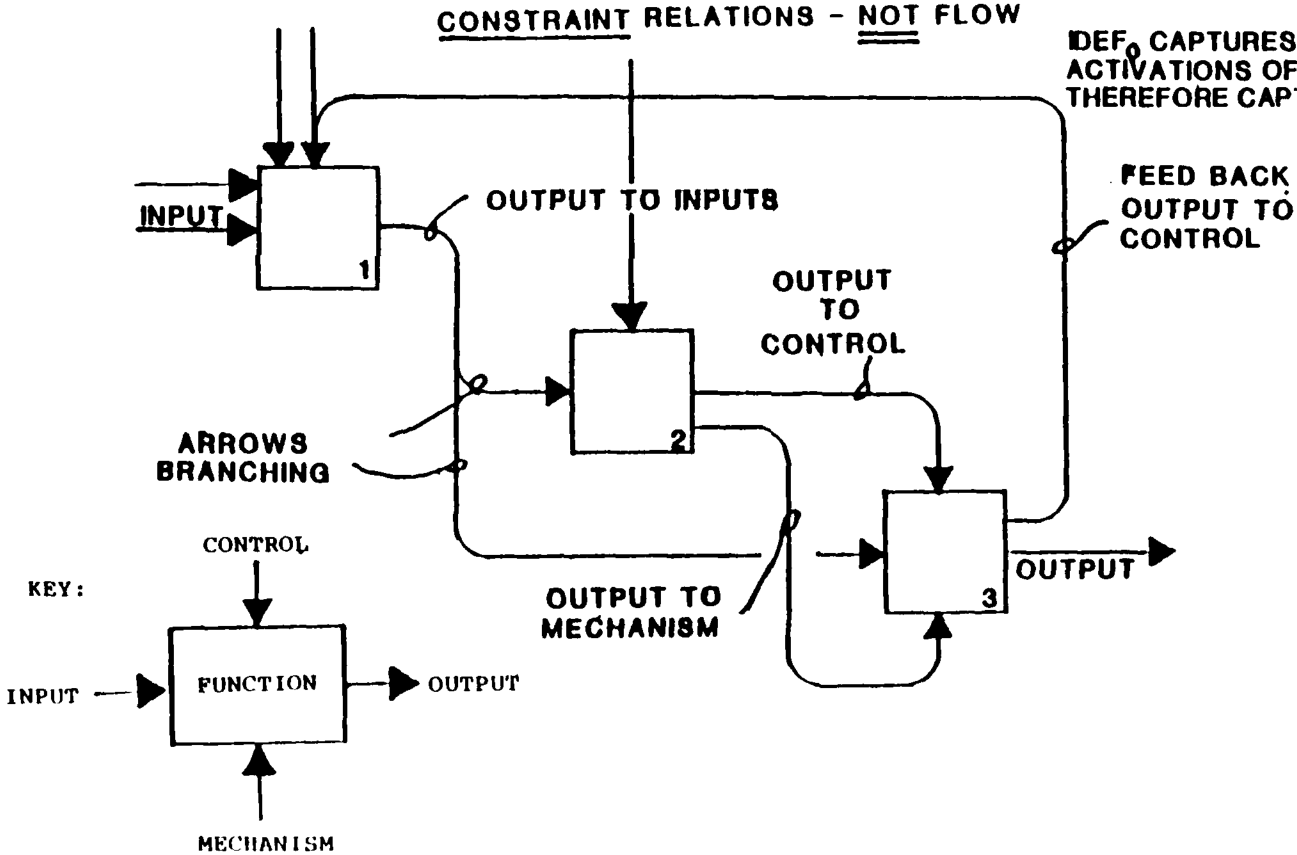
FUNCTIONS	INPUTS	CONTROLS	OUTPUTS	MECHANISMS

AUTHORING CONCEPTS | BOX AND ARROW RELATIONS: CONSTRAINTS

BOX AND ARROW CONNECTIONS SHOW

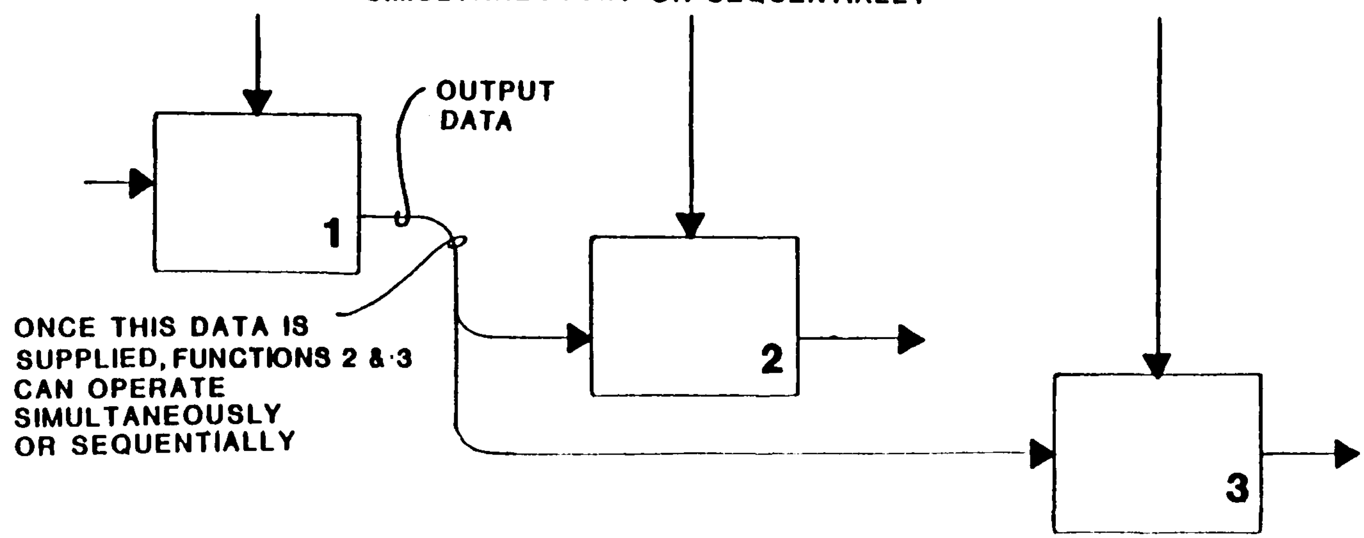
CONSTRAINT RELATIONS - NOT FLOW

IDEF$_0$ CAPTURES ALL POSSIBLE ACTIVATIONS OF FUNCTION, THEREFORE CAPTURES ALL TIME.



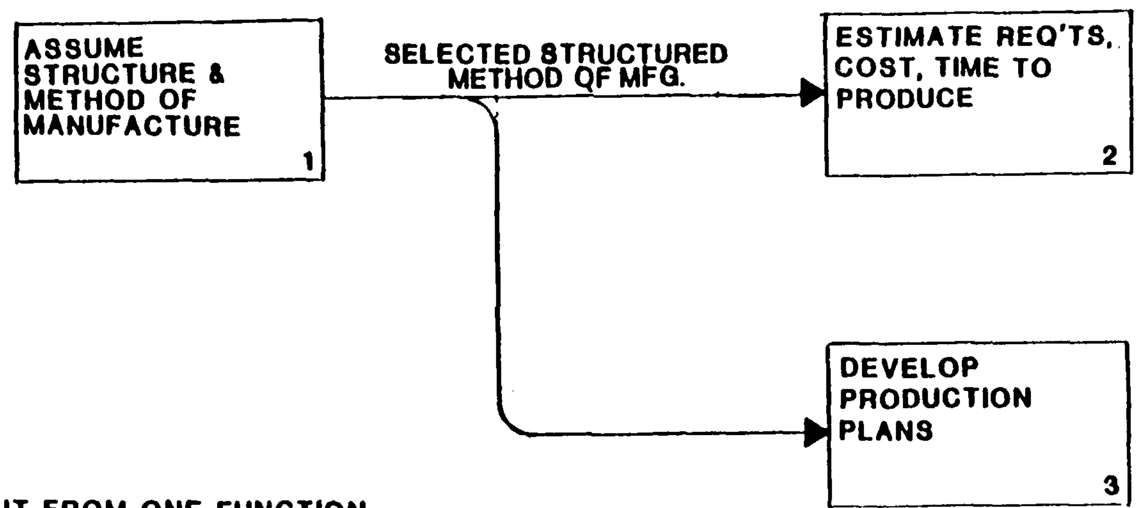
AUTHORING CONCEPTS | ARROWS: "BRANCHING"

OUTPUT CAN BRANCH AND BE USED BY TWO FUNCTIONS SIMULTANEOUSLY OR SEQUENTIALLY



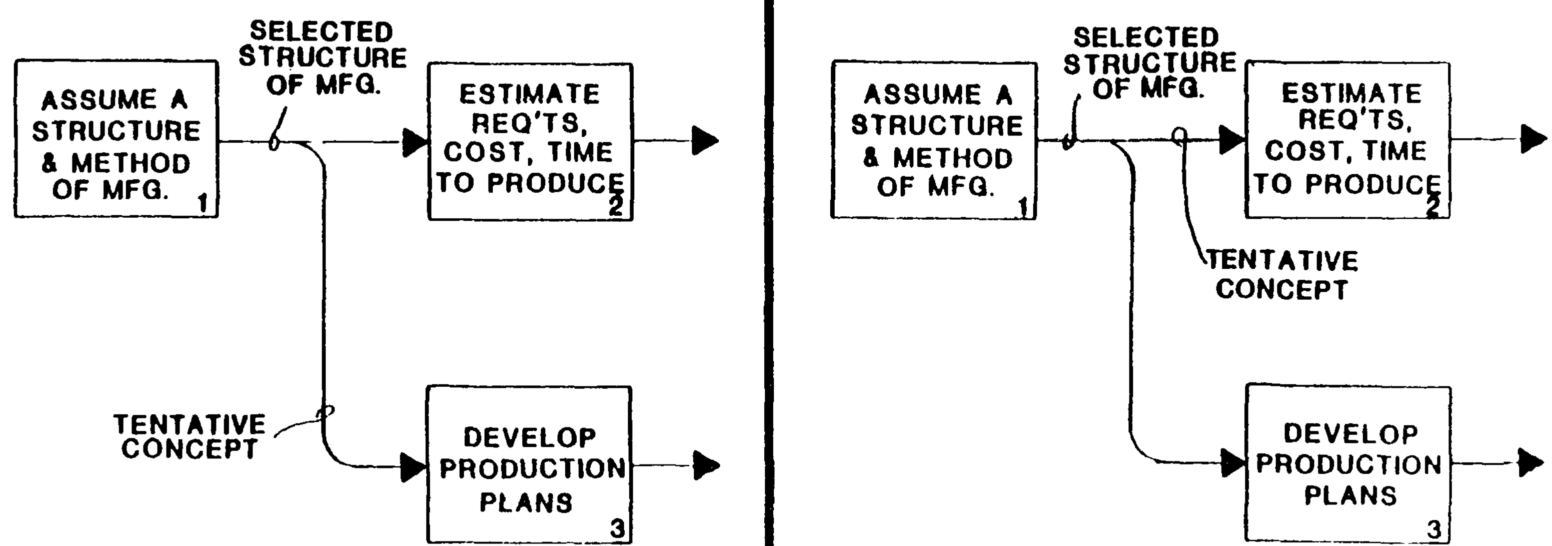
● WITHOUT LABELS WE CANNOT TELL HOW THE BRANCH OCCURS

AUTHORING CONCEPTS | ARROWS: "BRANCHING"



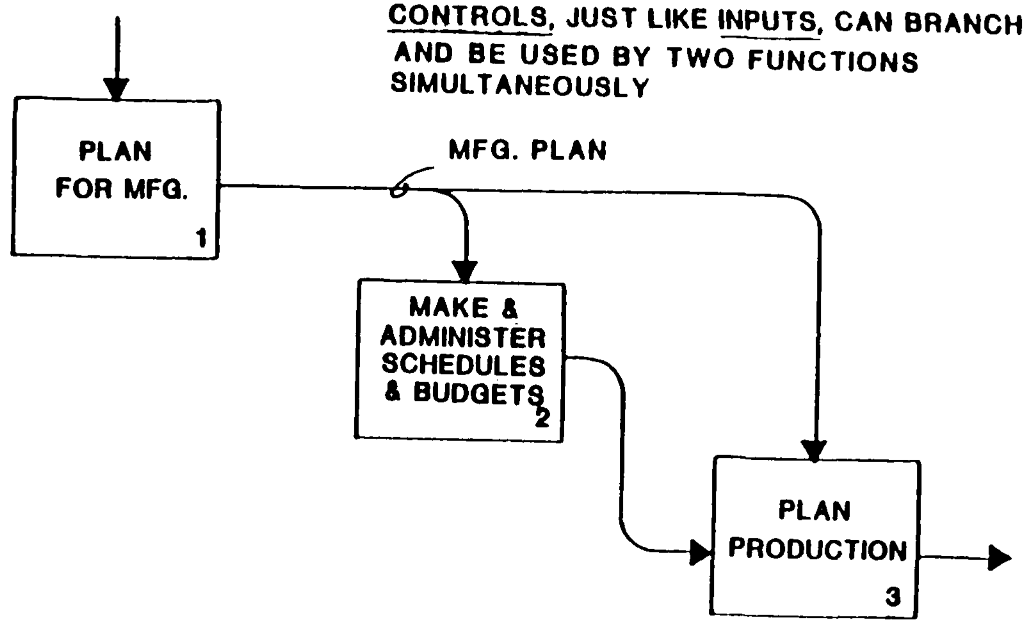
OUTPUT FROM ONE FUNCTION IN ABOVE EXAMPLE SEPARATES INTO TWO CATEGORIES AND BECOMES INPUT TO TWO OTHER FUNCTIONS

AUTHORING CONCEPTS | ARROWS -"BRANCHING"



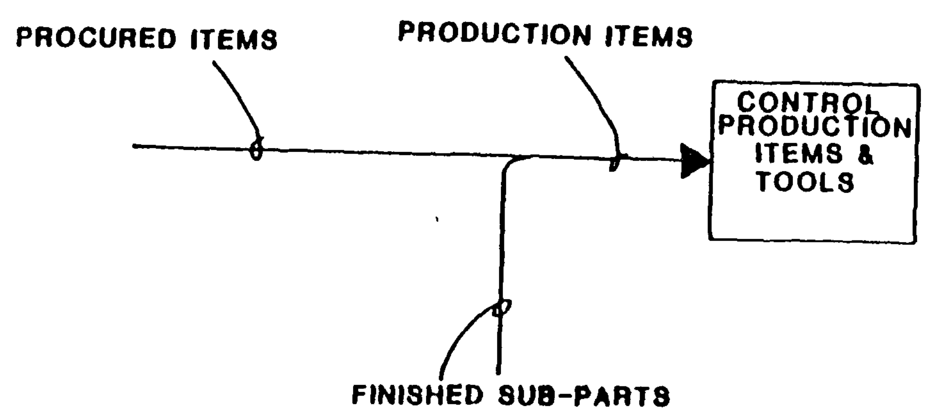
AUTHORING CONCEPTS | ARROWS: "BRANCHING"

CONTROLS, JUST LIKE INPUTS, CAN BRANCH AND BE USED BY TWO FUNCTIONS SIMULTANEOUSLY



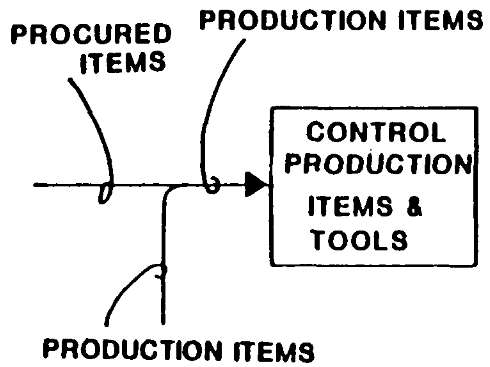
AUTHORING CONCEPTS | ARROWS - "JOINING"

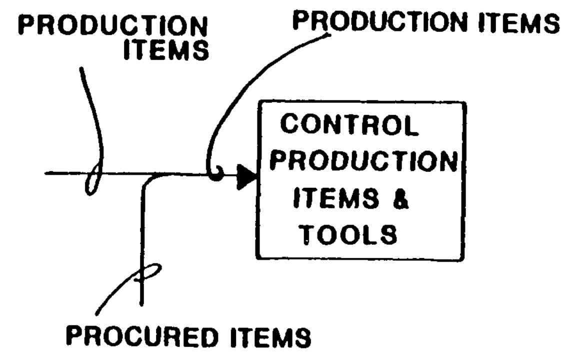
EXAMPLE:



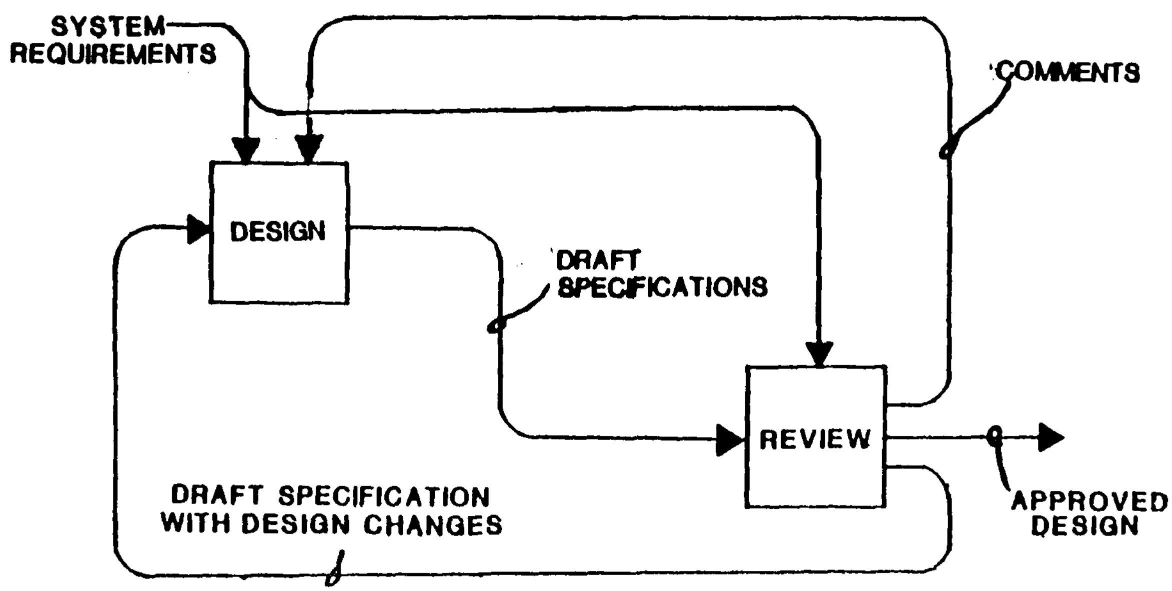
AUTHORING CONCEPTS | ARROWS - "JOINING"

OTHER VALID FORMS





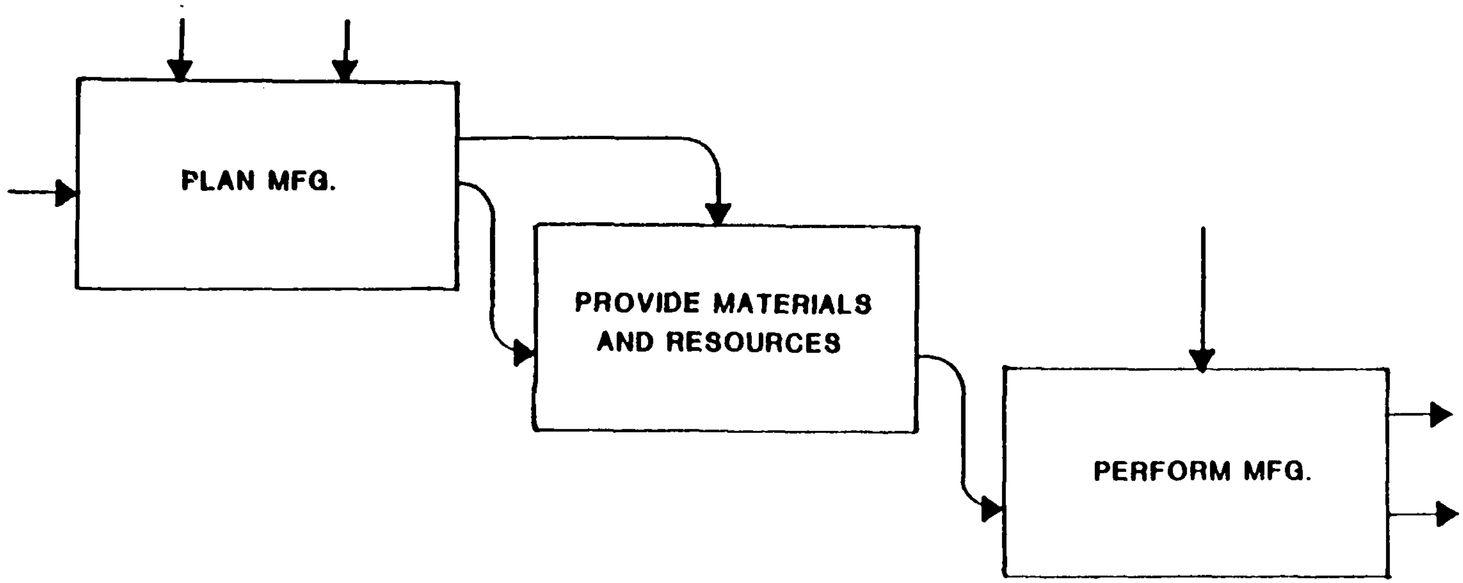
AUTHORING CONCEPTS | ARROWS-"FEEDBACK"



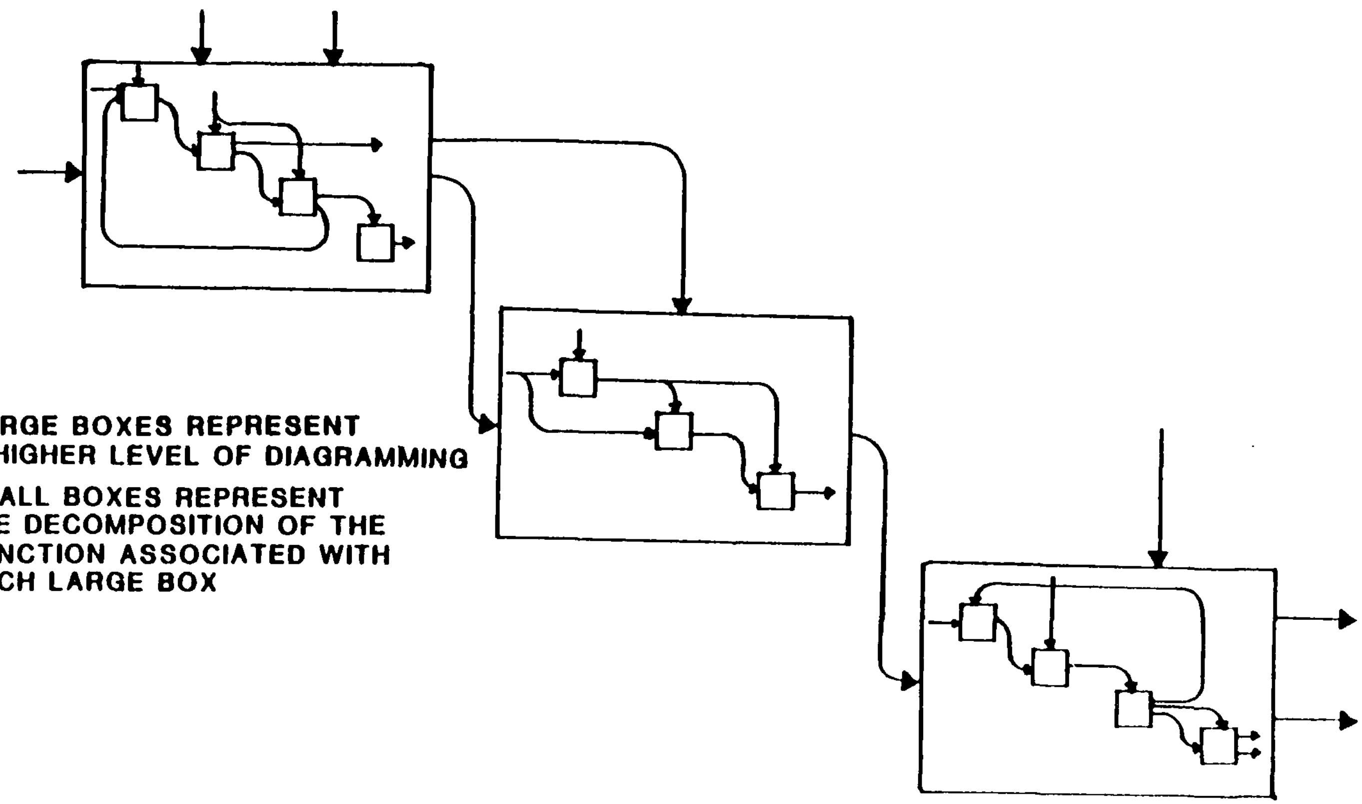
AUTHORING CONCEPTS | DECOMPOSITION

- FUNCTIONS ARE COMPRISED OF SUBFUNCTIONS
- DECOMPOSITION IS AN "EXPLOSION" OF DETAIL (LEVEL BY LEVEL)
- DATA CONSISTENCY IS REQUIRED (LEVEL BY LEVEL)
- ESTABLISHES MODEL HIERARCHY AND NODE NUMBERING

AUTHORING CONCEPTS | DECOMPOSITION



AUTHORING CONCEPTS | DECOMPOSITION



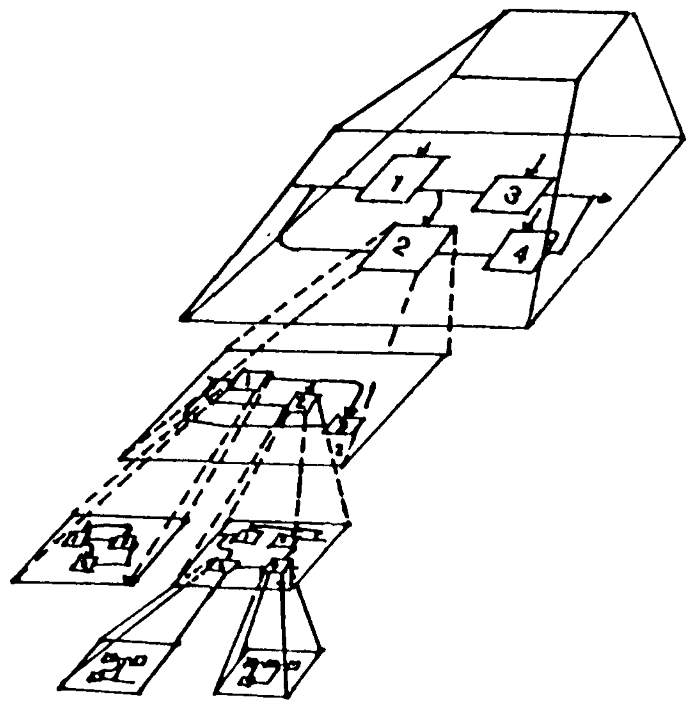
LARGE BOXES REPRESENT
A HIGHER LEVEL OF DIAGRAMMING

SMALL BOXES REPRESENT
THE DECOMPOSITION OF THE
FUNCTION ASSOCIATED WITH
EACH LARGE BOX

AUTHORING CONCEPTS | DECOMPOSITION

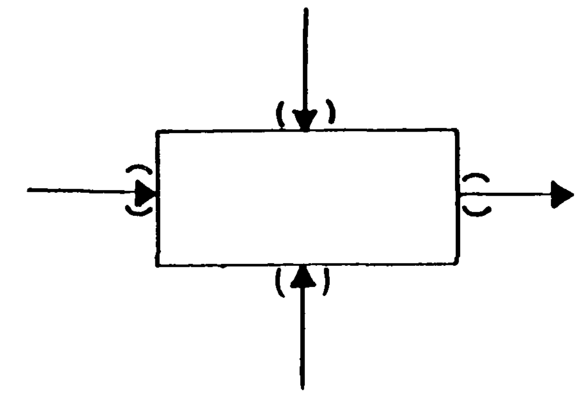
MORE GENERAL

MORE DETAILED

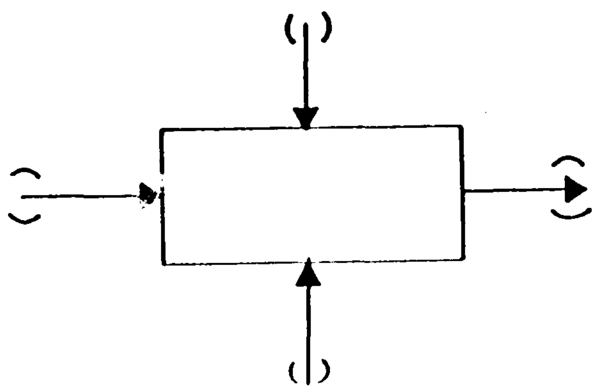


AUTHORING CONCEPTS | DECOMPOSITION

TUNNELLED ARROWS



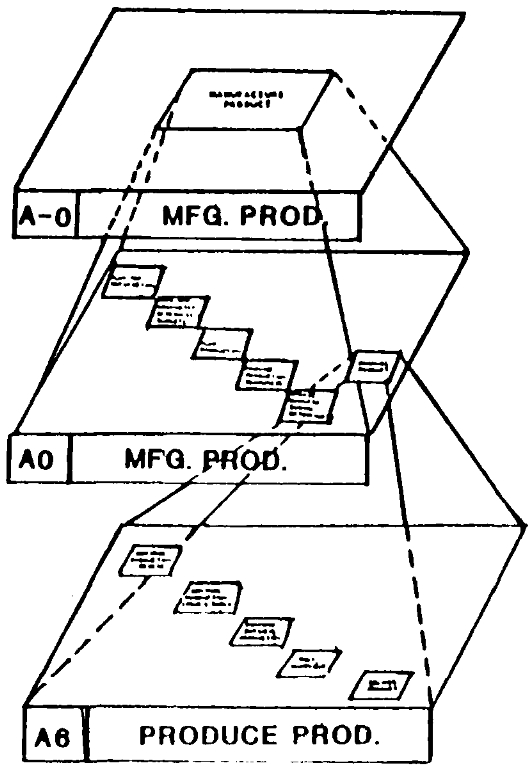
ARROW WILL NOT APPEAR
ON DECOMPOSED DIAGRAM



ARROW WILL NOT APPEAR
ON PARENT DIAGRAM

AUTHORING CONCEPTS | DECOMPOSITION

A MODEL ORGANIZES DIAGRAMS INTO A STRUCTURED DECOMPOSITION



A-0 → CONTEXT

A0 → FIRST LEVEL OF DECOMPOSITION

SECOND LEVEL OF DECOMPOSITION

AUTHORING CONCEPTS | NODE NUMBER

INDICATES

- DIAGRAM, TEXT, FEO, GLOSSARY
- LEVEL OF HIERARCHY (DECOMPOSITION)
- PARENT DIAGRAM
- LOCATION IN PARENT DIAGRAM

AUTHORING CONCEPTS | NODE NUMBER

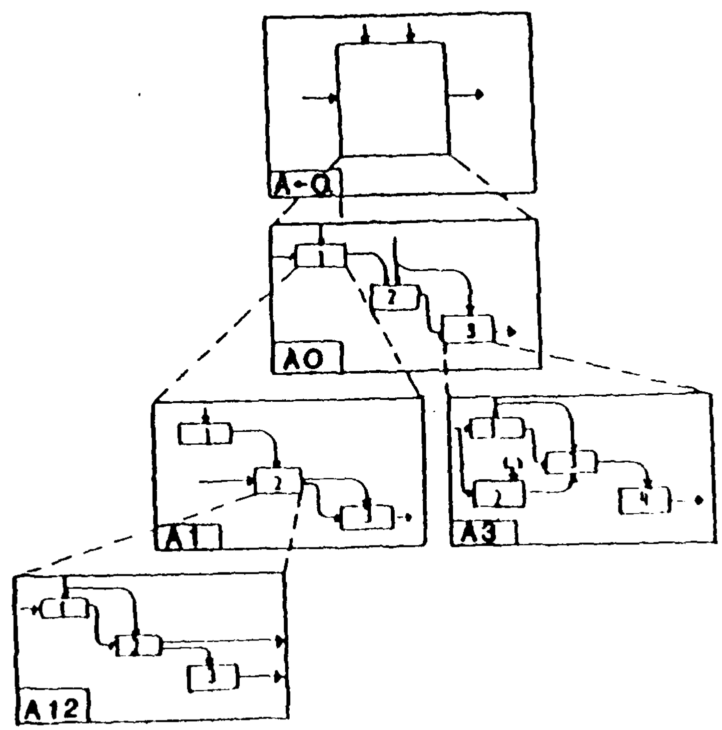
NODE NUMBER CORRESPONDS TO POSITION IN HIERARCHY

A-0 = TOP LEVEL (CONTEXT)

A0 = FIRST LEVEL

A1, A3 } PARTIAL DECOMPOSITION OF A0

A12 = PARTIAL DECOMPOSITION OF A1



AUTHORING PROCEDURES | PROCESS

- DEFINE CONTEXT, VIEWPOINT AND PURPOSE
- BOUND THE CONTEXT
- COLLECT DATA
- LIST DATA AND FUNCTIONS
- CLUSTER DATA AND FUNCTIONS
- SKETCH DATA AND ARROWS (LAYOUT)
- REFINE LAYOUT
- CONSTRUCT FEO'S, TEXT, AND GLOSSARY WHERE NEEDED

AUTHORING PROCEDURES | ORIENTATION OF MODELS

DEFINITIONS:

- <u>CONTEXT</u> (SUBJECT)

  THE SCOPE OR BOUNDARIES OF THE SUBJECT MATTER

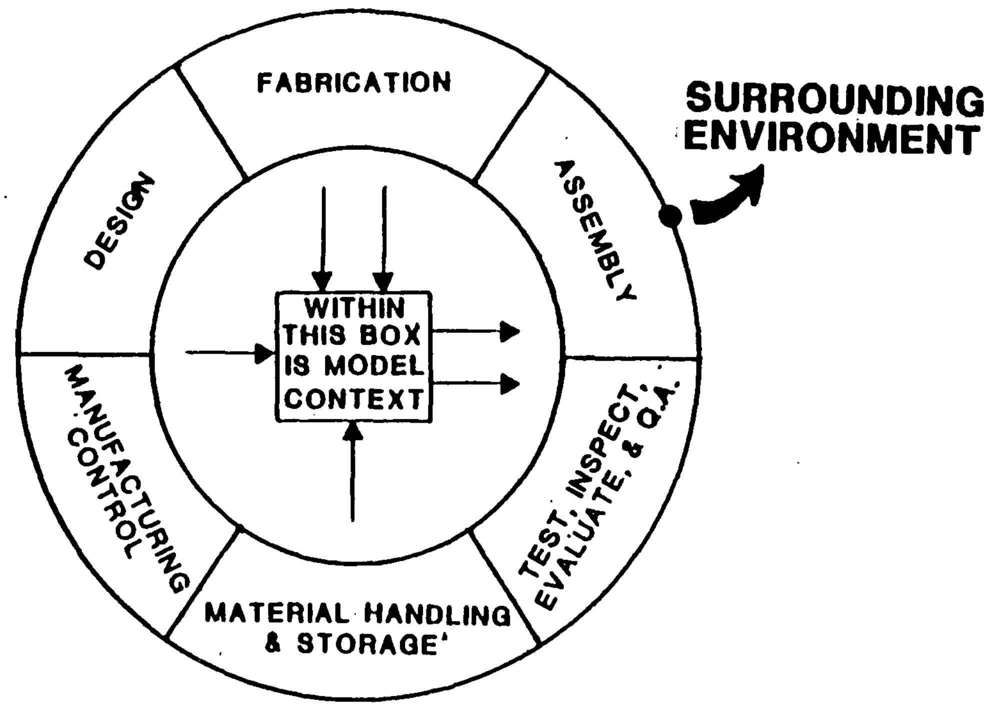
- <u>VIEWPOINT</u> (BIAS)

  THE PERSPECTIVE FROM WHICH A SUBJECT IS ANALYZED

- <u>PURPOSE</u> (OBJECTIVE)

  THE REASON(S) A MODEL IS CREATED: THE WAYS THAT IT COULD BE USED

AUTHORING PROCEDURES | **BOUND THE CONTEXT**



THE INPUTS, CONTROLS, OUTPUTS, AND MECHANISMS DEFINE THE INTERFACE BETWEEN THE MODEL CONTEXT AND THE SURROUNDING ENVIRONMENT.

AUTHORING PROCEDURES | DATA COLLECTION

HOW:

- READ RELEVANT REFERENCE MATERIAL
- INTERVIEW EXPERTS
- OBSERVE THE SYSTEM IN PROGRESS

AUTHORING PROCEDURES | DATA COLLECTION

WHAT:

- DEFINITIONS
- FUNCTIONS
- DATA

AUTHORING PROCEDURES | LIST DATA AND FUNCTIONS

USED AT: | AUTHOR: C. Menken | DATE: 9/19/79 | [x] WORKING | READER | DATE | CONTEXT:
PROJECT: MCS | REV: | DRAFT
NOTES: 1 2 3 4 5 6 7 8 9 10 | | RECOMMENDED
| | PUBLICATION

Data

Shop Orders
Shop Order Form
Raw Material Inventory
Shelf Quantity
Material Losses
Material Shortage Reports

Shop load
Budget
Dates for Release
Shops Capacity
Ordering Errors
Revised Orders
Notice of Revisions

Production Requirements
Company Specifications

Functions

Review Shoporders
Review Material Inventories
Calculate Shop Capacity
Estimate Load
Review Shortages

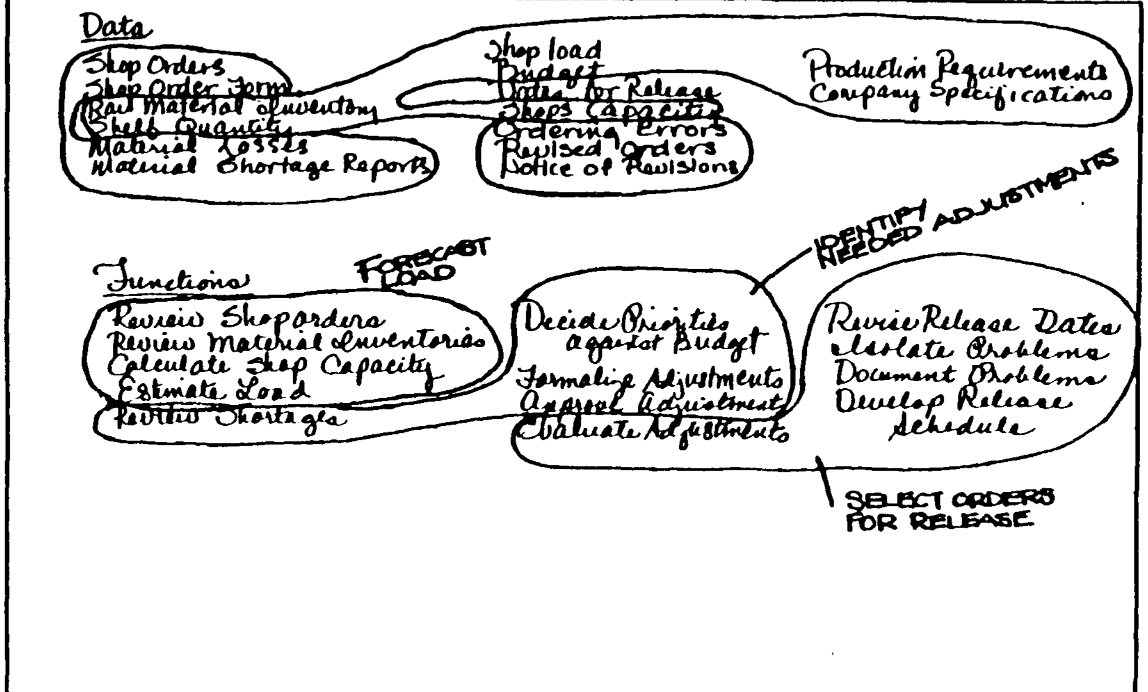
Decide Priorities against Budget
Formalize Adjustments
Approve Adjustments
Evaluate Adjustments

Revise Release Dates
Isolate Problems
Document Problems
Develop Release Schedule

NODE: AO F1 | TITLE: Adjust Release Schedule | NUMBER: Cm -

AUTHORING PROCEDURES | CLUSTER DATA AND FUNCTIONS

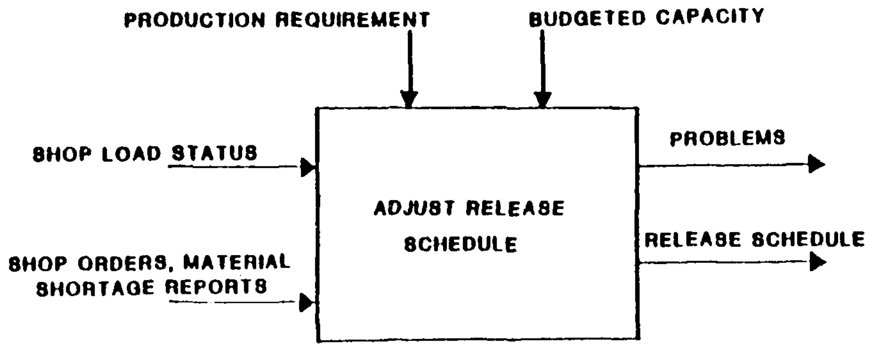
USED AT:	AUTHOR: C. Menken PROJECT: MCS NOTES: 1 2 3 4 5 6 7 8 9 10	DATE: 9/19/79 REV:	X WORKING / DRAFT / RECOMMENDED / PUBLICATION	READER DATE	CONTEXT:



NODE: A0 F1	TITLE: Adjust Release Schedule	NUMBER: Cm -

AUTHORING PROCEDURES | A-O DIAGRAM

USED AT: | AUTHOR: | PROJECT: | DATE: | REV: | NOTES: 1 2 3 4 5 6 7 8 9 10 | WORKING | DRAFT | RECOMMENDED | PUBLICATION | READER | DATE | CONTEXT:

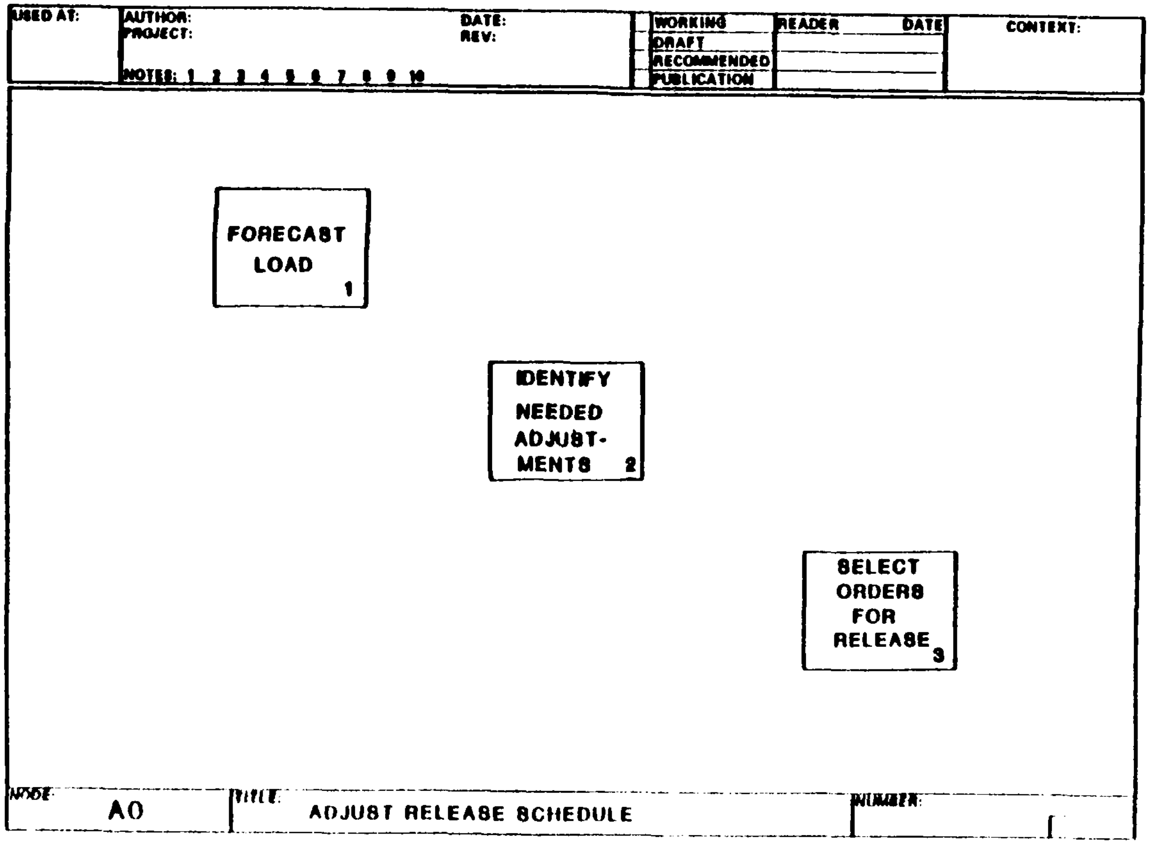


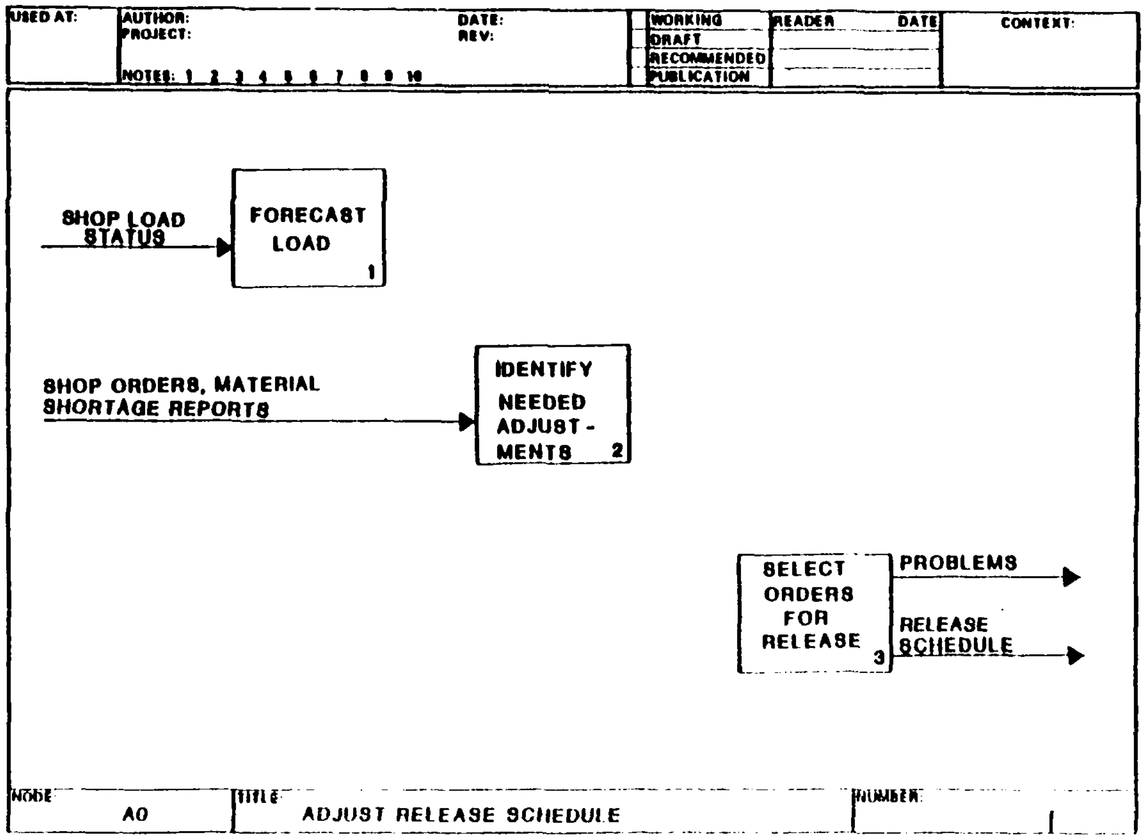
PURPOSE: TO IDENTIFY POINTS IN THE SCHEDULING PROCESS WHICH MAY CAUSE OR FAIL TO ANTICIPATE SLIPPAGES

VIEWPOINT: MANAGER OF PRODUCTION PLANNING AND CONTROL

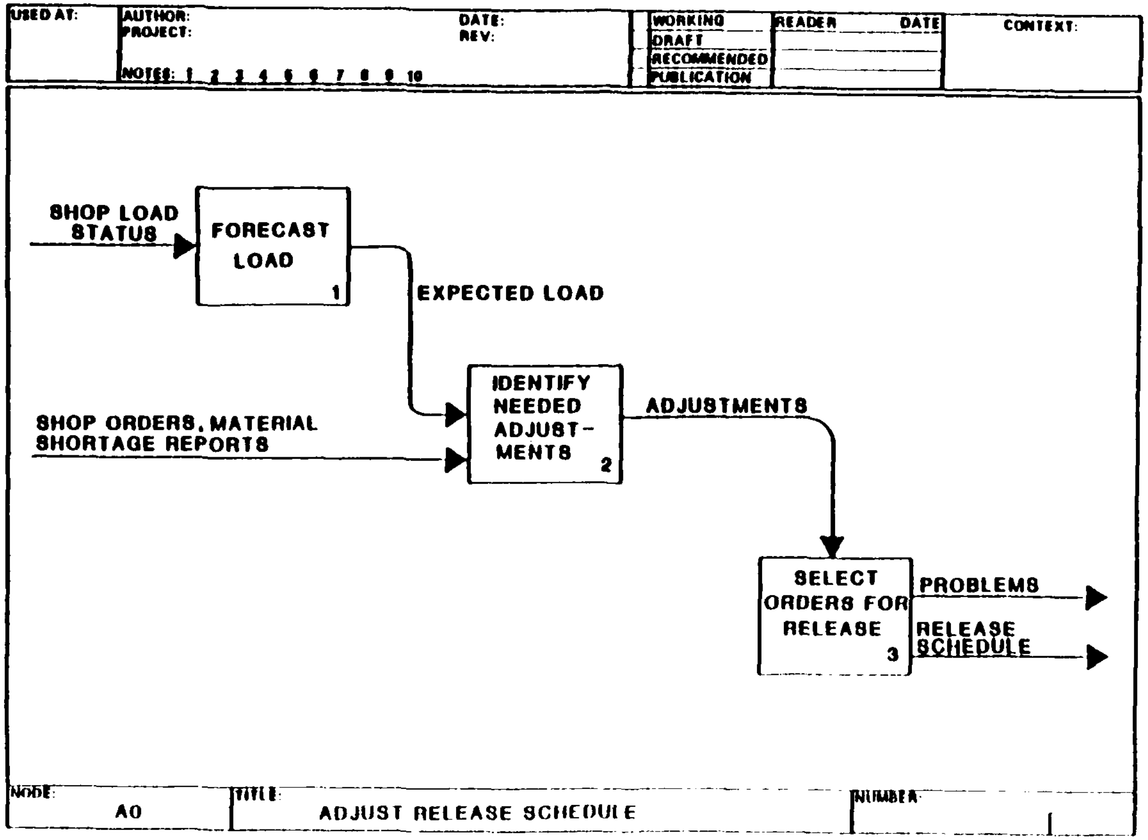
NODE: A-0 | TITLE: CONTEXT. ADJUST RELEASE SCHEDULE | NUMBER:

AUTHORING PROCEDURES | LAY OUT DIAGRAM

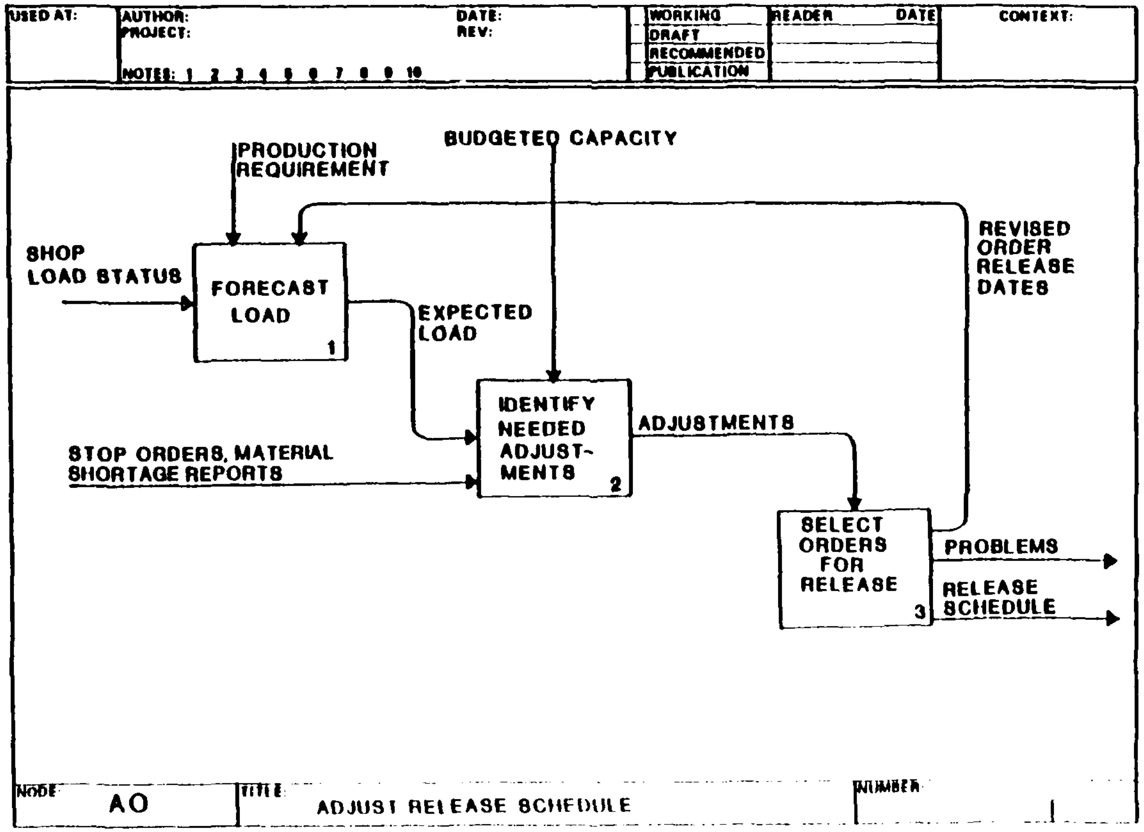



USED AT:
AUTHOR:
PROJECT:
NOTES: 1 2 3 4 5 6 7 8 9 10
DATE:
REV:
WORKING
DRAFT
RECOMMENDED
PUBLICATION
READER
DATE
CONTEXT:
SHOP LOAD STATUS
FORECAST LOAD 1
SHOP ORDERS, MATERIAL SHORTAGE REPORTS
IDENTIFY NEEDED ADJUST-MENTS 2
SELECT ORDERS FOR RELEASE 3
PROBLEMS
RELEASE SCHEDULE
NODE: A0
TITLE: ADJUST RELEASE SCHEDULE
NUMBER:

AUTHORING PROCEDURES | LAY OUT DIAGRAM



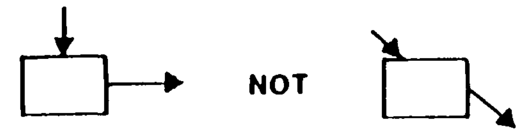
AUTHORING PROCEDURES | LAY OUT DIAGRAM



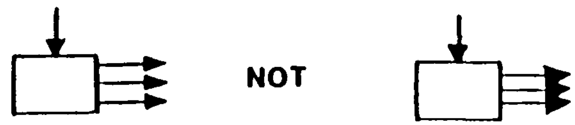
AUTHORING PROCEDURES | REFINE LAYOUT

ARROW LAYOUT AFFECTS READABILITY

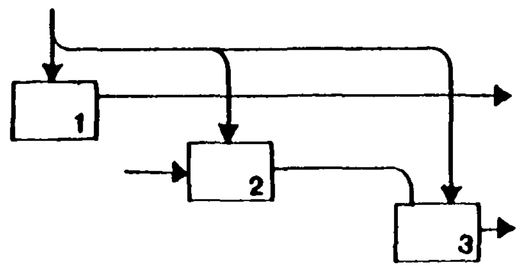
1. DRAW ARROWS ALONG VERTICAL AND HORIZONTAL LINES



2. SPACE PARALLEL ARROWS ADEQUATELY

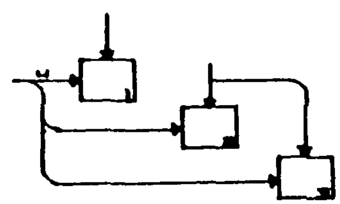


3. PLACE ARROWS AND INTERSECTIONS A REASONABLE DISTANCE AWAY FROM BOXES AND EACH OTHER

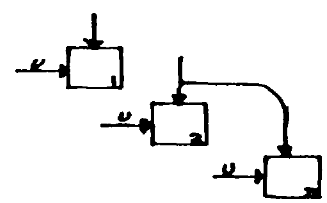


AUTHORING PROCEDURES | REFINE LAYOUT

4. CONNECT OPEN-ENDED (PARENT) ARROWS TO SHOW ALL THE PLACES AFFECTED



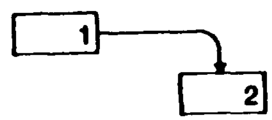
NOT



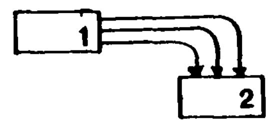
5. DON'T USE THE KEY WORDS (DATA, FUNCTION, OUTPUT, ETC.) IN LABELING ARROWS AND BOXES

AUTHORING PROCEDURES | REFINE LAYOUT

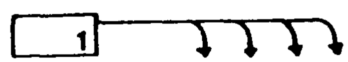
6. BUNDLE ARROWS WITH THE SAME SOURCE AND THE SAME DESTINATION IF AND WHEN IT IS REASONABLE



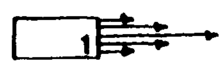
RATHER THAN



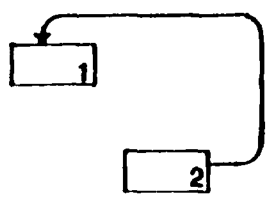
7. ON ANY SIDE OF A BOX, IT IS BETTER TO HAVE NO MORE THAN FOUR ARROWS



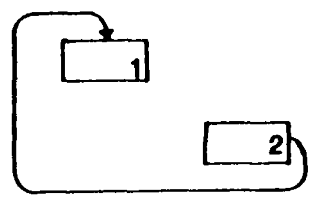
RATHER THAN



8. CONTROL FEED-BACKS SHOULD BE SHOWN AS "UP AND OVER"

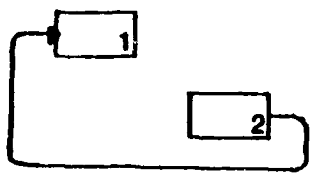


RATHER THAN

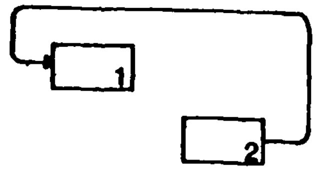


AUTHORING PROCEDURES | REFINE LAYOUT

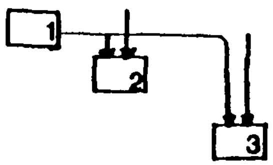
9. INPUT FEED-BACKS SHOULD BE SHOWN AS "DOWN AND UNDER"



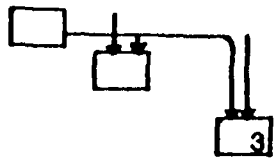
RATHER THAN



10. IF AN ARROW BRANCHES AND FEEDS INTO SEVERAL BOXES, DRAW IT AT THE SAME RELATIVE POSITION

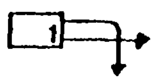


RATHER THAN



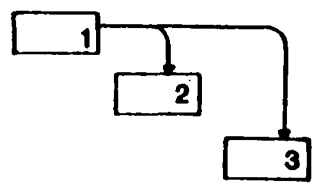
11. DON'T CROSS ARROWS IF POSSIBLE

RATHER THAN

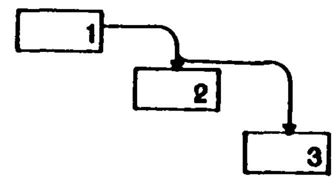


AUTHORING PROCEDURES | REFINE LAYOUT

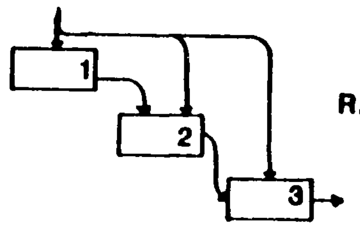
12. MINIMIZE CURVES



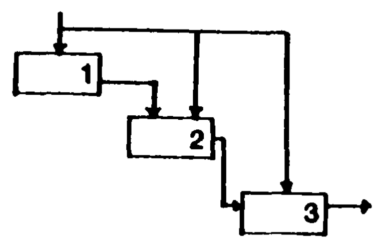
RATHER THAN



13. ROUND CORNERS

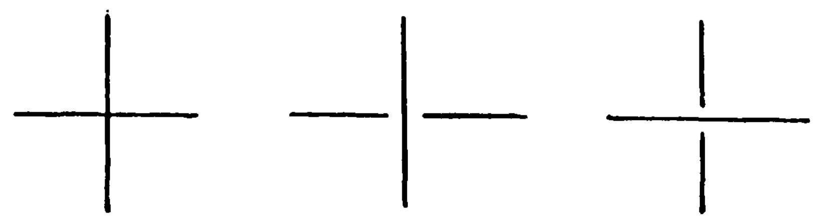


RATHER THAN

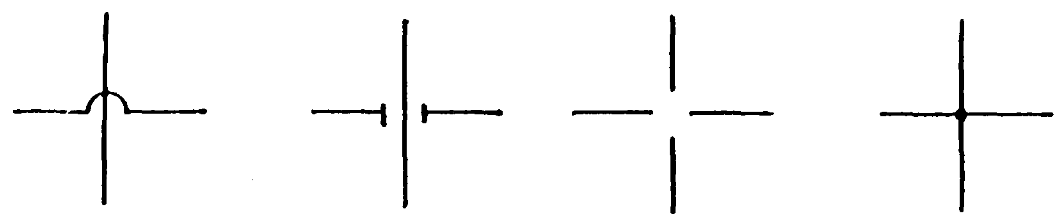


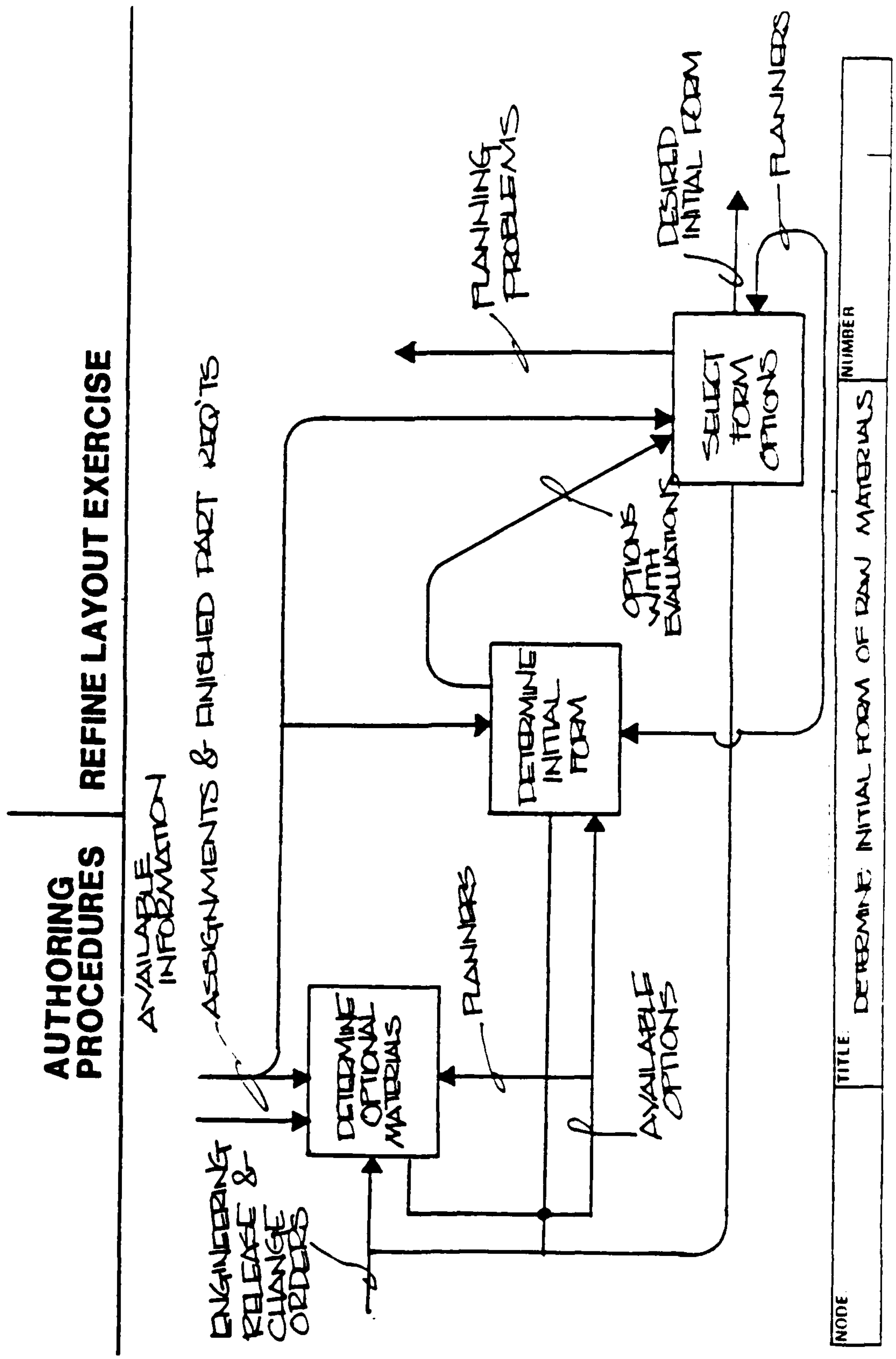
AUTHORING PROCEDURES | REFINE LAYOUT

ALLOWED



NOT ALLOWED




AUTHORING PROCEDURES
REFINE LAYOUT EXERCISE
AVAILABLE INFORMATION
ASSIGNMENTS & FINISHED PART REQ'TS
ENGINEERING RELEASE & CHANGE ORDERS
DETERMINE OPTIONAL MATERIALS
PLANNERS
AVAILABLE OPTIONS
DETERMINE INITIAL FORM
OPTIONS WITH EVALUATIONS
SELECT FORM OPTIONS
PLANNING PROBLEMS
DESIRED INITIAL FORM
PLANNERS
NODE
TITLE: DETERMINE INITIAL FORM OF RAW MATERIALS
NUMBER

AUTHORING PROCEDURES

REFINE LAYOUT EXERCISE

USED AT:	AUTHOR: PROJECT: NOTES: 1 2 3 4 5 6 7 8 9 10	DATE: REV:	WORKING DRAFT RECOMMENDED PUBLICATION	READER	DATE	CONTEXT:

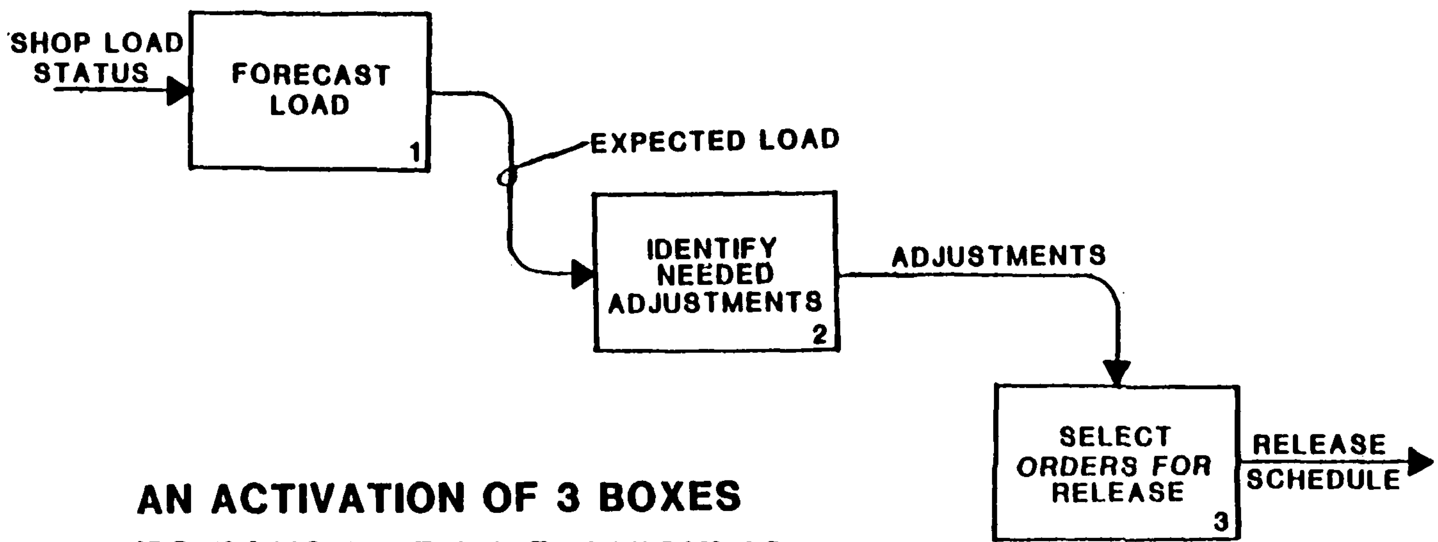
NODE:	TITLE:	NUMBER:

AUTHORING PROCEDURES | FEO (FOR EXPOSITION ONLY)

A FEO:

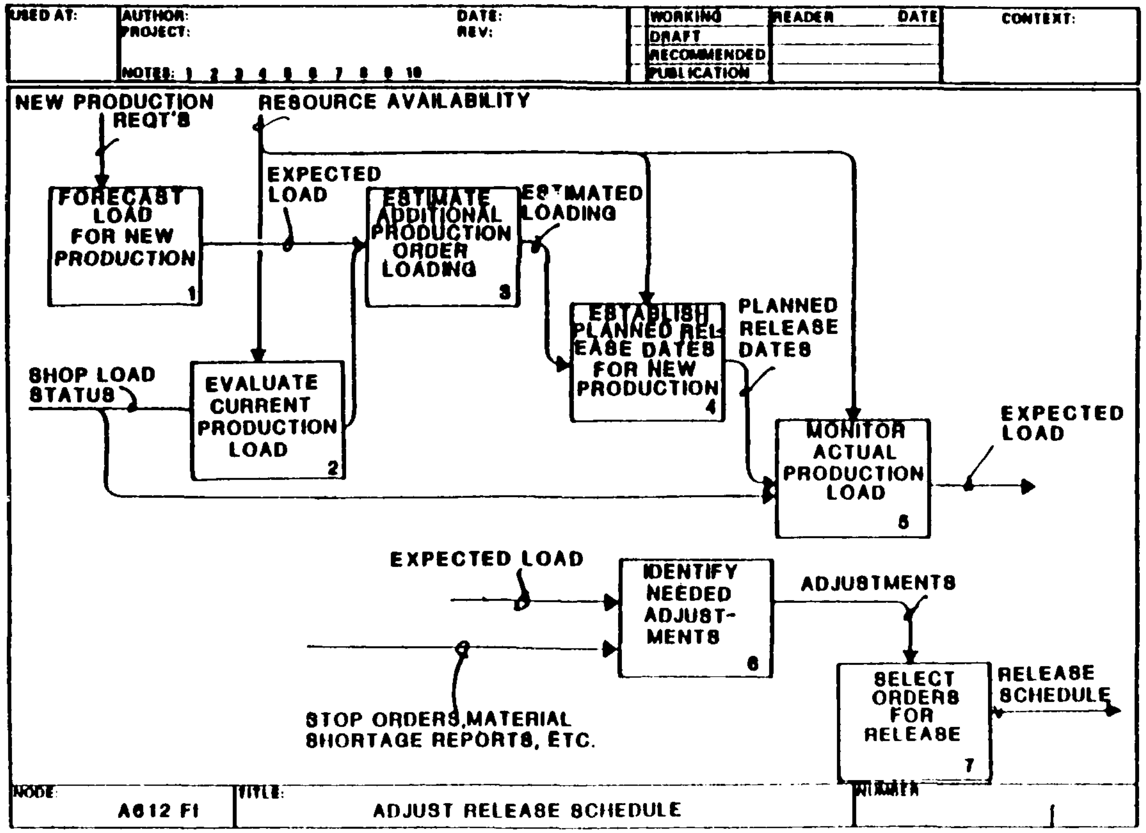
- IS USED BY THE AUTHOR
  - TO ILLUSTRATE A POINT
  - TO CLARIFY A DIAGRAM
- IS A DIAGRAM THAT FALLS OUTSIDE THE STRICT HIERARCHY
- MAY CONTAIN MORE THAN SIX BOXES AND HAVE PARTIAL ARROW STRUCTURE i.e. VIOLATE $IDEF_0$ (FUNCTION MODEL) SYNTAX
- MAY USE OTHER METHODOLOGIES i.e. PERT, CPM, etc.

AUTHORING PROCEDURES | FEO (FOR EXPOSITION ONLY) EXAMPLE



AN ACTIVATION OF 3 BOXES TO ILLUSTRATE A PARTICULAR SCENARIO.

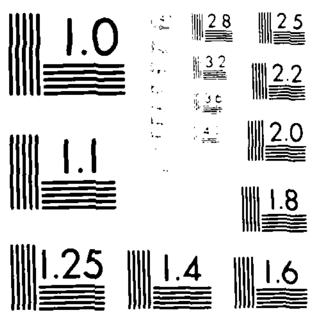
AUTHORING PROCEDURES | FEO (FOR EXPOSITION ONLY) EXAMPLE



AD-A144 732 INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM) ARCHITECTURE PART 3 VOLUME..(U) SOFTECH INC WALTHAM MA A W SNODGRASS SEP 83 1080-37

4/6

UNCLASSIFIED AFWAL-TR-82-4063-PT-3-VOL-8 F/G 13/8 NL



MICROCOPY RESOLUTION TEST CHART

AUTHORING PROCEDURES | TEXT

USED AT:	AUTHOR: PROJECT: NOTES: 1 2 3 4 5 6 7 8 9 10	DATE: REV:	WORKING DRAFT RECOMMENDED PUBLICATION	READER	DATE	CONTEXT:

TEXT

A612 FI - IS A FEO (FOR EXPOSITION ONLY) DIAGRAM REPRESENTING A CLARIFICATION VIEW OF DIAGRAM A612, ADJUST RELEASE SCHEDULE. THE A612 FEO SHOWS AN EXPANDED VIEW OF ADJUST RELEASE SCHEDULE FOR READER'S CLARIFICATION.

A612 FI - SHOWS THE STEPS INVOLVED IN ADJUSTING THE SHOP LOAD FOR ACTUAL CONDITIONS. BASED ON THE PRODUCTION REQUIREMENTS AND EXISTING LOAD, A FORECASTED LOAD IS DETERMINED ON THE SHOP TO MEET THE NEW PRODUCTIONS REQUIREMENTS.

THESE ADJUSTMENTS TAKE THE FORM OF REVISED SCHEDULING IN THE SHOP DUE TO SHIFTING OF THE LOAD DATES, SHOP ORDERS , AND MATERIAL SHORTAGES.

NODE:	TITLE:	NUMBER:
A612FITI	ADJUST RELEASE SCHEDULE TEXT	

AUTHORING PROCEDURES | GLOSSARY

USED AT:	AUTHOR: PROJECT: NOTES: 1 2 3 4 5 6 7 8 9 10	DATE: REV:	WORKING / DRAFT / RECOMMENDED / PUBLICATION	READER	DATE	CONTEXT:

GLOSSARY:

EXPECTED LOAD - LOAD AS FORECASTED FOR NEW PRODUCTION.

ADJUSTMENTS - ADJUSTED LOAD FOR ACTUAL NEW PRODUCTION LOAD CONDITION.

MATERIAL SHORTAGE REPORTS - REPORT CONSISTING OF NEW PROMISE DATES, LOT EFFECTIVITY AND WORK BREAKDOWN STRUCTURE IMPACT FOR SHORTAGE ITEMS.

RESOURCE AVAILABILITY - MANPOWER, MACHINE, EQUIPMENT, AND/OR PROCESS AVAILABILITY.

ESTIMATED LOADING - THE ESTIMATE OF SHOP LOAD CONDITIONS FOR NEW PRODUCTION ORDER LOADING.

PLANNED RELEASE DATES - DATES PLANNED FOR RELEASE OF NEW PRODUCTION ORDERS BASED ON CURRENT PRODUCTION LOAD AND FORCASTED LOAD REQUIREMENTS.

SHOP LOAD STATUS - CURRENT AVAILABILITY OF SHOP LOAD.

RELEASE SCHEDULE- SCHEDULE FOR RELEASE ORDERS FOR NEW PRODUCTION.

NEW PRODUCTION REQUIREMENTS - REQUIREMENTS FOR MANHOURS, MATERIALS, EQUIPMENT, PROCESSES FOR NEW PRODUCTION.

NODE:	TITLE:	NUMBER:
A612F1G1	ADJUST RELEASE SCHEDULE GLOSSARY	

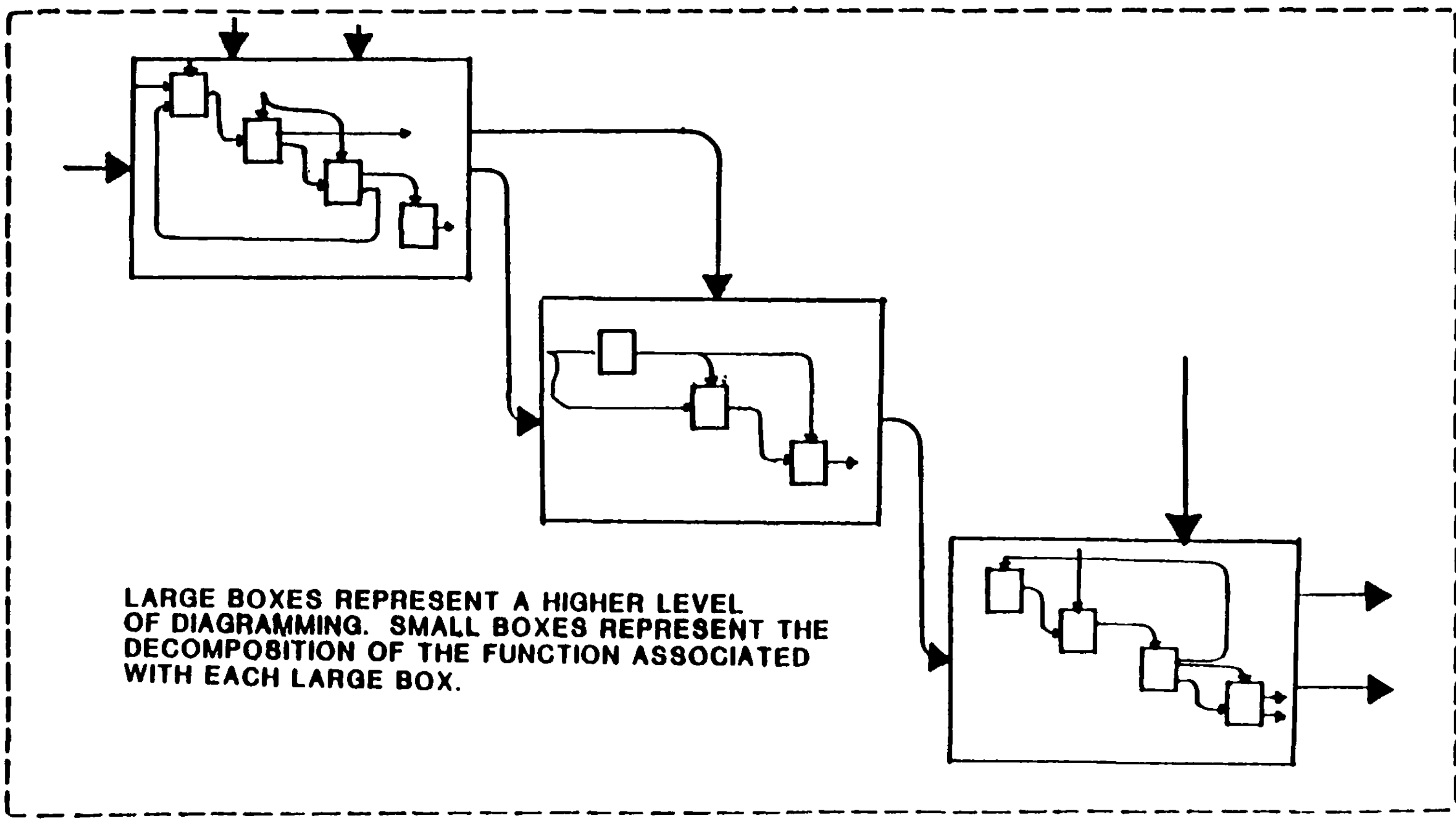
AUTHORING PROCEDURES | DECOMPOSITION

- AUTHOR A DIAGRAM
- VERIFY AND REFINE
- DECOMPOSE AND ITERATE

AUTHORING PROCEDURES | DECOMPOSITION PROCESS

- CHOOSE BOX FOR DECOMPOSITION
- COLLECT DATA
- BOUND CONTEXT
- CLUSTER DATA AND FUNCTIONS
- SKETCH BOXES AND ARROWS (LAY OUT DIAGRAM)
- REFINE LAYOUT
- CONFIRM INTERFACE WITH PARENT
- SEND OUT KIT FOR REVEW (VERIFY)

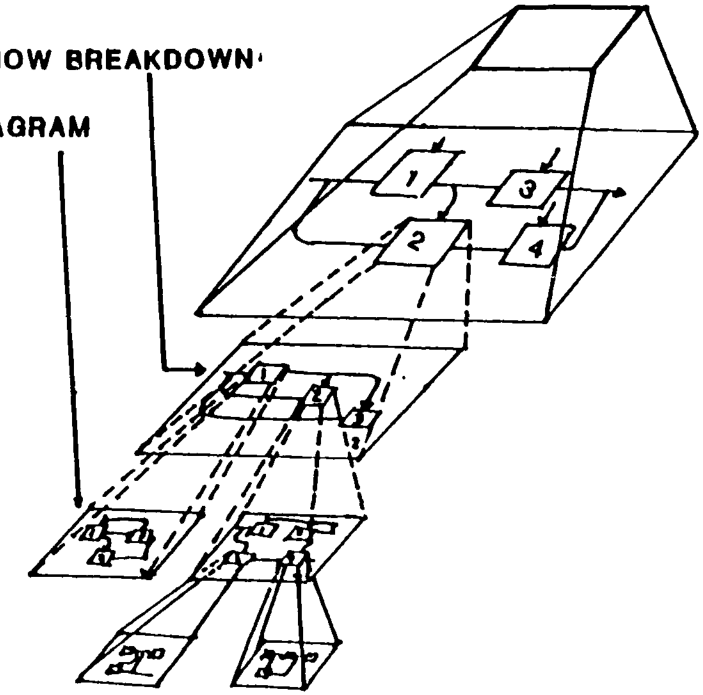
AUTHORING PROCEDURES | DECOMPOSITION



LARGE BOXES REPRESENT A HIGHER LEVEL OF DIAGRAMMING. SMALL BOXES REPRESENT THE DECOMPOSITION OF THE FUNCTION ASSOCIATED WITH EACH LARGE BOX.

AUTHORING PROCEDURES | DECOMPOSITION

NUMBERED BOXES SHOW BREAKDOWN
OF SINGLE BOX
IN MORE GENERAL DIAGRAM

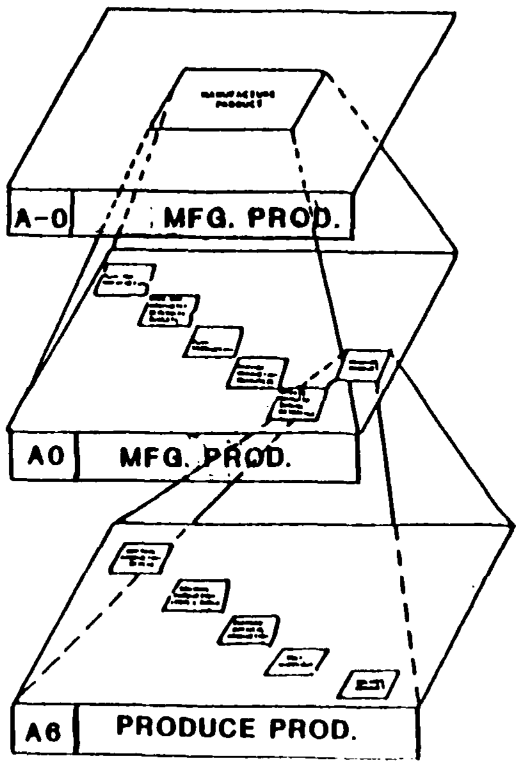


MORE GENERAL

MORE DETAILED

AUTHORING PROCEDURES

DECOMPOSITION



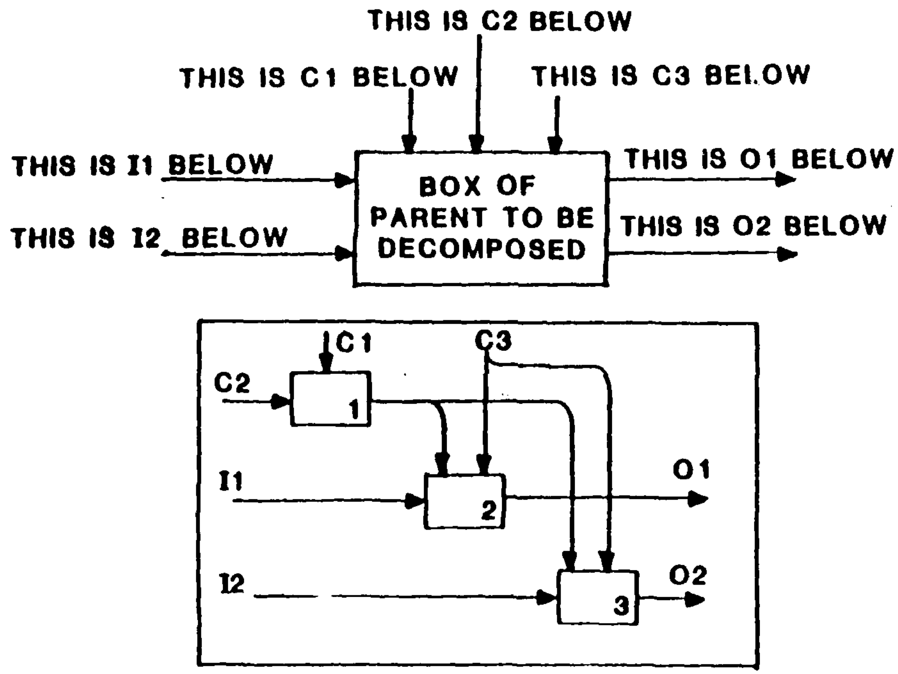
A MODEL ORGANIZES DIAGRAMS INTO A STRUCTURED DECOMPOSITION

A-0 ⟶ CONTEXT

A0 ⟶ FIRST LEVEL OF DECOMPOSITION

SECOND LEVEL OF DECOMPOSITION

AUTHORING PROCEDURES | DECOMPOSITION

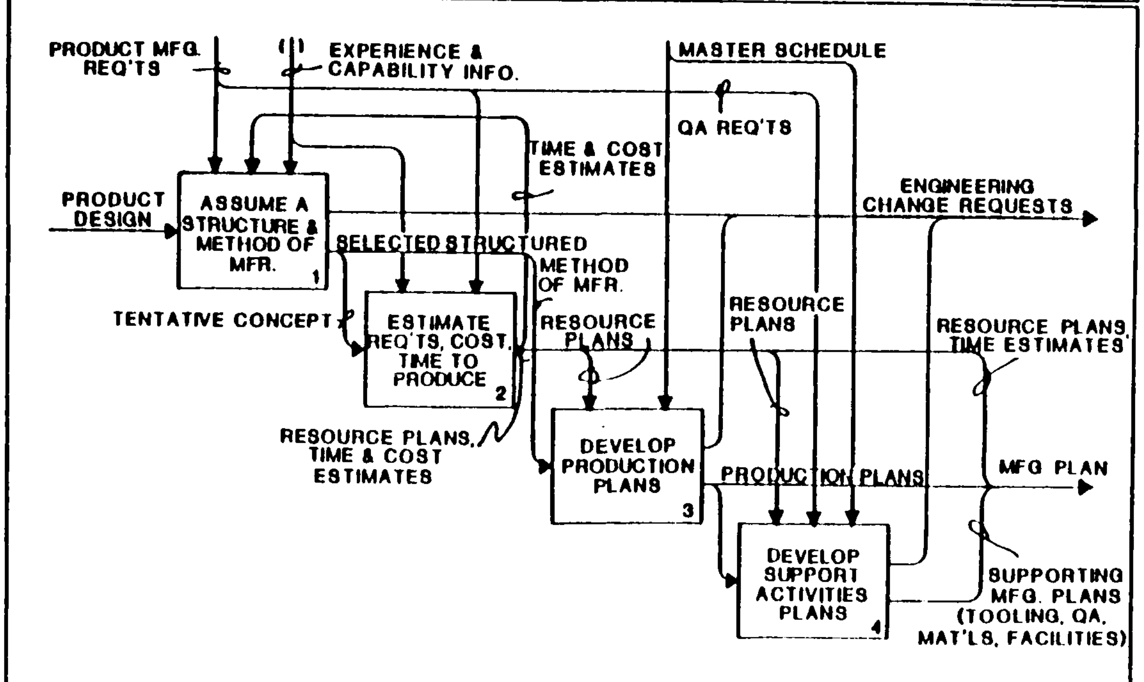


ICOM CODES ARE WRITTEN ON THE DECOMPOSED DIAGRAM

AS THEY APPEAR ON THE PARENT DIAGRAM

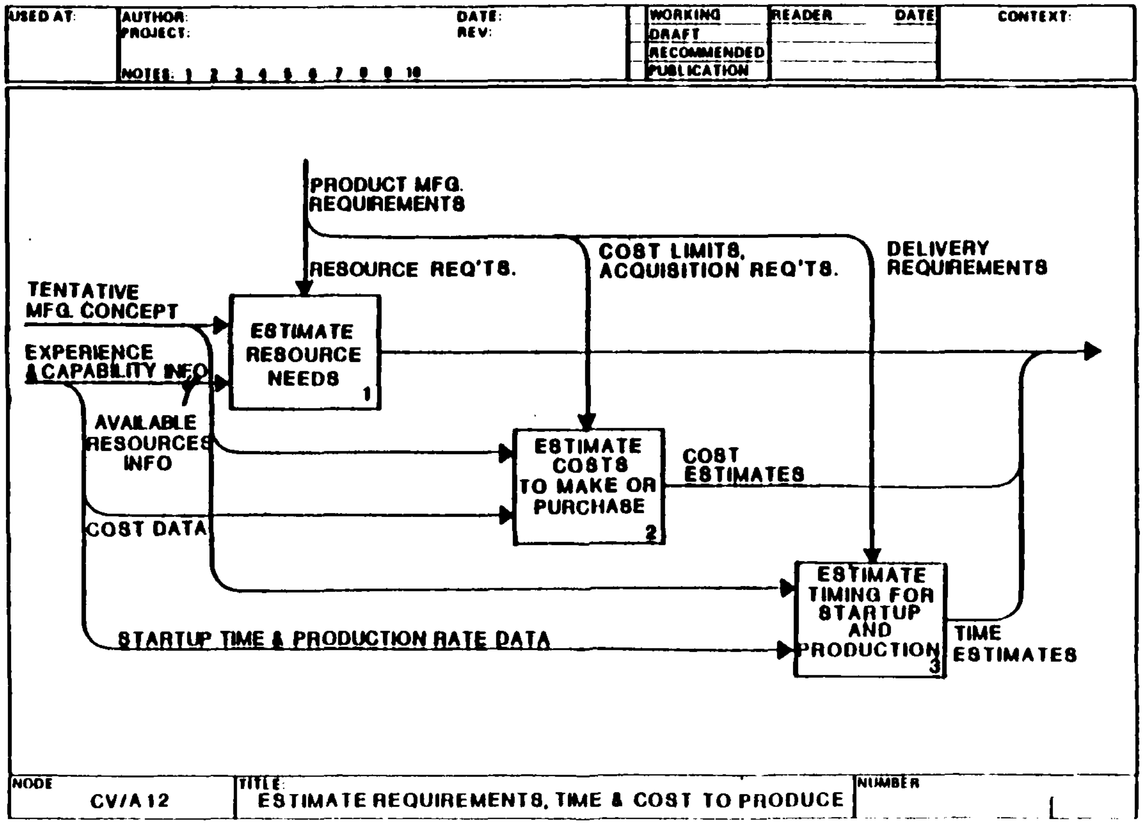
AUTHORING PROCEDURES | **DECOMPOSITION**

USED AT: AUTHOR: PROJECT: DATE: REV: NOTES: 1 2 3 4 5 6 7 8 9 10 WORKING DRAFT RECOMMENDED PUBLICATION READER DATE CONTEXT:



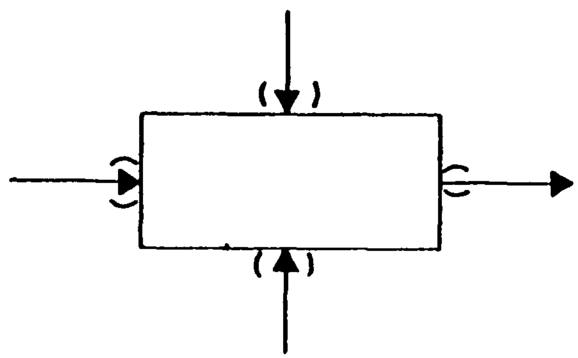
NODE: CV/A1 | TITLE: PLAN FOR MANUFACTURE | NUMBER:

AUTHORING PROCEDURES | DECOMPOSITION

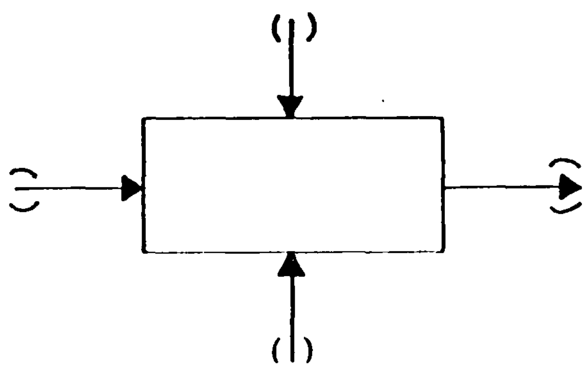


AUTHORING PROCEDURES | DECOMPOSITION

TUNNELLED ARROWS

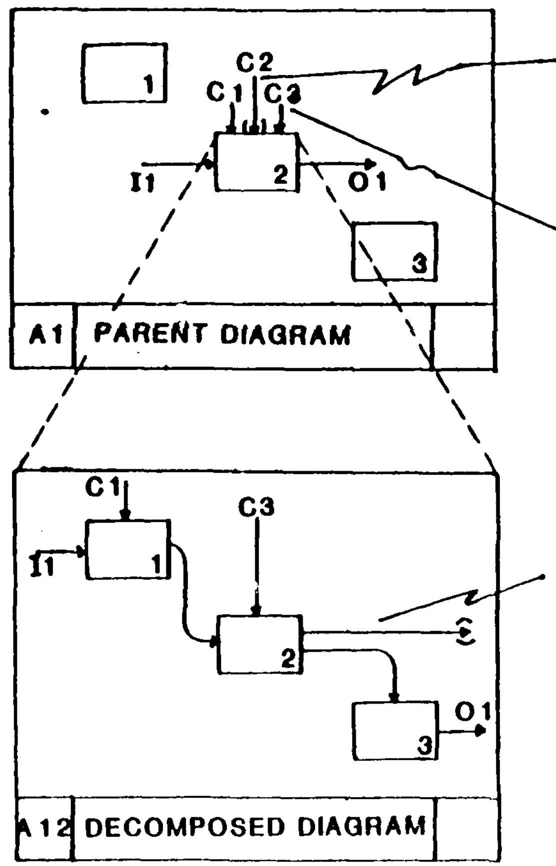


ARROW WILL NOT APPEAR
ON DECOMPOSED DIAGRAM



ARROW WILL NOT APPEAR
ON PARENT DIAGRAM

AUTHORING PROCEDURES | DECOMPOSITION



CONTROL WILL NOT BE SHOWN ON DECOMPOSED DIAGRAM.

THIS ARROW IS STILL DESIGNATED AS C3 ON THE DECOMPOSED DIAGRAM.

OUTPUT NOT SHOWN ON PARENT DIAGRAM.

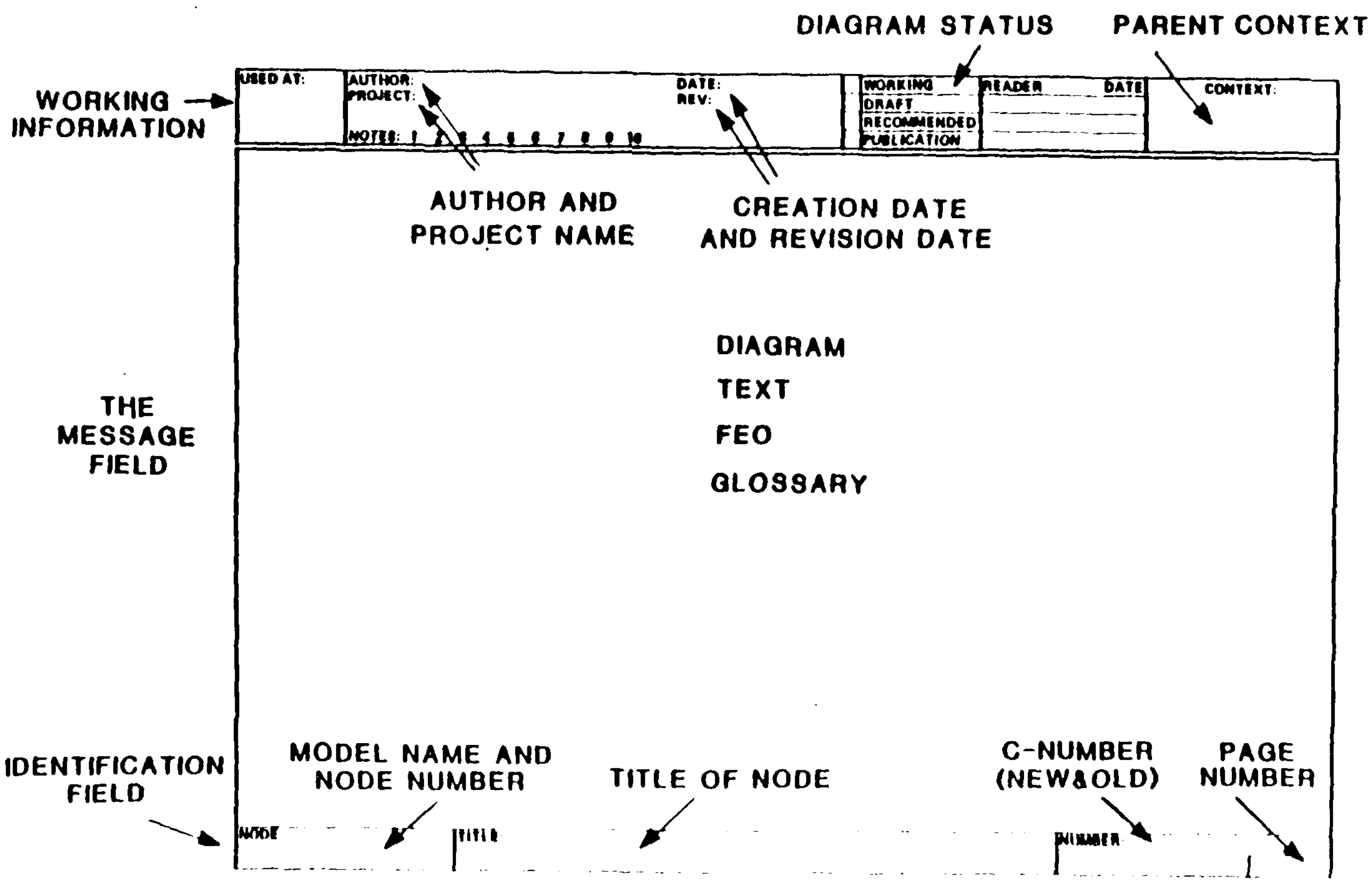
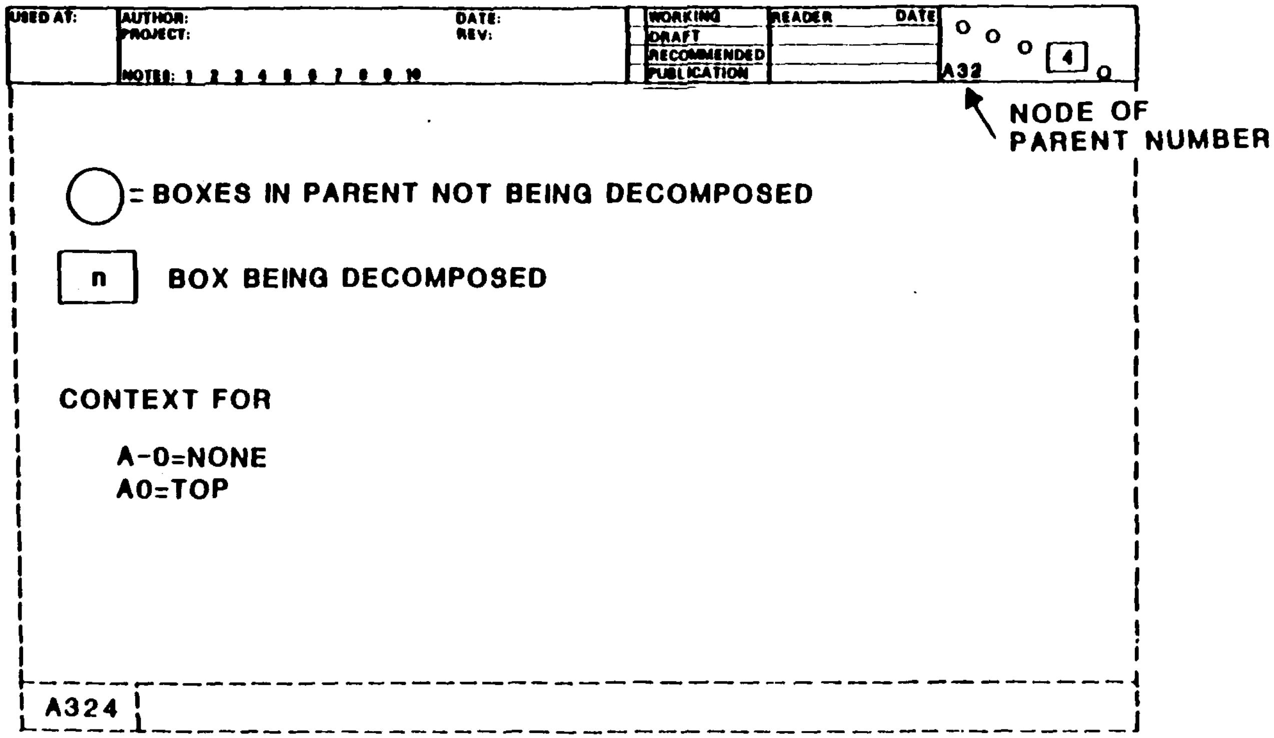


DIAGRAM STATUS
PARENT CONTEXT
WORKING INFORMATION
USED AT:
AUTHOR:
PROJECT:
NOTES: 1 2 3 4 5 6 7 8 9 10
DATE:
REV:
WORKING
DRAFT
RECOMMENDED
PUBLICATION
READER
DATE
CONTEXT:
AUTHOR AND PROJECT NAME
CREATION DATE AND REVISION DATE
THE MESSAGE FIELD
DIAGRAM
TEXT
FEO
GLOSSARY
IDENTIFICATION FIELD
MODEL NAME AND NODE NUMBER
TITLE OF NODE
C-NUMBER (NEW&OLD)
PAGE NUMBER
NODE
TITLE
NUMBER

AUTHORING PROCEDURES | CONTEXT ENTRY



AUTHORING PROCEDURES | NODE NUMBER ENTRY

COMPOSED OF

- MODEL NAME
- NUMBER OF SPECIFIC NODE

NODE:	TITLE:	NUMBER:
MFG/A0	ADJUST RELEASE SCHEDULE	

IDENTIFIES TYPE OF PAGE

- DIAGRAM
- TEXT
- GLOSSARY
- FEO

NODE:	TITLE:	NUMBER:
MFG/A0T	ADJUST RELEASE SCHEDULE	

NODE:	TITLE:	NUMBER:
MFG/A0G	ADJUST RELEASE SCHEDULE	

NODE:	TITLE:	NUMBER:
MFG/A0F	ADJUST RELEASE SCHEDULE	

AUTHORING PROCEDURES | C-NUMBER ENTRY

<u>CREATION NUMBER IS REFERRED TO AS C-NUMBER</u>

COMPOSED OF

- TWO OR THREE LETTERS OF AUTHOR'S INITIALS
- FOLLOWED BY A NUMBER SEQUENTIALLY ASSIGNED BY AUTHOR

PRIMARY MEANS OF REFERENCE TO A SHEET FOUND IN THE LOWER LEFT CORNER OF THE NUMBER FIELD

NODE:	TITLE:	NUMBER:
		CM15

IF A DIAGRAM REPLACES A PREVIOUS DIAGRAM, THE ORIGINAL C-NUMBER IS WRITTEN IN PARENTHESES FOLLOWING THE NEW C-NUMBER

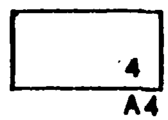
NODE:	TITLE:	NUMBER:
		CM22(CM15)

AUTHORING PROCEDURES | REFERENCE EXPRESSION

TO FIND THE DETAILS OF A BOX, USE THE REFERENCE EXPRESSION TO IDENTIFY THE NODE NUMBER OF THE DECOMPOSED BOX.

REFERENCE EXPRESSION APPEARS

- OUTSIDE THE BOX
- BELOW THE BOX NUMBER



IF NO REFERENCE APPEARS, THE BOX HAS NOT YET BEEN DECOMPOSED.

AUTHORING PROCEDURES | DOCUMENTATION- NODE INDEX

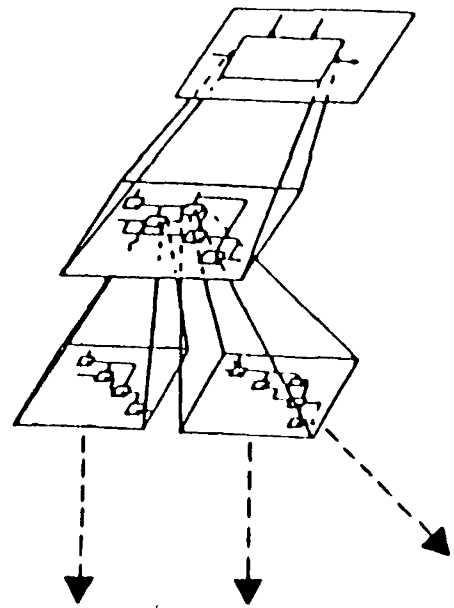
NODE INDEX

A-0 MANUFACTURE PRODUCT (CONTEXT)

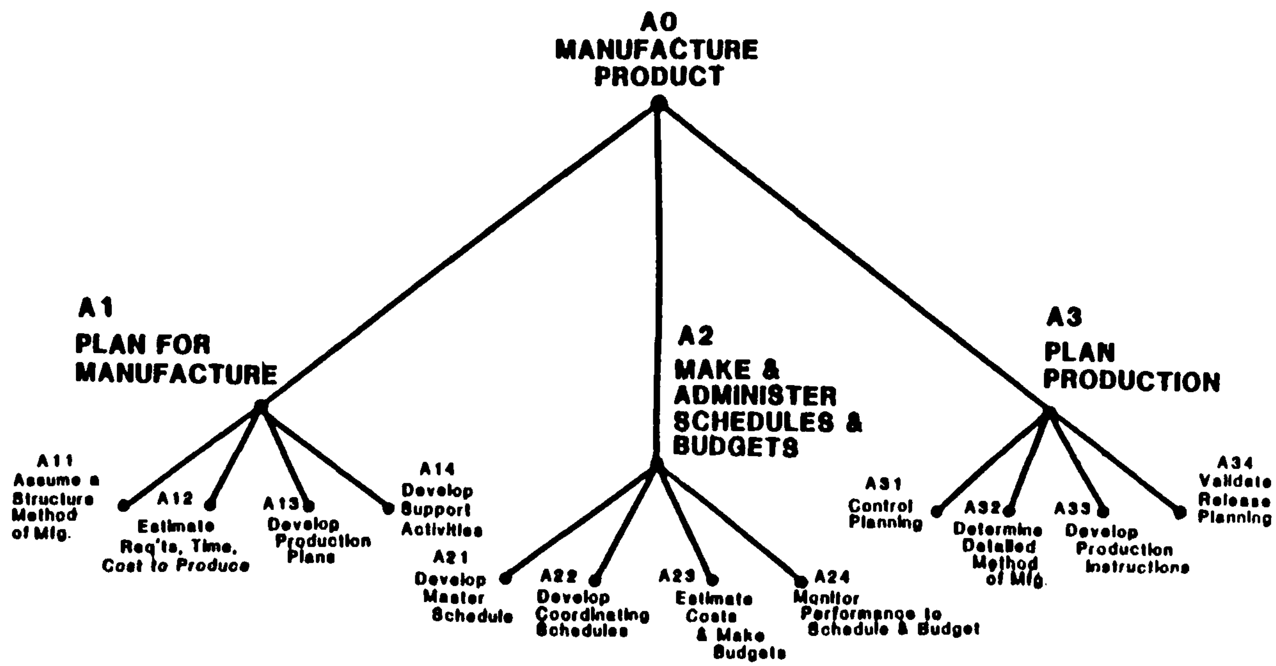
A0 MANUFACTURE PRODUCT

- A1 PLAN FOR MANUFACTURE
  - A11 ASSUME A STRUCTURE AND METHOD OF MANUFACTURE
  - A12 ESTIMATE REQUIREMENTS, TIME, AND COST TO PRODUCE
  - A13 DEVELOP PRODUCTION PLANS
  - A14 DEVELOP SUPPORT ACTIVITIES PLANS
- A2 MAKE AND ADMINISTER SCHEDULES AND BUDGETS
  - A21 DEVELOP MASTER SCHEDULE
  - A22 DEVELOP COORDINATING SCHEDULES
  - A23 ESTIMATE COSTS AND MAKE BUDGETS
  - A24 MONITOR PERFORMANCE TO SCHEDULE AND BUDGET
- A3 PLAN PRODUCTION
  - A31 CONTROL PLANNING
  - A32 DETERMINE DETAILED METHOD OF MANUFACTURE
  - A33 DEVELOP PRODUCTION INSTRUCTIONS
  - A34 VALIDATE RELEASE PLANNING

CORRESPONDING DECOMPOSITION STRUCTURE



AUTHORING PROCEDURES | DOCUMENTATION - NODE TREE



AUTHORING CONCEPTS AND PROCEDURES

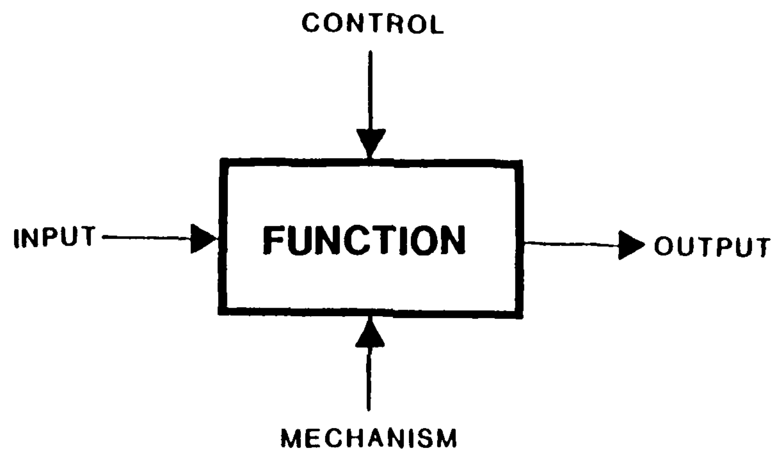
AUTHORING EXERCISE

BASED ON THE FOLLOWING MODEL PURPOSE AND VIEWPOINT, CREATE AN A-0 AND A0 DIAGRAM OF YOUR JOB.

PURPOSE: TO UNDERSTAND AND COMMUNICATE THE FUNCTION OF MY JOB (PUT YOUR JOB IN PERSPECTIVE BY IDENTIFYING THE ORGANIZATION(S) YOU ARE PART OF.)

VIEWPOINT: "MYSELF" (STATE YOUR BACKGROUND AND EXPERIENCE)

$IDEF_0$



COMMENTiNG
CONCEPTS AND PROCEDURES

COMMENTING CONCEPTS & PROCEDURES

LEARNING OBJECTIVES

1. UNDERSTAND THE IMPORTANCE OF IDEF COMMENTING
2. UNDERSTAND THE IDEF KIT CYCLE
3. UNDERSTAND THE IDEF WALKTHROUGH MEETING PROCESS
4. UNDERSTAND THE IDEF LIBRARY FUNCTIONS

COMMENTING CONCEPTS | COMMENTING

PRINCIPLES OF COMMENTING:

1. UNDERSTANDING: WHAT IS THE AUTHOR SAYING ?

2. AGREEMENT : DO I AGREE WITH THE AUTHOR?

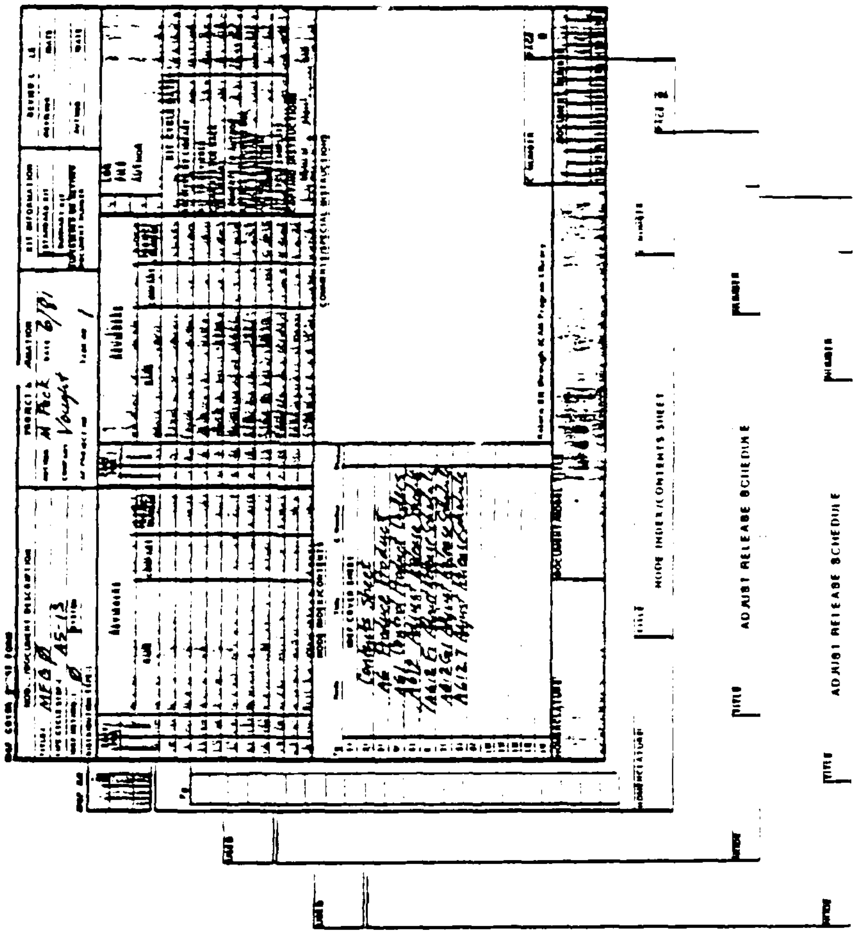
COMMENTING CONCEPTS | COMMUNICATION

AUTHORING + COMMENTING =

COMMUNICATION

COMMENTING CONCEPTS

IDEF KIT



COMMENTING CONCEPTS

IDEF DIAGRAM COMMENTING PROCESS

ASPECTS TO LOOK FOR:

- CLARITY
- CONSISTENCY
- CORRECT SYNTAX
- CORRECT SEMANTICS

COMMENTING PROCEDURES | IDEF DIAGRAM COMMENTING PROCESS

MECHANICS

- Ⓝ NOTES
- NOTE FIELD
- USE RED INK

ABOVE ALL → MAKE COMMENTS

- CLEAR
- BRIEF
- CONSTRUCTIVE

COMMENTING PROCEDURES | IDEF DIAGRAM

COMMENTING PROCESS

PROCESS STEPS:

- INITIAL AND DATE KIT
- CHECK SYNTAX AND LAYOUT OF DIAGRAM
- READ DIAGRAM
- CHECK SEMANTICS OF DIAGRAM
- CHECK SUGGESTIONS DOCUMENTATION (e.g. FEO'S, TEXT, AND / OR GLOSSARY)
- MAKE CONSTRUCTIVE SUGGESTIONS

ITERATE FOR EACH DIAGRAM

COMMENTING CONCEPTS | TEXT/GLOSSARY COMMENTING

TEXT/GLOSSARY SHOULD HAVE :

- BREVITY
- *STRUCTURE*
- CLARITY

TEXT/GLOSSARY SHOULD BE WRITTEN :

- TO CLARIFY INFORMATION CONVEYED BY THE DIAGRAM

COMMENTING CONCEPTS | FEO COMMENTING

A FEO (FOR EXPOSITION ONLY):

DON'T FORGET! A FEO:

- IS ANY DIAGRAM THAT FALLS OUTSIDE THE STRICT HIERARCHY
- MAY CONTAIN MORE THAN SIX BOXES AND HAVE PARTIAL ARROW STRUCTURE
- IS USED BY THE AUTHOR
  - TO ILLUSTRATE A POINT
  - TO CLARIFY A DIAGRAM

A FEO ASKS:

- DO YOU UNDERSTAND ?
- DOES IT CLARIFY INFO FOR YOU ?
- DO YOU AGREE ?

COMMENTING CONCEPTS | APPROACHES TO COMMENTING

- IDEF KIT CYCLE
- IDEF WALKTHROUGH MEETING(S)

COMMENTING PROCEDURES | **COMMENTING**

USING KIT CYCLE <u>AND</u> WALKTHROUGH MEETING(S):

- CIRCULATE KITS THROUGH KIT CYCLE

AND / OR

- CONDUCT PERIODIC WALKTHROUGH MEETING(S)

COMMENTING PROCEDURES | COMMENTING

KIT CYCLING ALTERNATIVES:

- MAILING
- PERSONNEL MEETING

PRO'S AND CON'S

KIT CYCLE:

- SAVES TRAVEL COSTS
- GOOD FOR INITIAL CONTACT
- SLOWER COMMENTING TURN-OVER TIME
- SLOWER TO GAIN CONSENSUS

WALKTHROUGH MEETING(S):

- QUICKER COMMENTING TURN -OVER TIME
- QUICKER TO GAIN CONSENSUS
- MORE TRAVEL COSTS
- GOOD FOR KIT FINALIZATION

COMMENTING CONCEPTS | IDEF KIT CYCLE

STEPS AND PERSONNEL

STEPS	PERSONNEL
PRODUCE KIT	AUTHOR
READ AND COMMENT ON KIT	COMMENTER
REVIEW AND RESPOND TO COMMENTS	AUTHOR
REVIEW RESPONSES	COMMENTER
DISCUSS (IF NECESSARY)	AUTHOR AND COMMENTER

ITERATION
(IF REQUIRED)

COMMENTING PROCEDURES | IDEF KIT CYCLE

DISCUSSION

DISCUSSION RULES

- ONLY IF NECESSARY
- DISCUSS POINTS OF DISAGREEMENT ONLY
- LIMIT TIME
- DECIDE ACTIONS
- RECORD RESULTS

COMMENTING PROCEDURES | IDEF KIT CYCLE

AUTHOR RESPONDING

AUTHOR RESPONDS TO ALL COMMENTS

- UNDERSTAND COMMENTS
- "✓" IF AGREE
- "X" IF DISAGREE WITH EXPLANATION
- USE BLUE INK
- NOTE "LET'S TALK" – IF NECESSARY
- NOTE COMMENTS ON AUTHOR COPY
- RETURN KIT TO COMMENTER

COMMENTING PROCEDURES | WALKTHROUGH MEETING

STEPS AND PERSONNEL

STEPS	PERSONNEL
PRODUCE KIT ↓	AUTHOR
READ AND COMMENT ON KIT ↓	COMMENTER(S)
SET UP WALKTHROUGH MEETING ↓	PROJECT MANAGER
WALKTHROUGH MEETING & DISCUSSION	PROJECT MANAGER + AUTHOR + COMMENTER(S)

ITERATION (IF REQUIRED)

COMMENTING PROCEDURES | IDEF DIAGRAM WALKTHROUGH PROCESS

SIX STEPS:

1. SCAN THE DIAGRAM
2. LOOK AT THE PARENT DIAGRAM
3. CONNECT THE PARENT BOX AND THE DETAIL DIAGRAM
4. EXAMINE THE INTERNAL ARROW PATTERN
5. READ THE TEXT AND GLOSSARY
6. SET THE STATUS OF THE DIAGRAM

COMMENTING PROCEDURES | IDEF KIT CYCLE

ITERATION

AUTHOR REFINES DIAGRAM AND ITERATES

- INCORPORATES NECESSARY CHANGES
- ISSUES SUBSEQUENT KIT
- COMMENTERS REFER TO PREVIOUS KIT TO EVALUATE CHANGES

COMMENTING CONCEPTS & PROCEDURES | LIBRARY FUNCTION

WHETHER YOU USE IDEF KIT CYCLE OR
WALKTHROUGH MEETING PROCESS
(OR BOTH)-

YOU MUST HAVE SOME LEVEL OF

CONTROL FOR IDEF MODELING

TO MANAGE THE COMMUNICATION PROCESS

COMMENTING PROCEDURES | IDEF KIT CYCLE

LIBRARY FUNCTIONS

- MAINTAINS FILES
- CONTROLS DISTRIBUTION OF DOCUMENTED INFORMATION
- RECEIVES, COPIES, DISTRIBUTES, TRACKS AND TRANSFERS

COMMENTING CONCEPTS & PROCEDURES

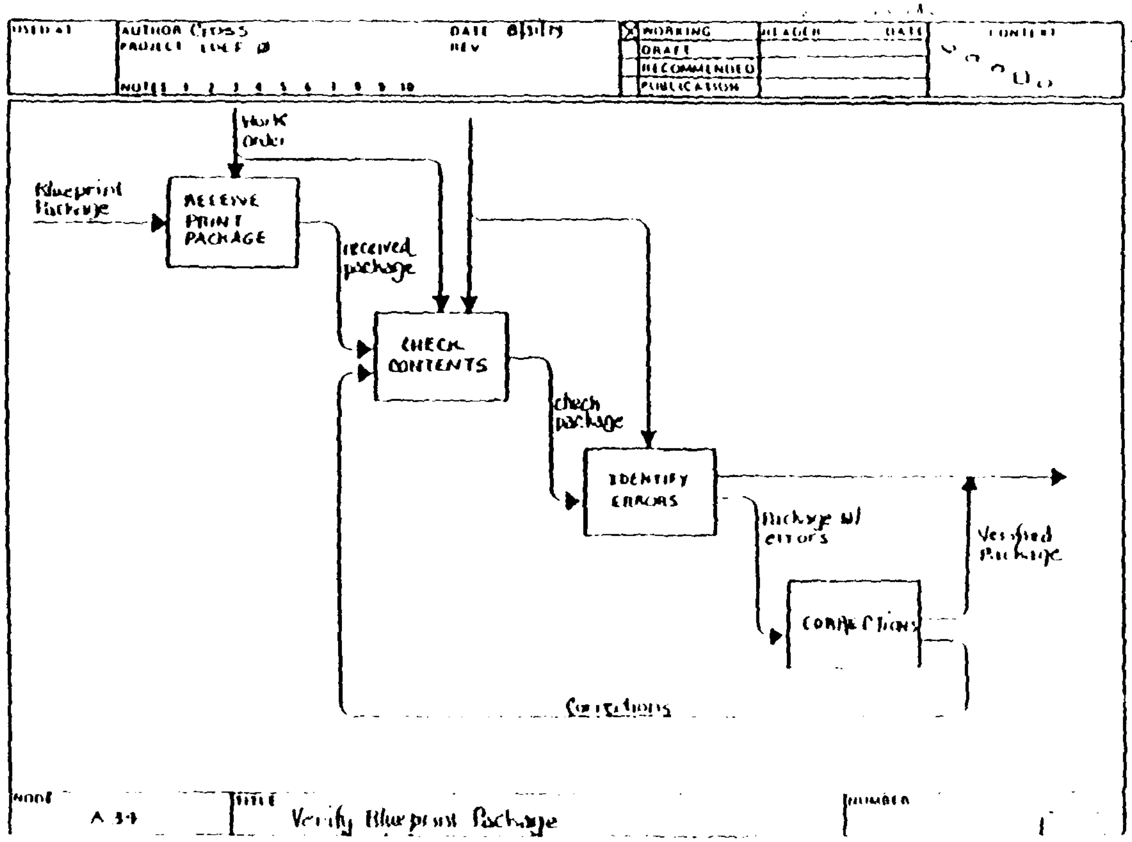
COMMENTING EXERCISE

YOU PLAY THE ROLE OF A COMMENTER
AND LOOK FOR:

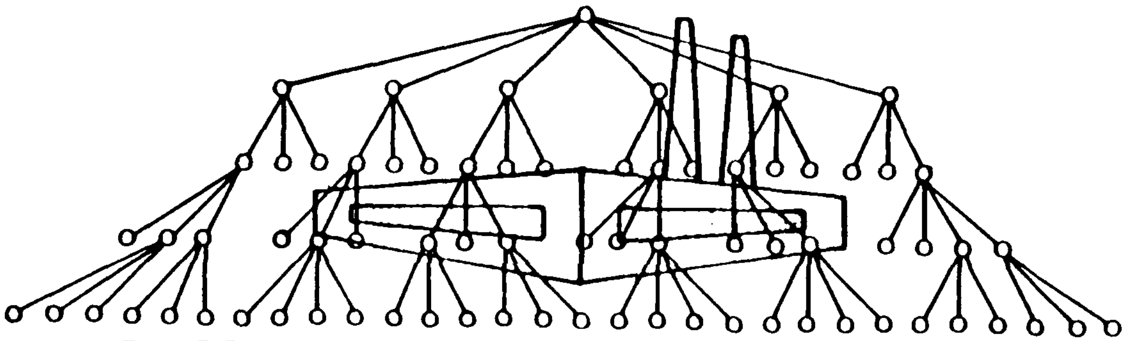
- SYNTAX ERRORS
  (IDEF$_0$ SYMBOLOGY AND RULES)
- SEMANTIC ERRORS
  (MISUNDERSTANDINGS OF THE INTENDED AUTHOR COMMUNICATION)
- DISAGREEMENTS WITH THE AUTHOR
  (AFTER YOU UNDERSTAND WHAT AUTHOR INTENDED)

THEN NOTE YOUR COMMENTS ON THE DIAGRAM FOLLOWING THE GUIDELINES JUST PROVIDED

COMMENTING CONCEPTS & PROCEDURES | IDEF KIT CYCLE COMMENTING EXERCISE

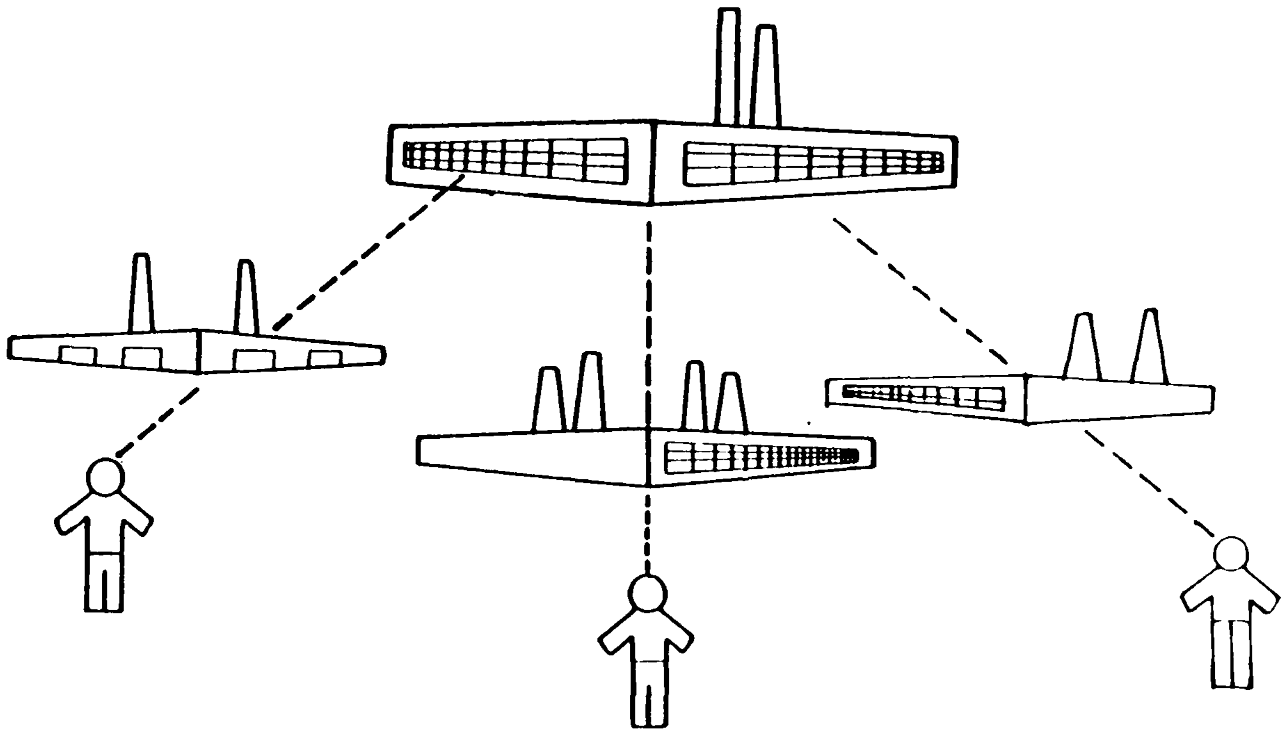


ARCHITECTURE

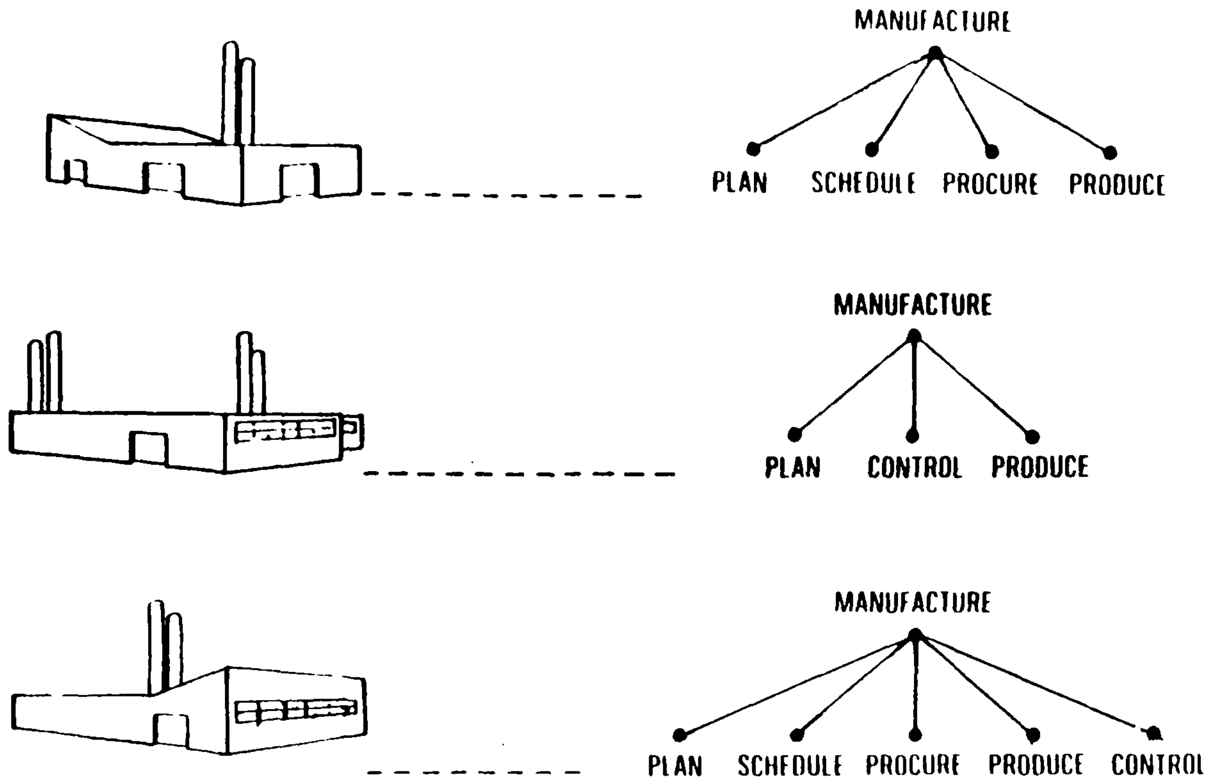


A STRUCTURED APPROACH TO MANUFACTURING

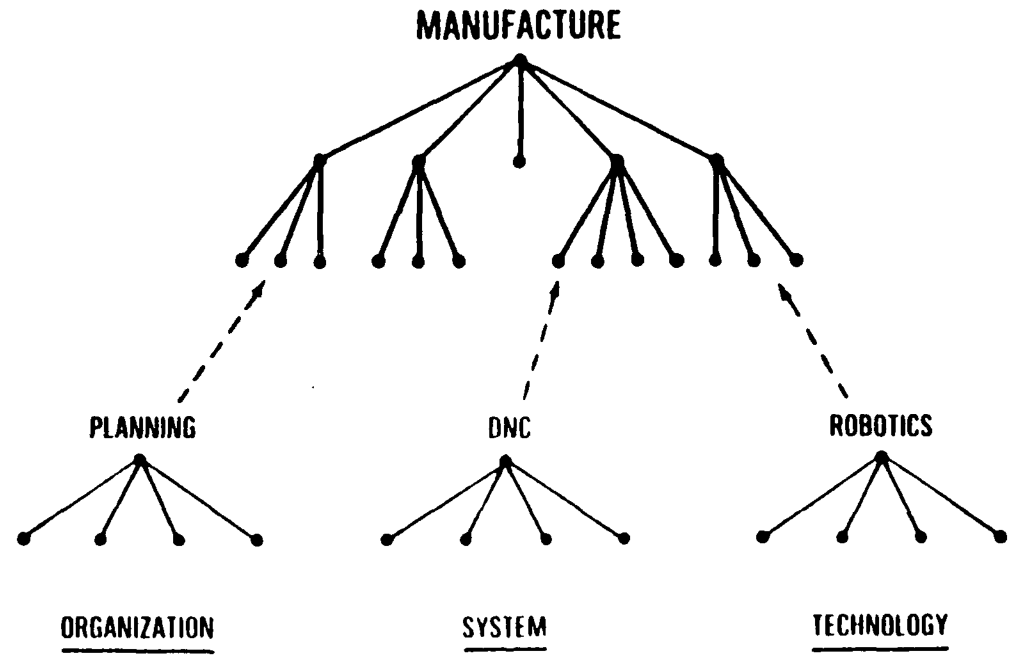
STANDARD FOR COMMUNICATION



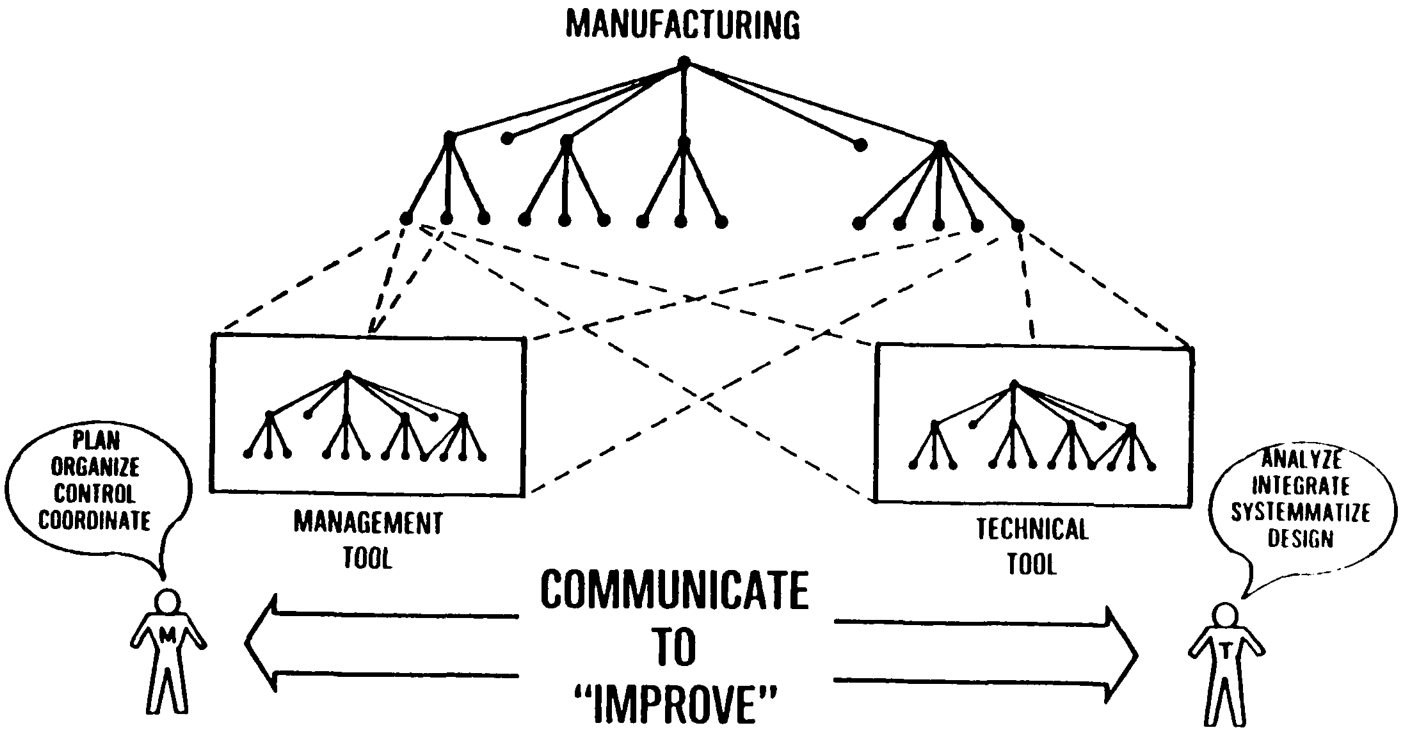
STANDARD FOR COMMUNICATION



STANDARD FOR COMMUNICATION



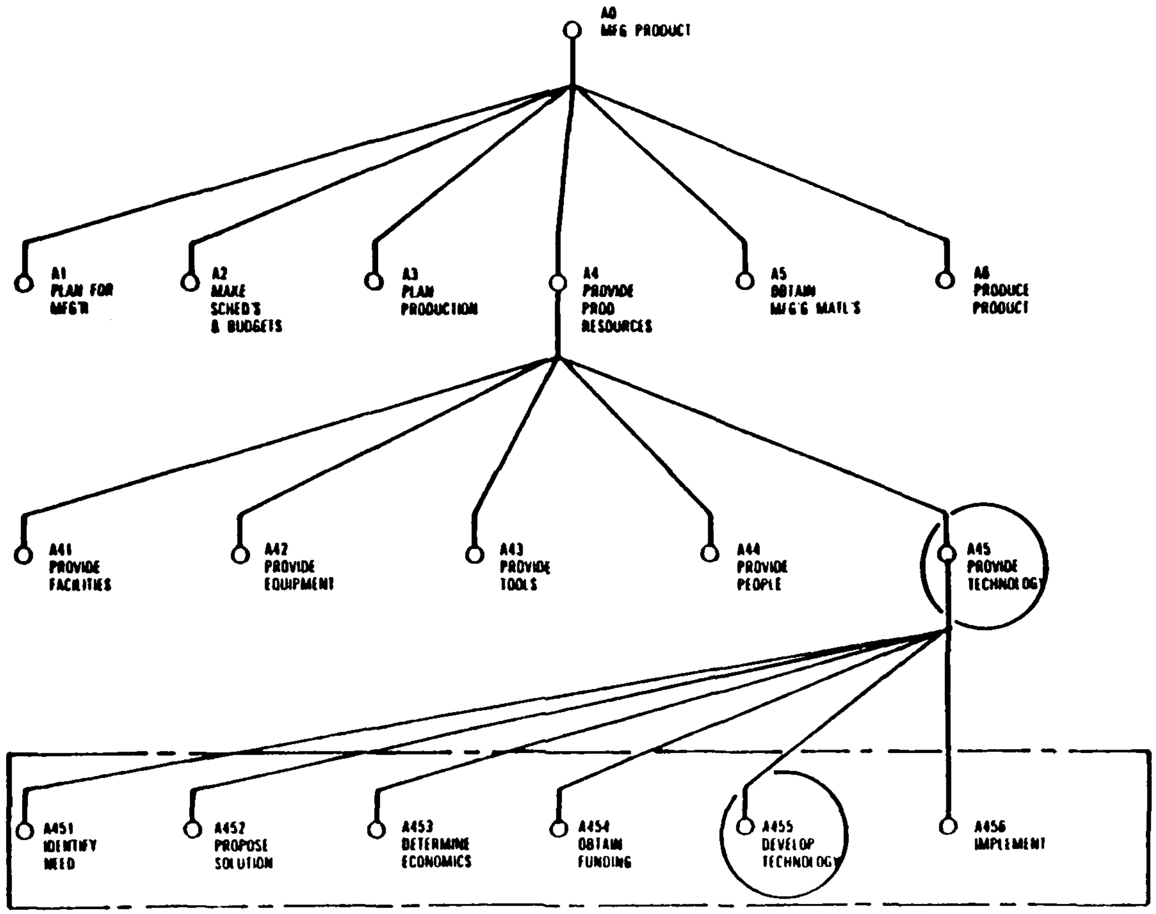
USES OF ARCHITECTURE



MANAGEMENT TOOL

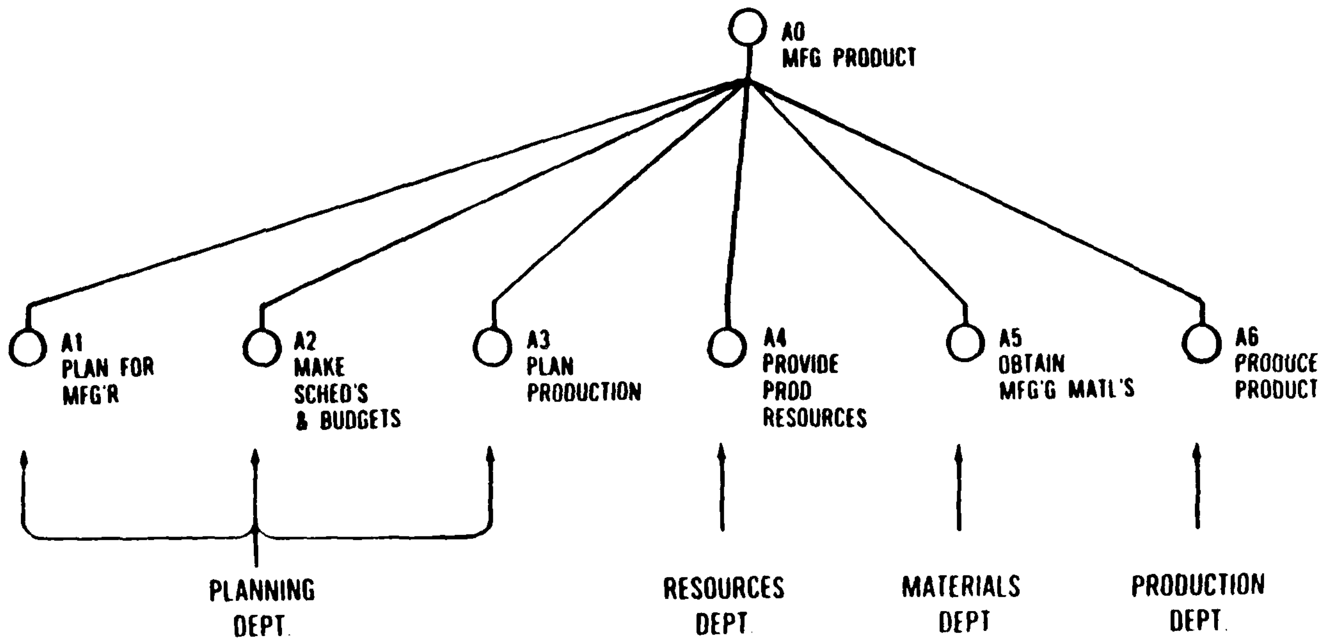
- PRESENTATION MEDIUM
- ORGANIZATIONAL STRUCTURE
- PLANNING VEHICLE
- PROGRAM MANAGEMENT

PRESENTATION MEDIUM

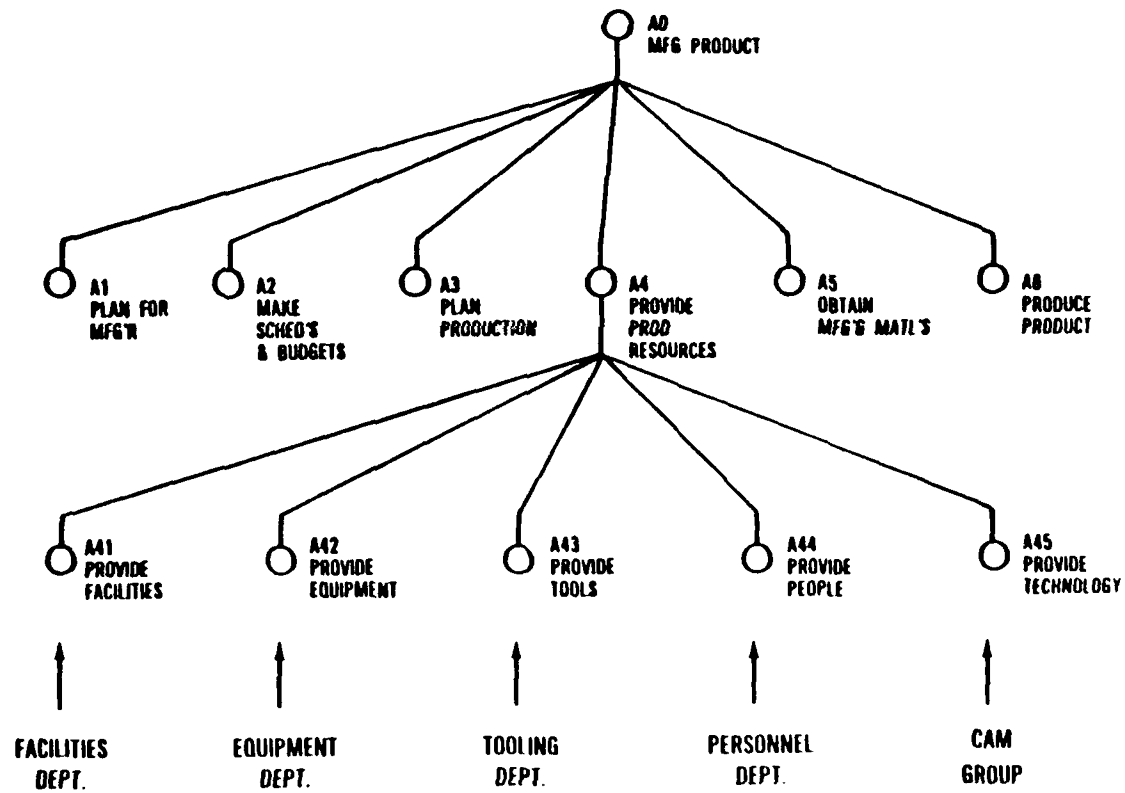


TECHNOLOGY MODERNIZATION PROGRAM

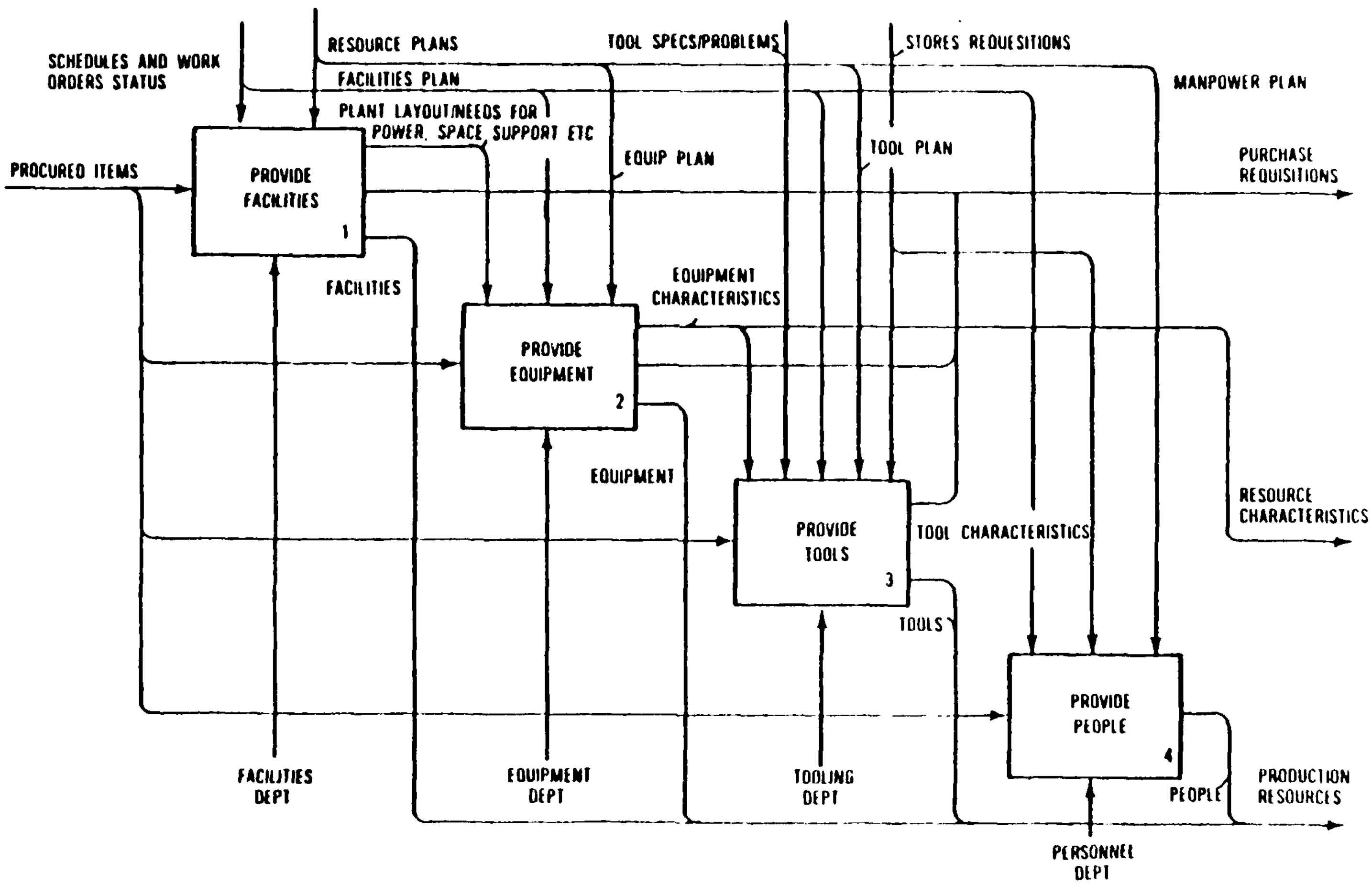
ORGANIZATIONAL STRUCTURE



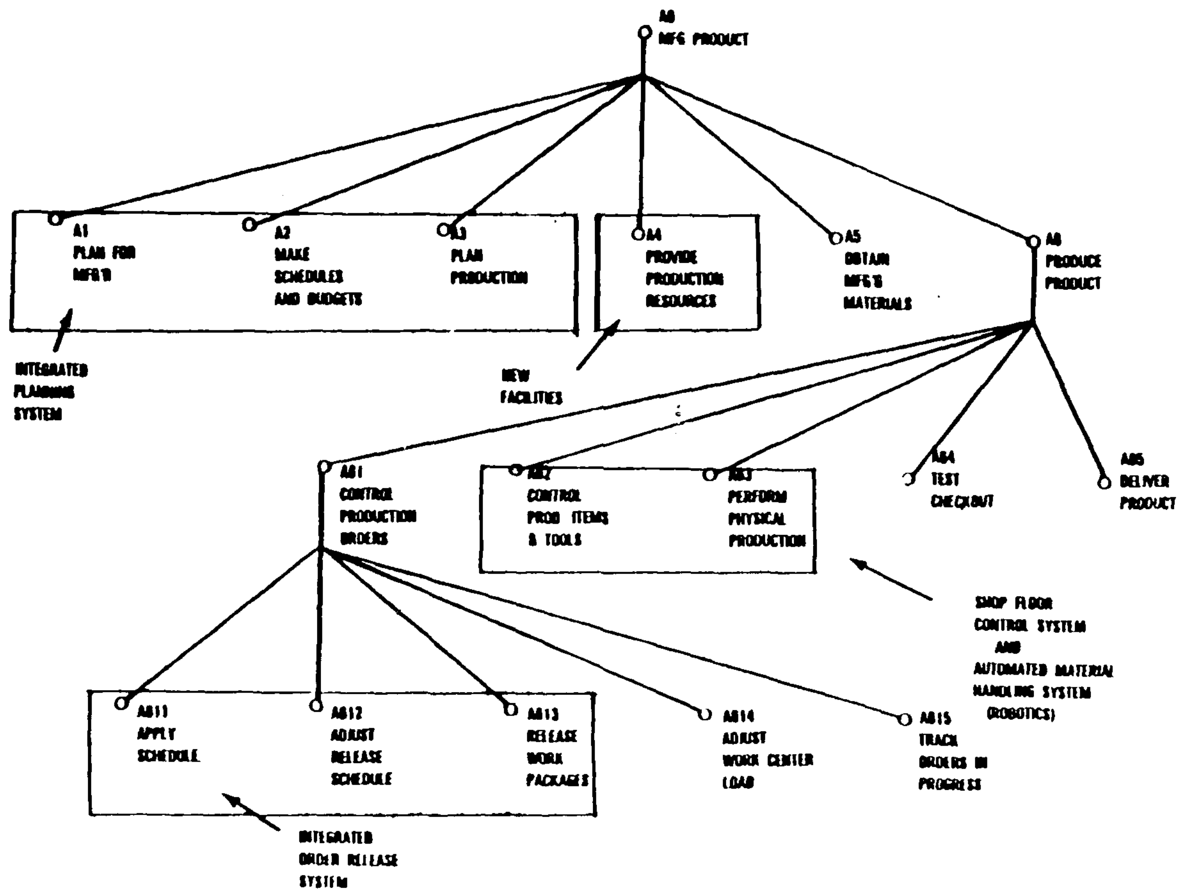
ORGANIZATIONAL STRUCTURE



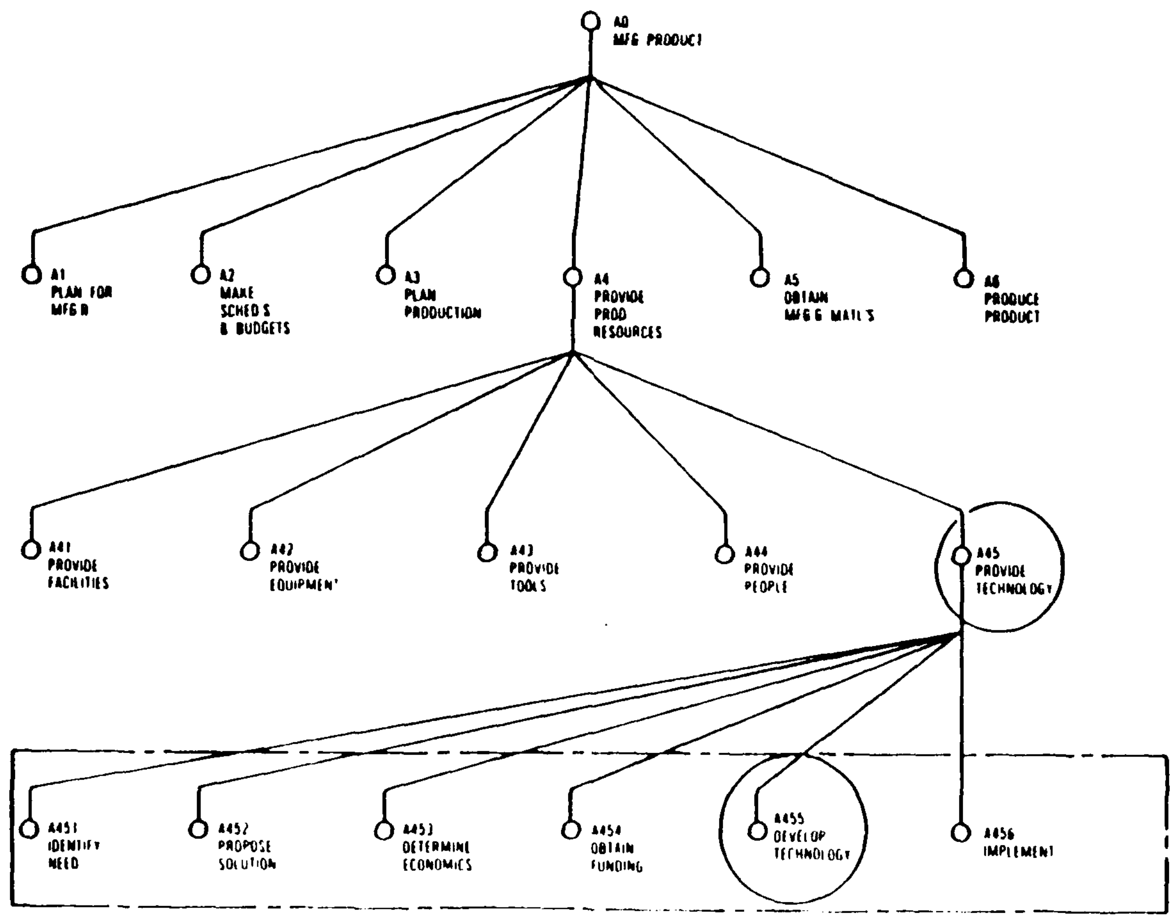
ORGANIZATIONAL STRUCTURE



PLANNING VEHICLE



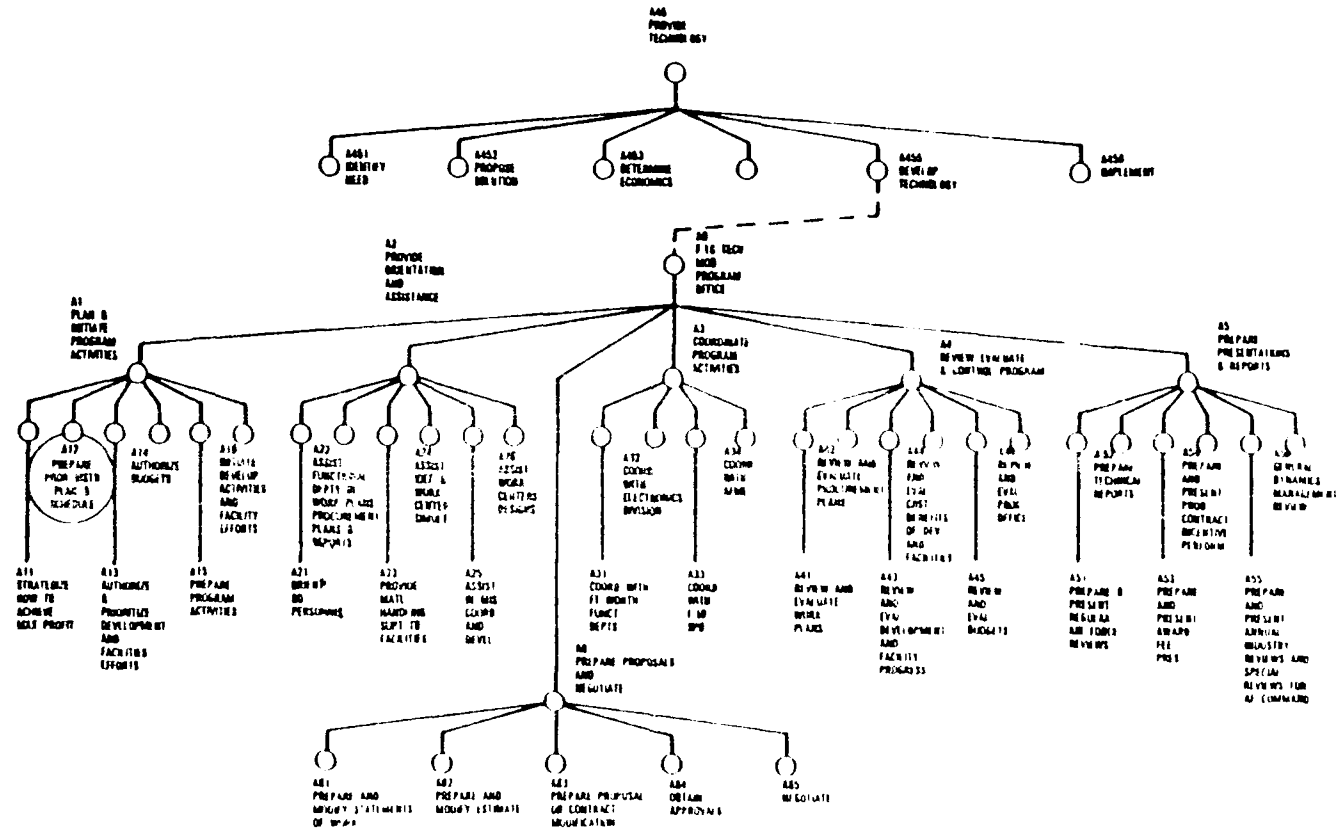
PROGRAM MANAGEMENT



TECHNOLOGY MODERNIZATION PROGRAM

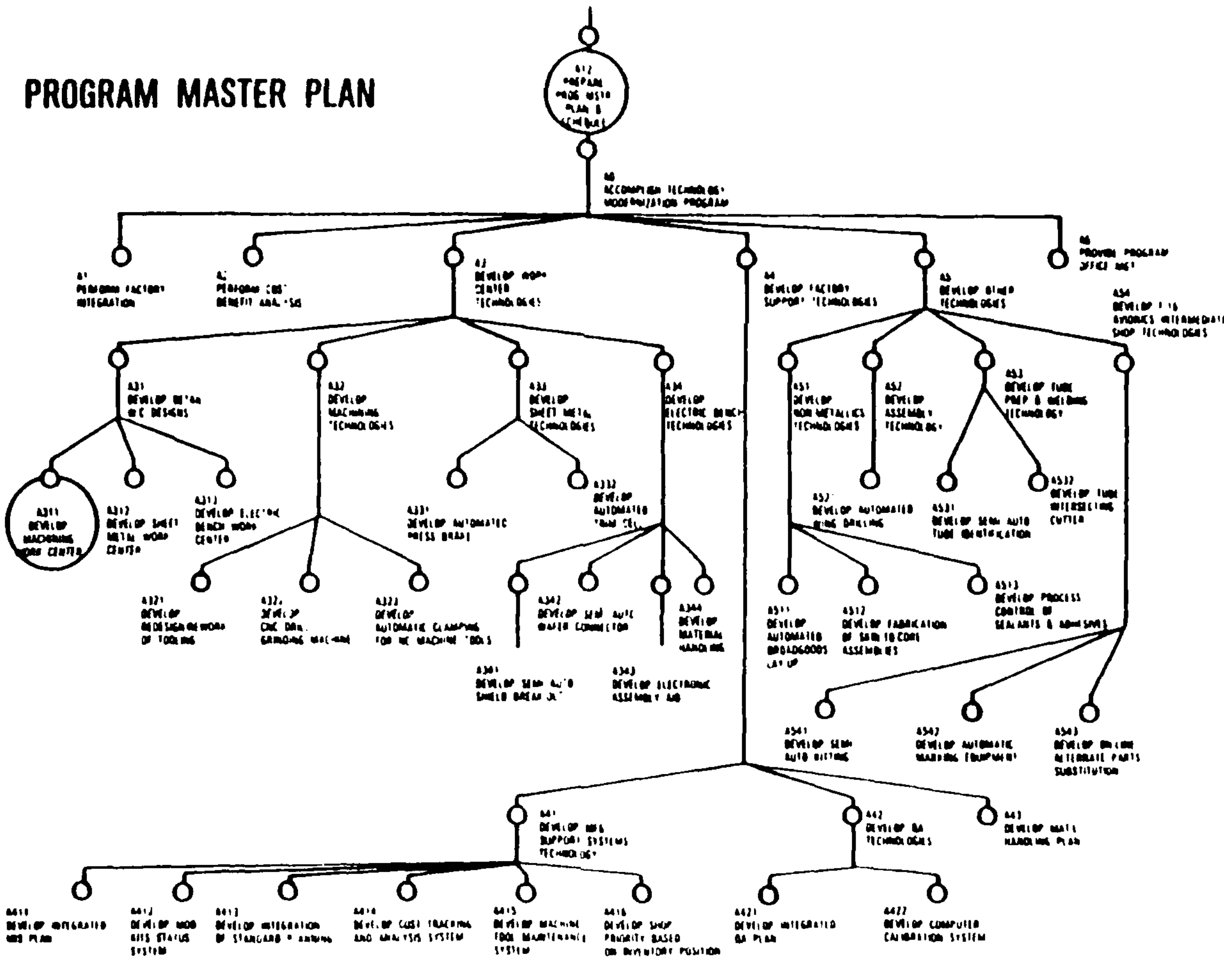
PROGRAM MANAGEMENT

F-16 TECH MOD PROGRAM OFFICE ACTIVITIES

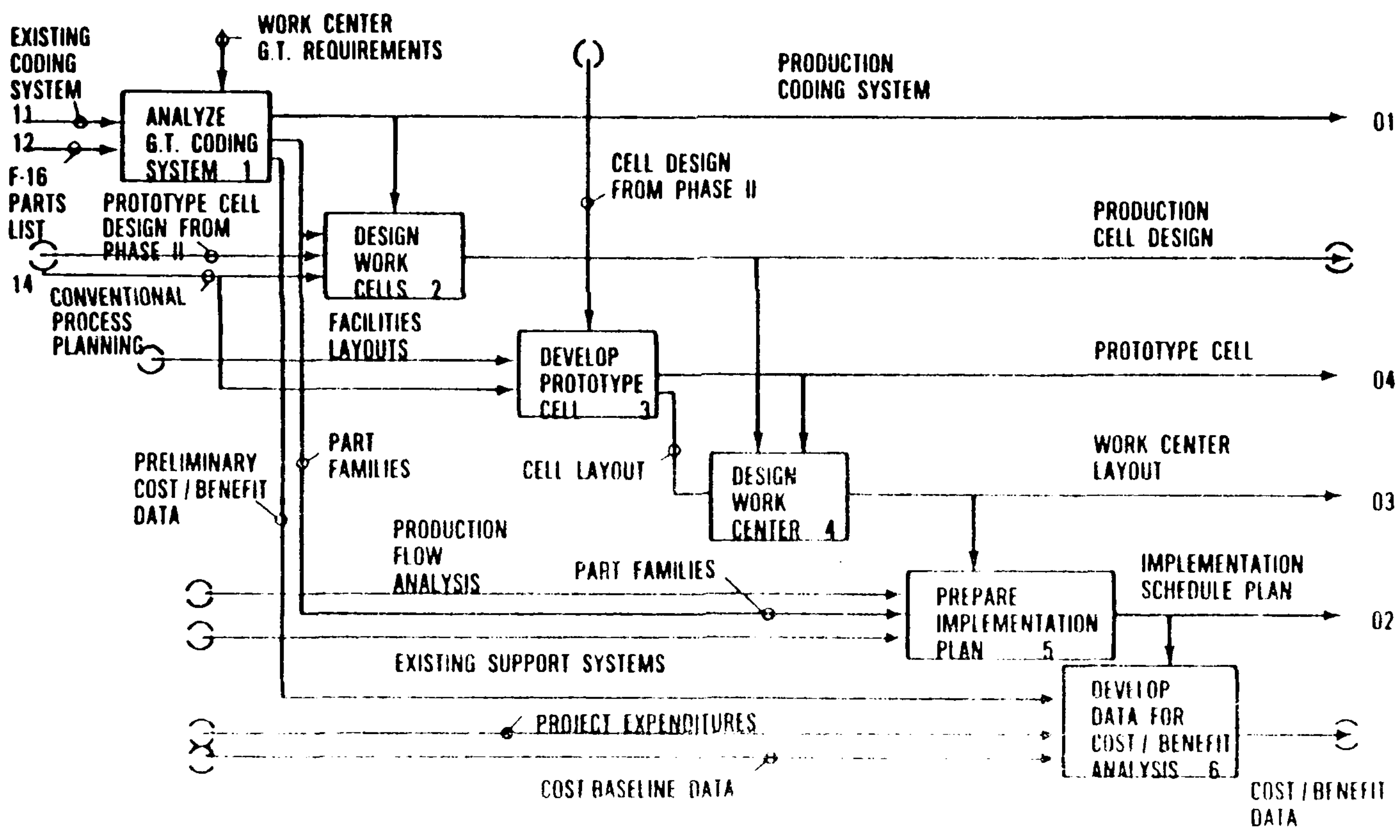


PROGRAM MANAGEMENT

PROGRAM MASTER PLAN



PROGRAM MANAGEMENT

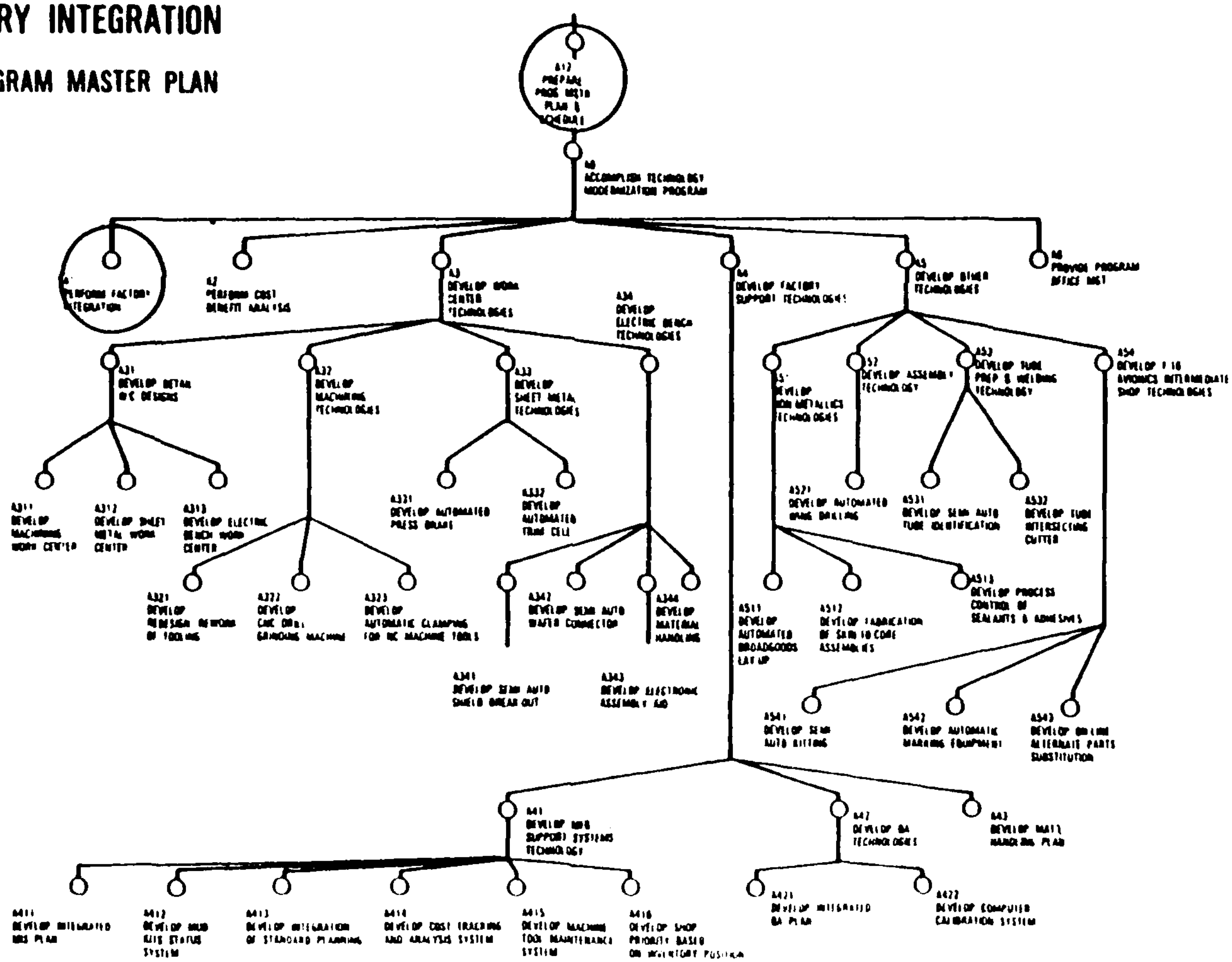


"TECHNICAL APPROACH"

PROGRAM MANAGEMENT

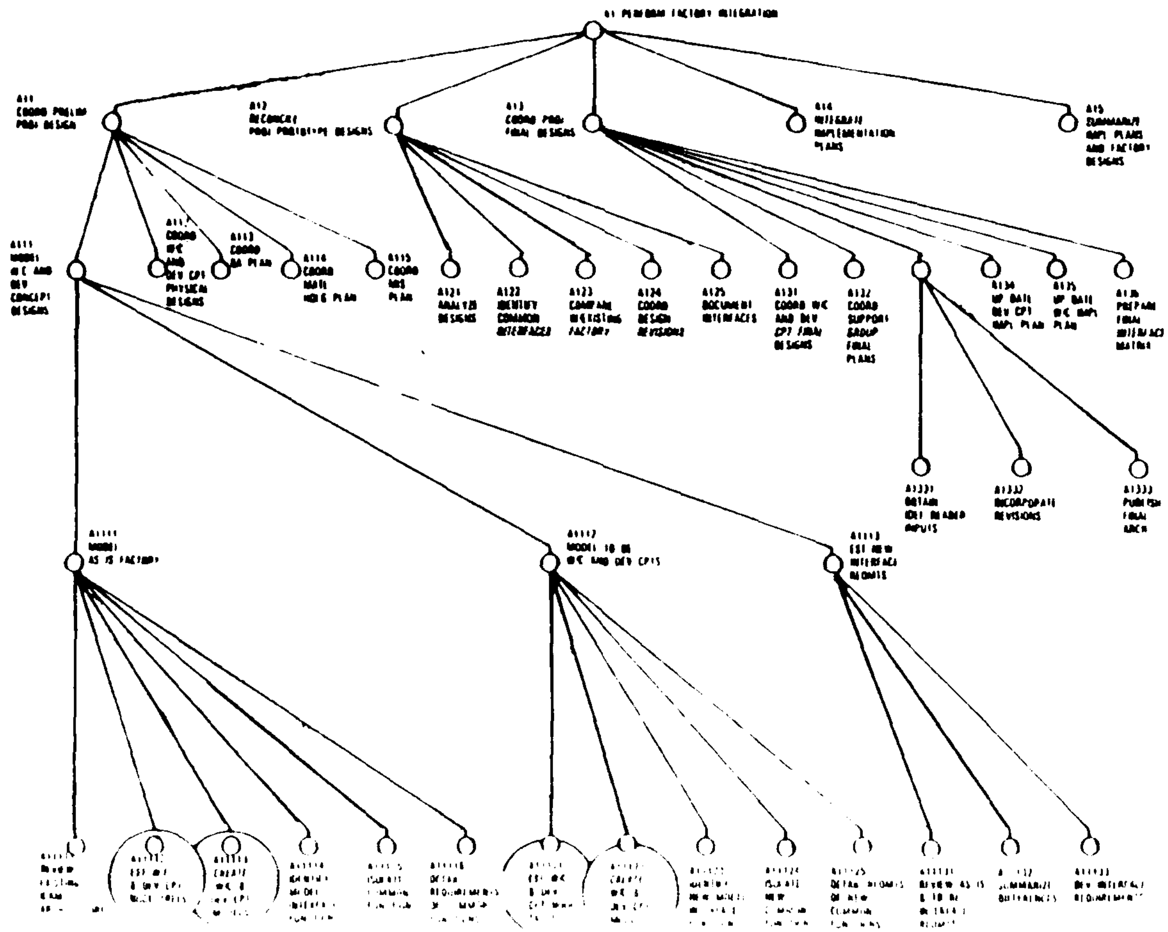
FACTORY INTEGRATION

PROGRAM MASTER PLAN



PROGRAM MANAGEMENT

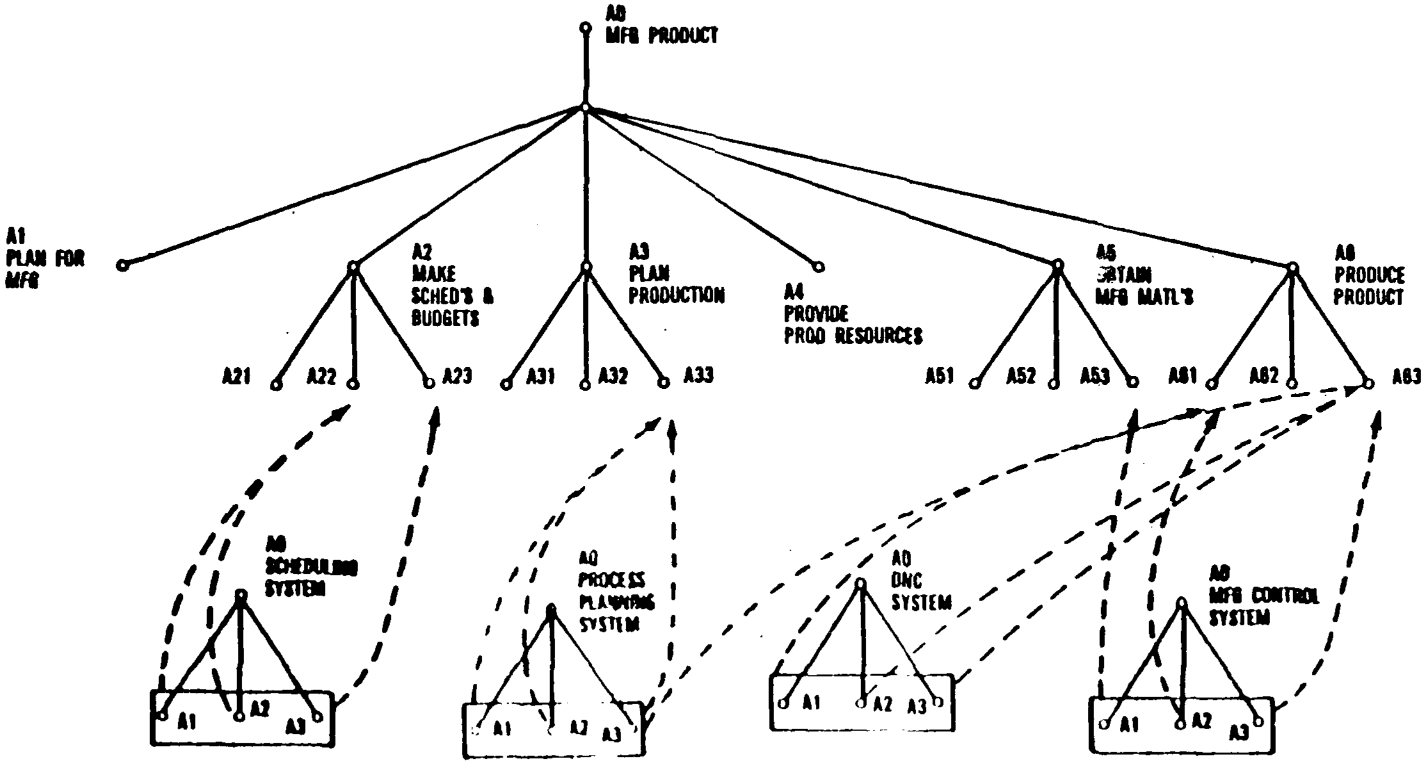
PLAN FOR FACTORY INTEGRATION



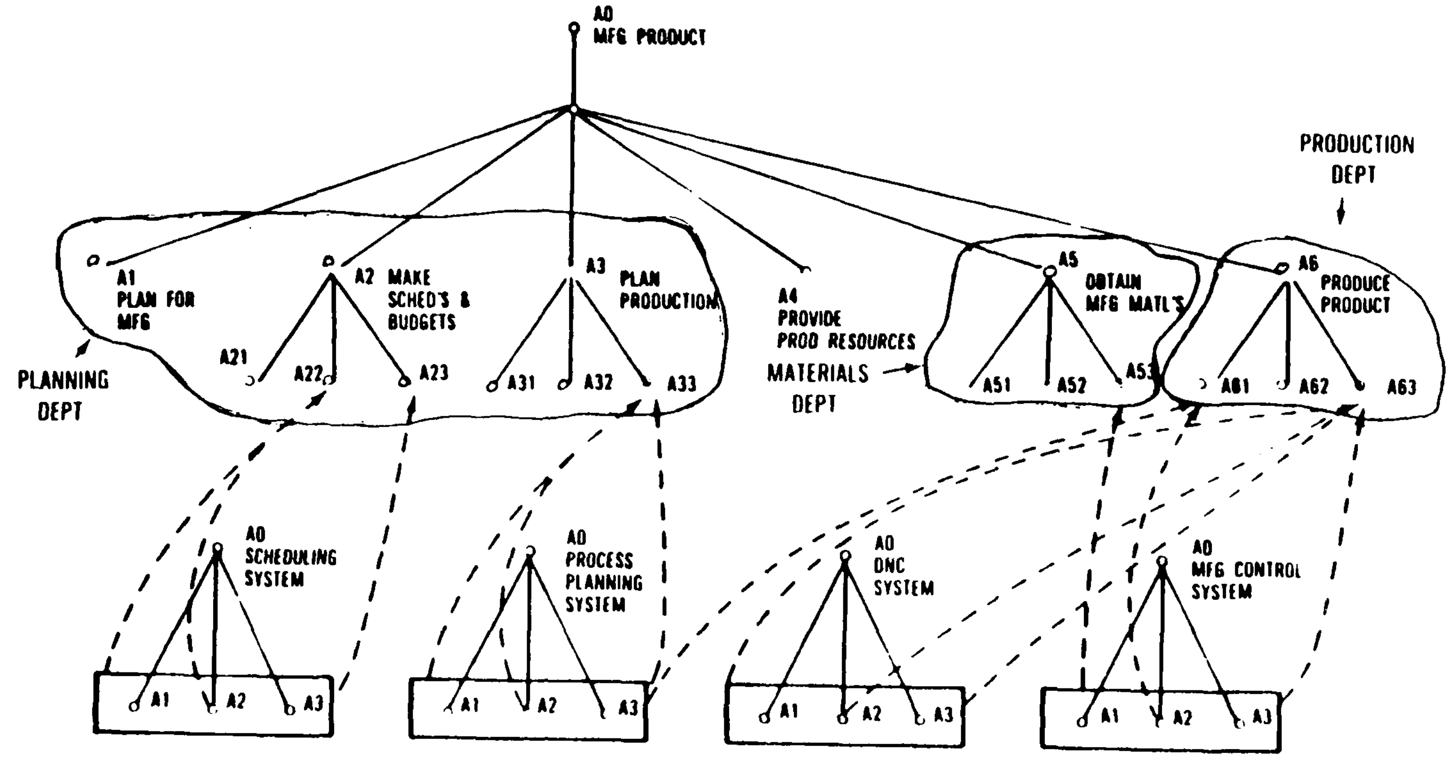
TECHNICAL TOOL

- SYSTEM(S) / TECHNOLOGY(S) STRUCTURE AND INTERFACES
- SYSTEM(S) / TECHNOLOGY(S) — ORGANIZATION(S) INTERACTIONS
- SYSTEM(S) / TECHNOLOGY(S) DEVELOPMENT AND INTEGRATION

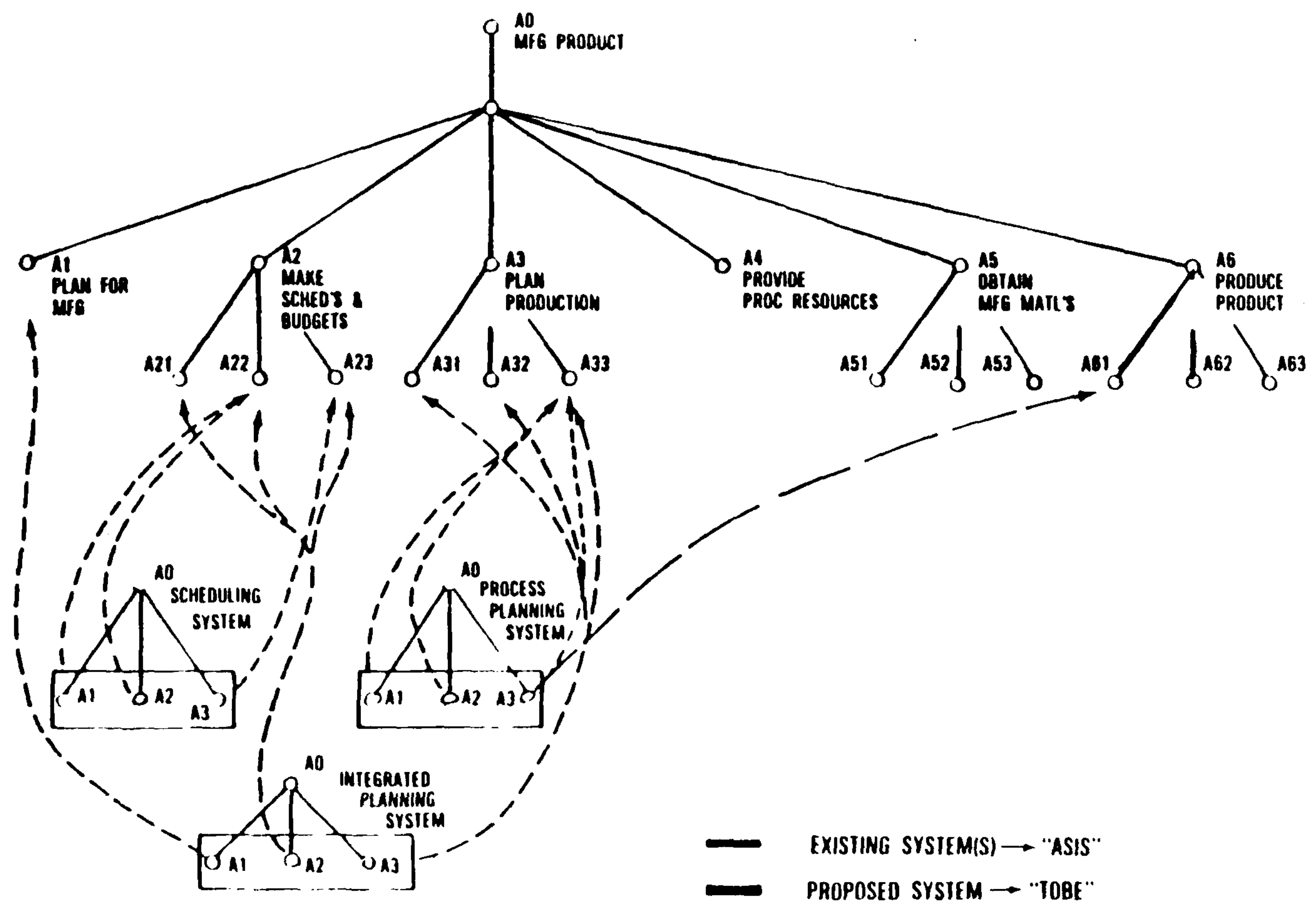
SYSTEM(S) / TECHNOLOGY(S) STRUCTURE AND INTERFACES



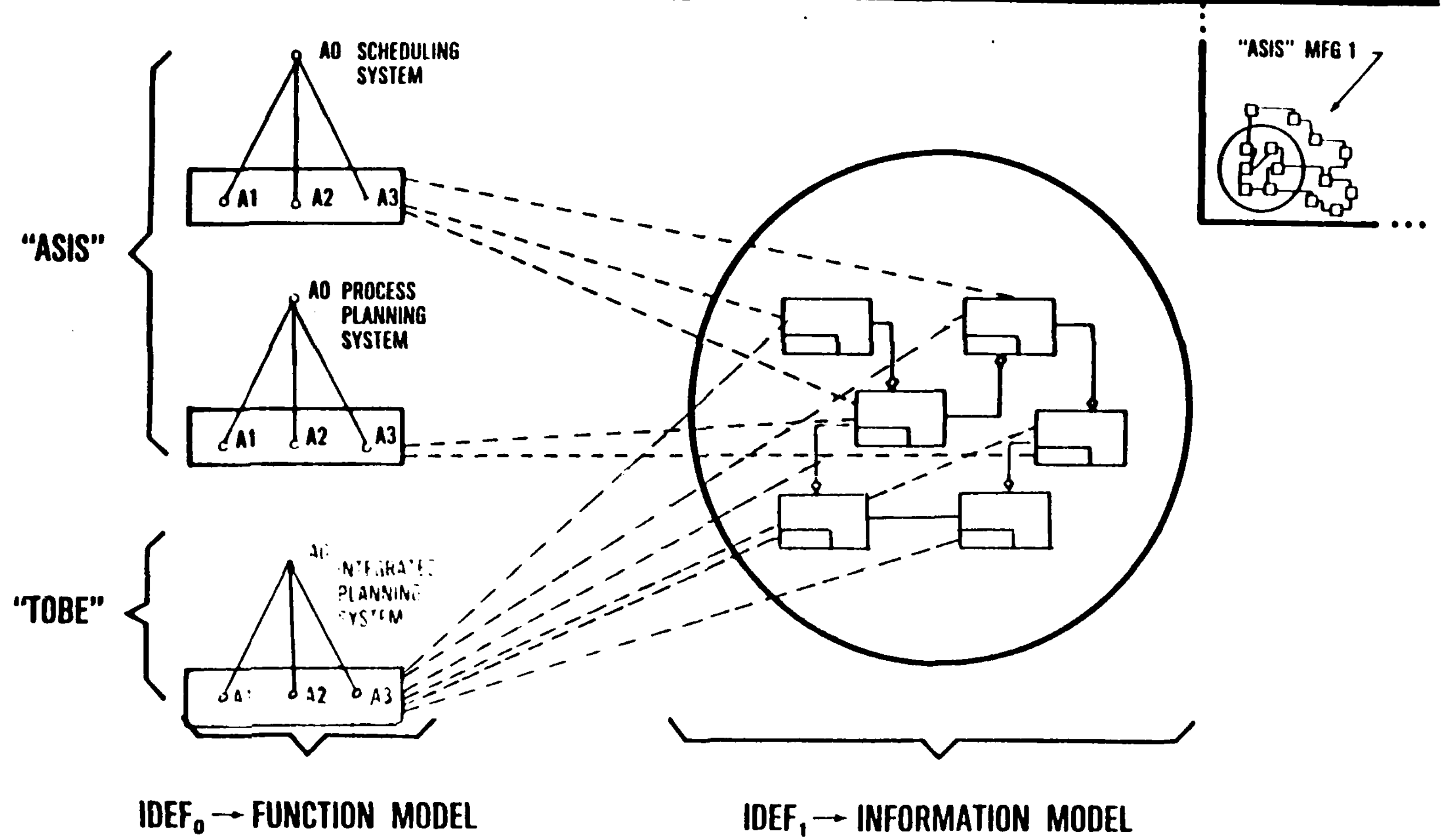
SYSTEM(S) / TECHNOLOGY(S) — ORGANIZATIONS INTERFACES



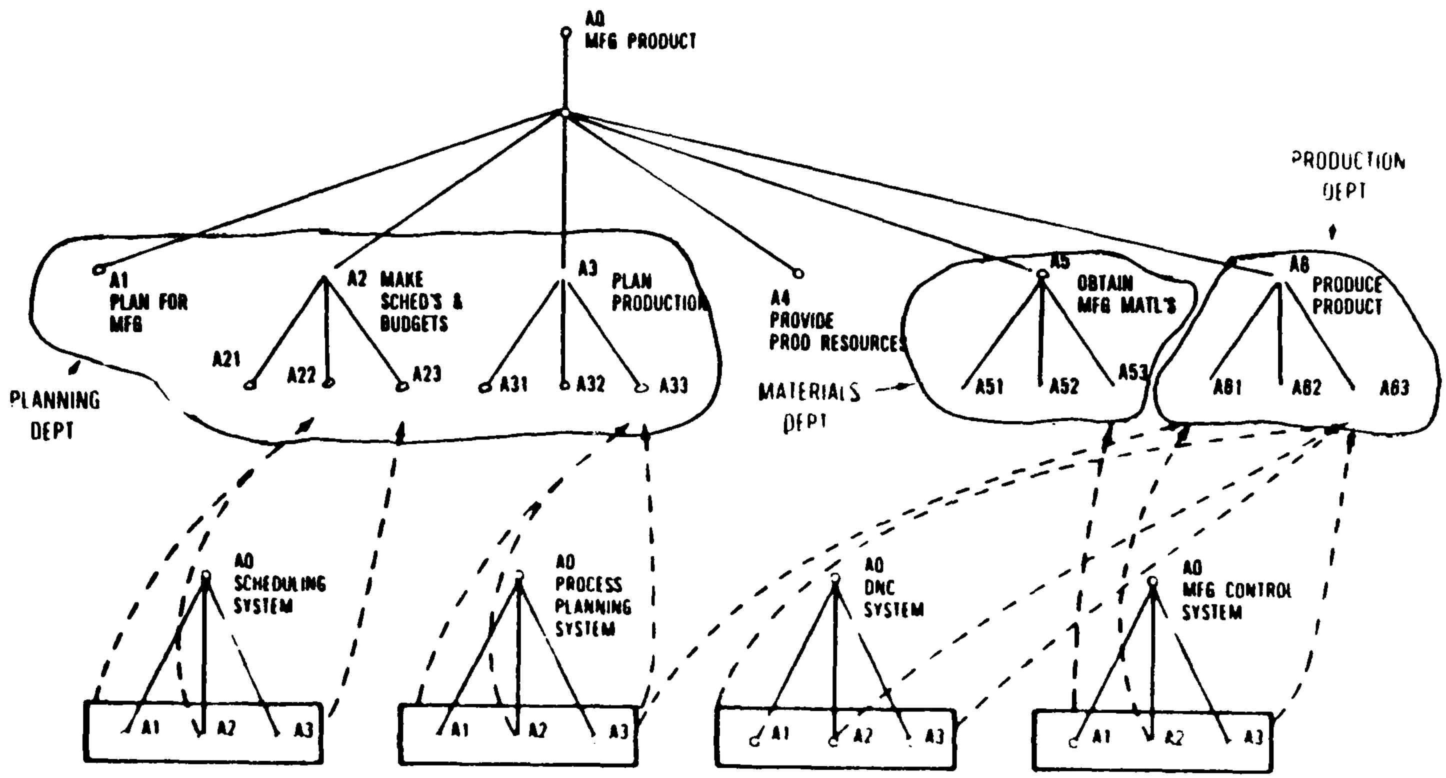
SYSTEM(S) / TECHNOLOGY(S) DEVELOPMENT AND INTEGRATION



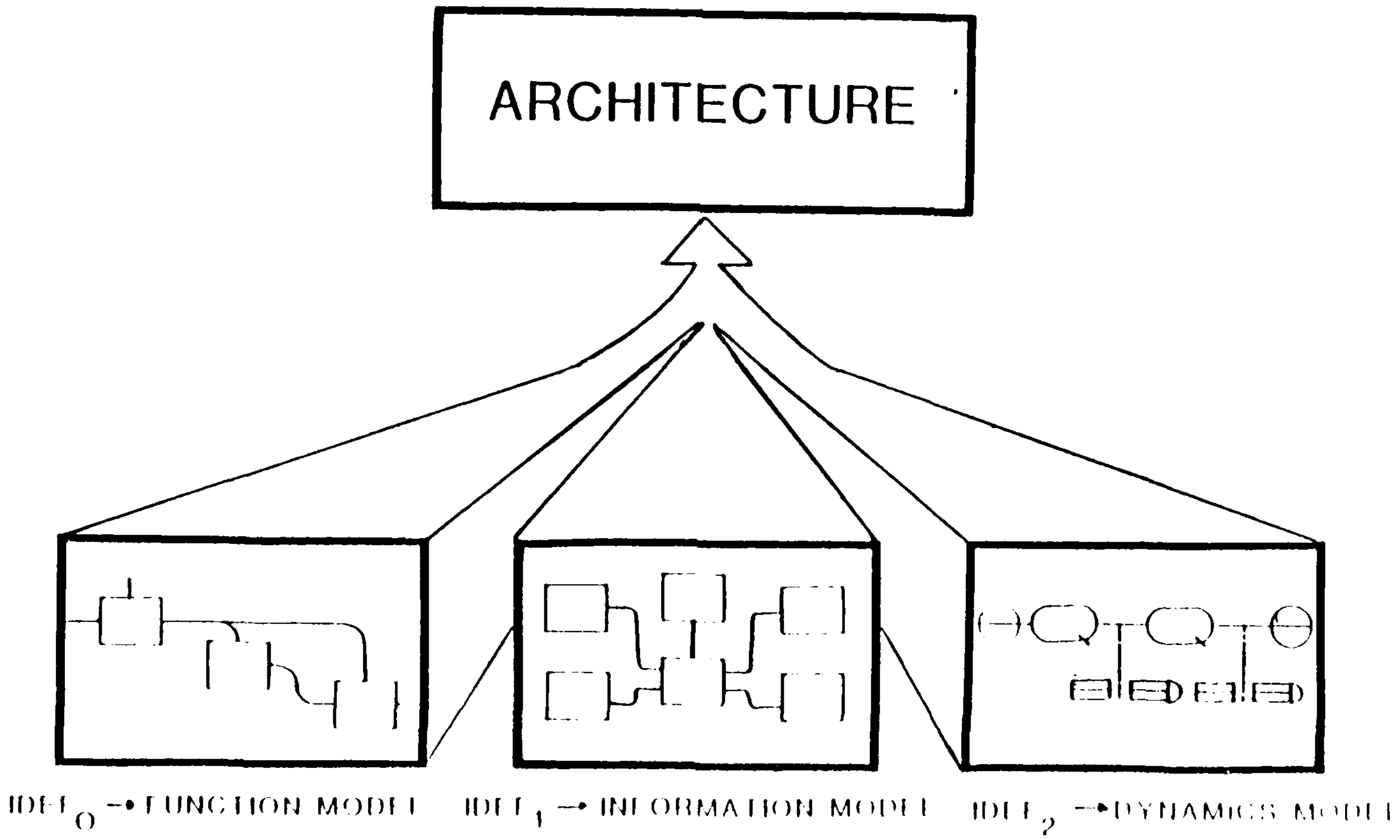
SYSTEM(S) / TECHNOLOGY(S) DEVELOPMENT AND INTEGRATION



EDUCATIONAL TOOL



ARCHITECTURE



2.4 Technology Transfer Practitioner's "Train the Trainers" Manual

FOREWORD

This Training Manual is designed to help teach an overview of the U.S. Air Force's Manufacturing TECHnology MODernization (TECH MOD) Program's use of related IDEF applications, concepts, and procedures. It also covers the use of the resulting Architecture in planning and controlling these Manufacturing Technology Modernization Programs to upgrade the U.S. industrial base.

This training manual is designed to give the instructor maximum efficiency in training manufacturing personnel by employing a step-by-step process, section-by-section, dealing with the concepts and procedures of IDEFØ Function Modeling, including reading, authoring, commenting on, and iterating IDEFØ Function Models.

TRAIN THE TRAINERS

2.4.1 Introduction

This is an instructor's manual intended to aid those teaching an overvew of the Air Force Manufacturing Technology Modernization (TECH MOD) Program's use of related ICAM IDEFØ Function Modeling Methodology. As an instructor's manual, it provides the elements and an order of presentation needed in teaching. The developing of style is left to the individual instructor.

This instructor's manual consists of a guide for conducting and presenting a practitioner's-level briefing; a set of overhead transparencies; and a step-by-step text, containing the objectives or procedures to be covered, concepts, and a suggested narration, handout materials and exercises.

The course materials are presented in a standardized format, divided into four sections. Each page is composed of a copy of the foil, the instructional objective that must be covered with that foil, and a suggested narration that may be followed until individual styles can be developed.

It must be made clear from the start that the ICAM Definition Language (IDEF) requires that both functions and data necessary to carry out a process be modeled.

The IDEFØ Function Modeling Methodology concerns itself with the modeling of functions along with the data those functions employ.

The IDEFØ Function Model is composed of diagrams, text, and glossary.

Both Authoring and Commenting roles and responsibilities of IDEF Function Model, are required for full development of each Function Model, because of the iterative nature of the IDEFØ methodology. This IDEF Training Course discusses Authoring Concepts and Procedures as well as Commenting Concepts and Procedures, respectively.

Overall planning for and conducting of actual training sessions is almost as critical to accomplishing participant learning objectives as the course presentation material. Attention must be given to planning for presentation set-up, pre-presentation, presentation, and post-presentation activities.

2.4.1.1 Presentation Set-Up

2.4.1.1.1 Audio/Visual Equipment:

a) Overhead vue foil projector

b) 35mm projector (if slides are used)

2.4.1.1.2 Audio/Visual Aids:

a) Overhead transparencies

b) 35mm color transparencies (when slides are used)

c) Training materials (handouts and/or manuals)

2.4.1.1.3 Room Set-up:

Everyone must be in hearing and seeing distance of the presentation.

REMEMBER: The best instructional program is no good if you can't hear and see it!

2.4.1.2 Pre-Presentation

- Review all training materials beforehand and be familiar with them.

- Make sure room, equipment, and materials are all in order and ready to go when you are.

REMEMBER: Prior planning prevents poor performance!

- Set up audio/visual equipment.

- Get audio/visual aids ready for presentation.

a) Make sure all overhead transparencies are in their order of presentation.

b) Make sure all 35mm color transparencies (when slides are used) are in their order of presentation and that they are all placed in carousel right-reading, (a slide in backwards or upside down can throw your whole presentation off kilter).

- Handout training materials:

  a) IDEFØ Function Modeling Manual (Vol. IV - AFWAL-TR-81-4023)

  b) Composite Function Model of "Manufacture Product" (MFGØ - Vol. VII - AFWAL-TR-81-4023)

  c) MFGØ Node Tree

  d) DESØ Node Tree

  e) IDEF Kit Cover Sheet

  f) IDEF Forms

  g) IDEF Templates

  h) Copies of Presentation Materials (Handed out section by section as applicable)

2.4.1.3 Presentation

- Give introduction

  a) Include purpose and viewpoint of presentation.

  b) Set atmosphere conducive to learning.

- Go through training materials step-by-step.

- Use peer cross-referencing method to check for understanding.

  PEER CROSS-REFERENCING METHOD

  a) Ask who understands the point you've just presented.

  b) Ask who isn't clear about it.

  c) Ask if anyone who understands the point can explain it to those who don't.

NOTE: If you don't get any takers, you must explain it over again, if possible, in different terms.

- REMEMBER:

  Just because you've presented the material doesn't mean that everyone has understood it.

2.4.1.4 Post Presentation

- Try not to leave any question unanswered. If you don't know, find out, and write or call with the answer.

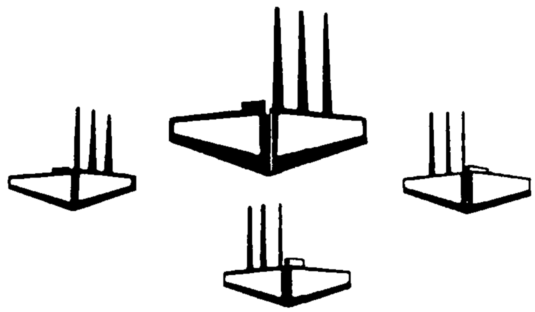
- At some time, a sheet could be filled out with the name, organization, department, phone number, etc. of those attending. Get sheet typed and make copies to give to everyone. Use for:

  - historical record
  - contact sheet.

2.4.2 ICAM IDEF/Architecture

ICAM

IDEF ⟶ ARCHITECTURE



TITLE SLIDE: ICAM IDEF/Architecture

COURSE OBJECTIVE: Orient and educate the executive level and upper mid-management personnel relative to the U.S. Air Force's Manufacturing Technology Modernization Program and the U.S. Air Force's ICAM planning and analytical tools.

NARRATION: "THE OBJECTIVE OF THIS PRESENTATION IS TO INTRODUCE ICAM DEFINITION METHODOLOGY (IDEF) AND THE UTILIZATION OF THE RESULTING ARCHITECTURE TO IMPROVE MANUFACTURING PRODUCTIVITY. WE WANT TO PROVIDE YOU WITH A BASIC UNDERSTANDING OF THE CONCEPTS AND TOOLS TO BE USED IN PUTTING TOGETHER AND MANAGING A MANUFACTURING TECHNOLOGY MODERNIZATION PROGRAM.

"APPLICATIONS OF THE MANUFACTURING TECHNOLOGY MODERNIZATION CONCEPT INCLUDE:

1. ANALYZING AND IMPROVING CURRENT PLANNING AND MANUFACTURING ACTIVITIES

2. PUTTING TOGETHER AND CARRYING OUT MANUFACTURING TECHNOLOGY MODERNIZATION PROPOSALS

3. MANAGING PROGRAMS USING ICAM TOOLS"

IDEF —ARCHITECTURE

- *WHAT IS ICAM ?*
- *WHAT IS IDEF ?*
- *HOW DOES IDEF RELATE TO ARCHITECTURE ?*

INSTRUCTIONAL OBJECTIVE: To provide an understanding of ICAM/IDEF Architecture.

NARRATION: "THIS SEGMENT OF OUR MANUFACTURING TECHNOLOGY MODERNIZATION PROGRAM ADDRESSES THESE QUESTIONS:

WHAT IS ICAM?

WHAT IS IDEF?

HOW DOES IDEF RELATE TO ARCHITECTURE?"

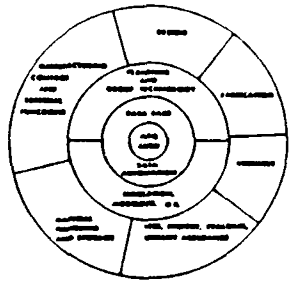
WHAT IS ICAM?

INSTRUCTIONAL OBJECTIVE: To provide an introductory break to the subject of ICAM.

NARRATION: "WHAT IS INTEGRATED COMPUTER AIDED MANUFACTURING? (ICAM) ICAM IS A USAF THRUST USED TO COMBINE THE POTENTIAL OF THE COMPUTER, INNOVATIVE MANUFACTURING, AND NEW MANAGEMENT CONCEPTS TO IMPROVE PRODUCTIVITY, ON ALL LEVELS, IN AMERICAN INDUSTRY."

ICAM

**INTEGRATED
COMPUTER-AIDED MANUFACTURING**

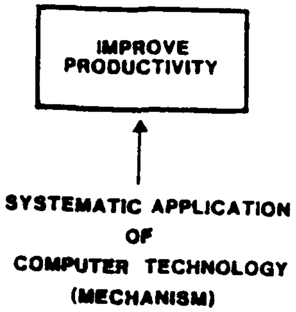


INSTRUCTIONAL OBJECTIVE: To provide an understanding of the importance placed upon the manufacturing architecture developed using the IDEF methodologies.

NARRATION: "THIS USAF ICAM LOGO ILLUSTRATES THE IMPORTANCE PLACED UPON THE MANUFACTURING ARCHITECTURE DEVELOPED BY THE IDEF METHODOLOGIES - IT IS THE CENTER PIECE OF THE PROGRAM - THE BASIS FOR DEVELOPING INTEGRATED DATABASES AND DATA AUTOMATION.

"THE ICAM LOGO GRAPHICALLY REPRESENTS THE DISCIPLINES OF MANUFACTURING THAT MUST BE RECOGNIZED AS INTEGRAL PARTS OF MANUFACTURING. THE CONCENTRIC PATTERN CAPTURES THE TRANSITION FROM THE INNER CIRCLE THRUST AREAS OF CONCEPT THROUGH TO THE SHOP FLOOR AND FINALLY TO THE PRODUCTION LINE FUNCTIONS AT THE OUTER CIRCLE AREAS."

PURPOSE OF ICAM

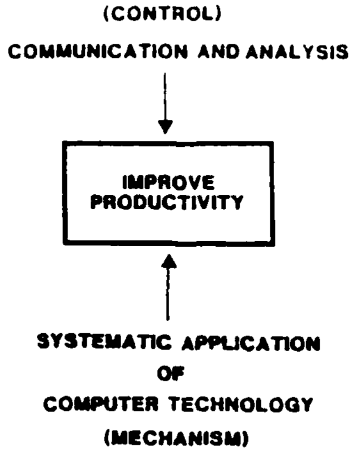


INSTRUCTIONAL OBJECTIVE: To provide an understanding of ICAM's purpose.

NARRATION: "THEREFORE - THE OVERALL PURPOSE OF ICAM IS TO IMPROVE MANUFACTURING PRODUCTIVITY THROUGH SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY. THE ICAM ARCHITECTURE OR FRAMEWORK THAT WE WILL BE DISCUSSING IS PREDICATED ON THIS 'SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY.'

"TO IMPROVE PRODUCTIVITY THROUGH THE DEVELOPMENT AND IMPLEMENTATION OF NEW TECHNOLOGY, WE MUST SYSTEMATICALLY 'PLAN - ORGANIZE - CONTROL AND COORDINATE' DATA. HERE WE DEFINE ICAM'S FUNCTION AS IMPROVE PRODUCTIVITY. THE MECHANISM TO 'MAKE IT HAPPEN' WILL BE THE 'SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY'."

ICAM APPROACH



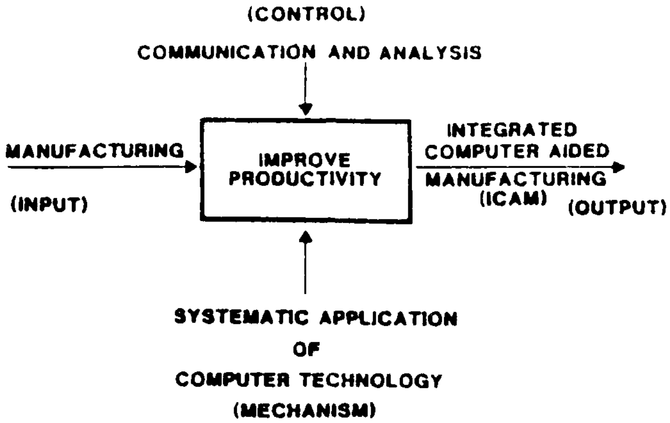
INSTRUCTIONAL OBJECTIVE: To provide an understanding of the fact that communication and analysis is the key control to improved productivity.

NARRATION: "THE ICAM APPROACH RECOGNIZES THAT MANUFACTURING IS A VERY COMPLEX ENVIRONMENT COMPRISED OF MANY PEOPLE, SYSTEMS, AND TECHNOLOGIES.

"WHEN WE REFER TO 'MANUFACTURING' WE ARE RELATING TO THE 'TOTAL MANUFACTURING ENTERPRISE', INCLUDING MANAGEMENT'S 'TOP-DOWN' REQUIREMENTS AS WELL AS 'BOTTOM-UP' REQUIREMENTS OF THE FACTORY FLOOR.

"TO IMPROVE PRODUCTIVITY, A COMMON UNDERSTANDING OF THE PROBLEM (EXISTING MANUFACTURING) AND A SOLUTION (FUTURE MANUFACTURING) IS NECESSARY. THIS COMMON UNDERSTANDING MUST BE COMMUNICATED TO AND ANLYZED BY MANY DIFFERENT PEOPLE RANGING FROM THE SHOP FLOOR USER TO THE MANUFACTURING ANALYST, TO THE SYSTEM DEVELOPER, AND FINALLY ON TO MANAGEMENT."

OBJECTIVE OF ICAM



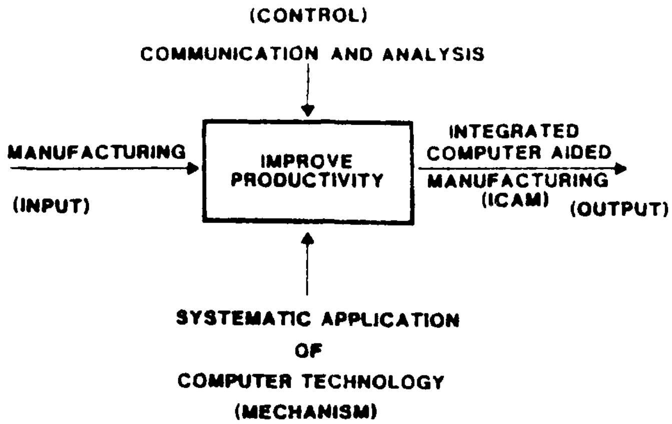
INSTRUCTIONAL OBJECTIVE: To provide an understanding that by utilizing manufacturing as an input, we will accomplish the function of improved productivity and output Integrated Computer Aided Manufacturing (ICAM).

NARRATION: "TO SUMMARIZE - THE ICAM OBJECTIVE IS:

- o FUNCTION - IMPROVE PRODUCTIVITY
- o INPUT - EXISTING MANUFACTURING
- o CONTROL - COMMUNICATION AND ANALYSIS
- o MECHANISM - SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY
- o OUTPUT - INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM).

ICAM RECOGNIZES THAT PRODUCTIVITY CAN BE IMPROVED NOT JUST THROUGH THE IMPLEMENTATION OF NEW MANUFACTURING TECHNOLOGY, BUT ALSO THROUGH THE SUCCESSFUL INTEGRATION OF THAT TECHNOLOGY INTO EXISTING MANUFACTURING."

OBJECTIVE OF ICAM



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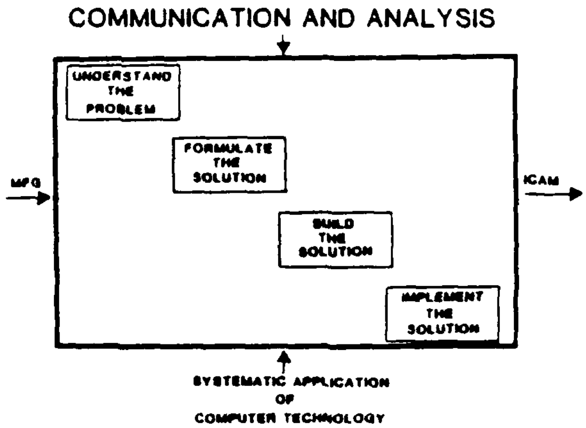
IMPROVE PRODUCTIVITY



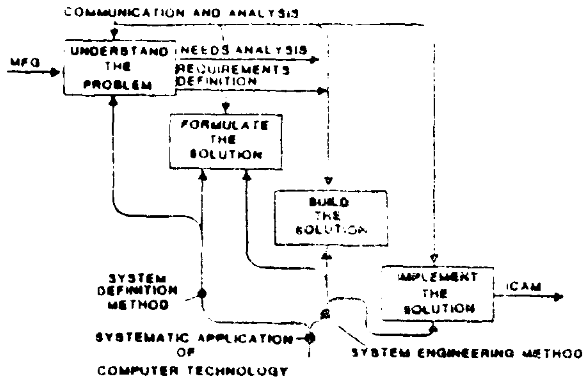
INSTRUCTIONAL OBJECTIVE: To provide an understanding of the $IDEF_0$ decomposition process and the ICAM life cycle.

NARRATION: "LET'S NOW TAKE AN $IDEF_0$ FUNCTION ANALYSIS APPROACH AND FURTHER DECOMPOSE (OR BREAKDOWN) THE ICAM LIFE CYCLE MODEL CONTEXT WE JUST DEFINED AND DISCUSSED.

"HERE THE ICAM APPROACH BEGINS TO TAKE SHAPE. ICAM HAS ESTABLISHED A 'SYSTEM DEVELOPMENT LIFE CYCLE' TO CONTROL ITS PROGRAM - UNDERSTAND THE PROBLEM, FORMULATE THE SOLUTION, BUILD THE SOLUTION, AND IMPLEMENT THE SOLUTION.

"EACH IS A FUNDAMENTAL 'COMMUNICATION AND ANALYSIS' ACTIVITY INVOLVED IN THE TRANSISTION OF EXISTING MANUFACTURING TO THE FUTURE ICAM."

IMPROVE PRODUCTIVITY



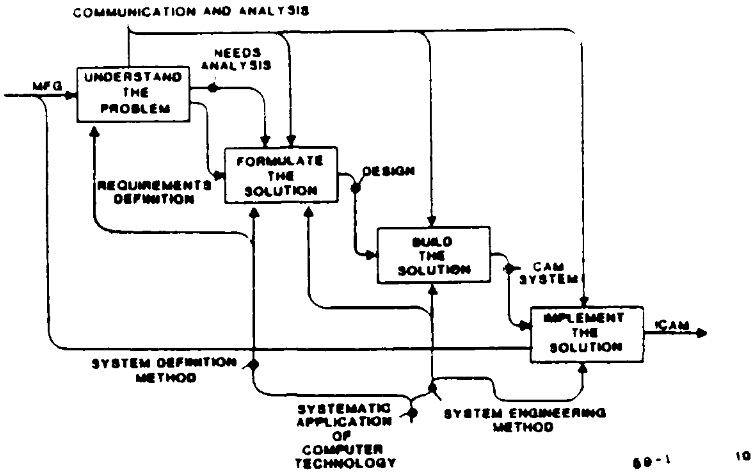
INSTRUCTINAL OBJECTIVE: To provide an understanding of the $IDEF_0$ decomposition process and the ICAM life cycle.

NARRATION: "THE ICAM SYSTEM DEVELOPMENT LIFE CYCLE IS SIMILIAR TO OTHER SUCH LIFE CYCLES EXCEPT THAT ICAM RECOGNIZES THAT THE CURRENT ENVIRONMENT MUST BE STUDIED IN DETAIL TO DETERMINE THE NEEDS OF THAT ENVIRONMENT TO PERMIT AN IN-DEPTH UNDERSTANDING (I.E. PEOPLE, SYSTEMS, AND TECHNOLOGIES).

THE USE OF A STRUCTURED SYSTEM DEFINITION SUCH AS THE USAF ICAM/IDEF METHODOLOGY WILL FACILITATE BETTER UNDERSTANDING, COMMUNICATION, AND ANALYSIS OF THE PROBLEM. BY EMPHASIZING THE 'UNDERSTANDING OF THE PROBLEM' PHASE, ICAM BELIEVES THAT THE TOTAL COST IN TERMS OF TIME AND MONEY FOR SYSTEM DEVELOPMENT AND IMPLEMENTATION WILL BE REDUCED, RESULTING IN THE SUCCESSFUL INTEGRATION OF NEW TECHNOLOGY INTO EXISTING MANUFACTURING.

(TALK THRU CHART DISCUSSING FUNCTIONS, INPUTS, CONTROLS, OUTPUTS, AND MECHANISMS.)

IMPROVE PRODUCTIVITY



INSTRUCTIONAL OBJECTIVE: To provide an example of how the use of a structured system definition such as the ICAM/IDEF methodology will facilitate better understanding, communication, and analysis of the problem.

NARRATION: "AS A RESULT OF ANALYZING THE NEEDS AND DEFINING THE REQUIREMENTS, ALTERNATIVE IMPROVEMENTS CAN BE CONSIDERED (NEEDS - INPUT REQUIREMENTS - CONTROL).

"THE EXISTING ENVIRONMENT IS MATCHED AGAINST THE NEEDS TO IDENTIFY THE IMPROVEMENTS WHICH CAN BE EVALUATED FOR INCLUSION IN THE 'TO BE' FUTURE DESIGN.

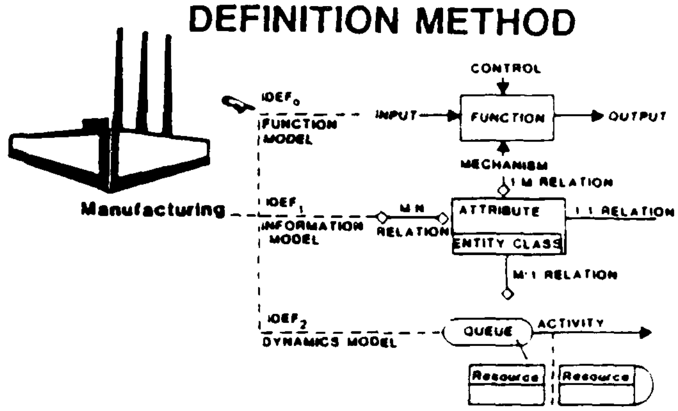
"USING A STRUCTURED SYSTEM DEFINITION METHOD LIKE THE IDEF METHODOLOGY FACILITATES BETTER UNDERSTANDING, COMMUNICATION, AND ANALYSIS OF THE SOLUTION. THE DESIGN IS THEN CONSTRUCTED AND INTEGRATED INTO EXISTING MANUFACTURING, RESULTING IN ICAM!

WHAT IS IDEF?

INSTRUCTIONAL OBJECTIVE: To provide an understanding of the ICAM Definition (IDEF) method, language or technique.

NARRATION: "IDEF, THE 'ICAM DEFINITION' METHOD, IS A STRUCTURED APPROACH TO A MODELING METHODOLOGY WHOSE PURPOSE IS TO GRAPHICALLY CAPTURE CHARACTERISTICS OF THE MANUFACTURING FUNCTIONS, INFORMATION SUPPORT FUNCTIONS, AND THE DYNAMICS OF THE FUNCTION AND INFORMATION INTERACTION."

IDEF - A SYSTEM DEFINITION METHOD

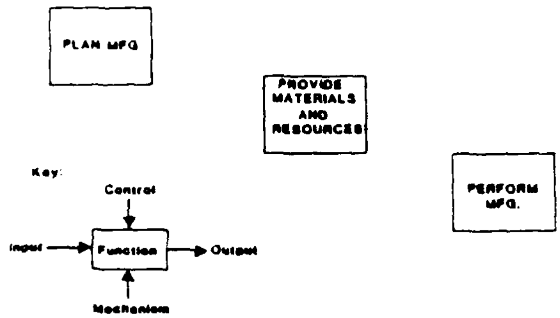


58-1 14

INSTRUCTIONAL OBJECTIVE: To introduce the $IDEF_0$ function modeling methodology.

NARRATION: "AN $IDEF_0$ FUNCTION MODEL ANSWERS SPECIFIC QUESTIONS RELATIVE TO THE BASIC FUNCTIONAL BREAKDOWN OR DECOMPOSITION OF THE MANUFACTURING ENTERPRISE."

IDEF$_0$ — FUNCTION MODEL



59-1 16

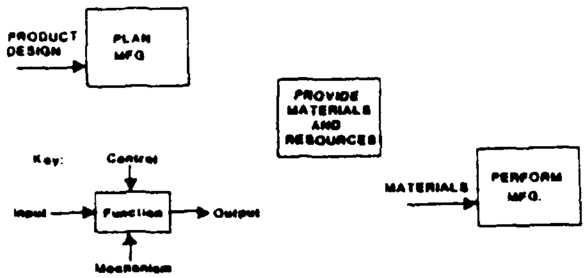
INSTRUCTIONAL OBJECTIVE: To introduce the IDEF$_0$ function modeling methodology.

NARRRATION: "LET'S CONSTRUCT A TOP LEVEL FUNCTION MODEL OF A MANUFACTURING ENTERPRISE'S PRODUCTION ACTIVITY:

- o PLAN MANUFACTURING
- o PROVIDE MATERIAL/RESOURCES
- o PERFORM MANUFACTURING

"PLEASE NOTE THE 'KEY' PROVIDED TO FACILITATE YOUR UNDERSTANDING THROUGH THE NEXT STEPS IN OUR MODEL CONSTRUCTION."

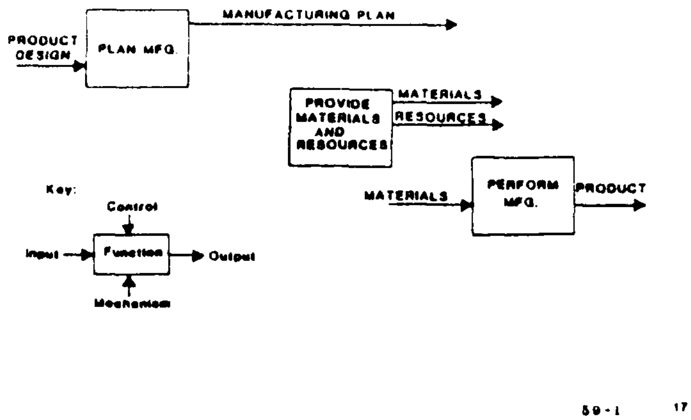
IDEF$_0$ -- FUNCTION MODEL



INSTRUCTIONAL OBJECTIVE: To introduce the IDEF$_0$ function modeling methodology.

NARRATION: "WHAT IS BEING TRANSFORMED AND WHAT IS THE RESULT? HERE WE INPUT 'PRODUCT DESIGN' INTO THE FUNCTION OF 'PLAN MANUFACTURING'."

IDEF$_0$ -- FUNCTION MODEL



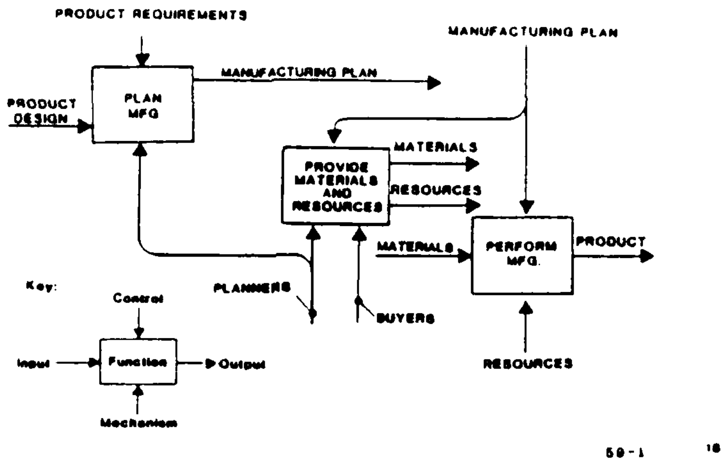
INSTRUCTIONAL OBJECTIVE: To introduce the IDEF$_0$ function modeling methodology.

NARRATION: "OUR PRODUCT DESIGN 'INPUT' IS BEING TRANSFORMED INTO A MANUFACTURING PLAN AND EVENTUALLY INTO A PRODUCT 'OUTPUT'.

"THE 'OUTPUT' OF THE FUNCTION 'PROVIDE MATERIALS AND RESOURCES' IS 'MATERIALS AND RESOURCES'.

"IN ORDER TO ACCOMPLISH OUR 'PERFORM MANUFACTURING' FUNCTION, WE MUST 'INPUT' MATERIALS."

IDEF$_0$ -- FUNCTION MODEL



INSTRUCTIONAL OBJECTIVE: To introduce the IDEF$_0$ function modeling methodology.

NARRATION: "WHAT INFLUENCES THESE FUNCTIONS?

'PLAN MANUFACTURING' IS INFLUENCED BY 'PRODUCT REQUIREMENTS'.

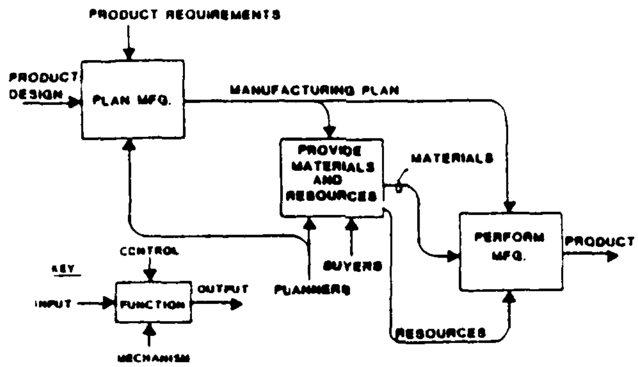
'PROVIDE MATERIALS AND RESOURCES' AND 'PERFORM MANUFACTURING' ARE INFLUENCED BY THE 'MANUFACTURING PLAN'.

WHAT IS NECESSARY TO CARRY OUT THESE FUNCTIONS?

'PERFORM MANUFACTURING' REQUIRES THE MECHANISM OF 'RESOURCES' SUCH AS EQUIPMENT, TOOLS, AND PEOPLE.

THE OTHER FUNCTIONS REQUIRE PEOPLE - PLANNERS AND BUYERS."

IDEF$_0$ -- FUNCTION MODEL



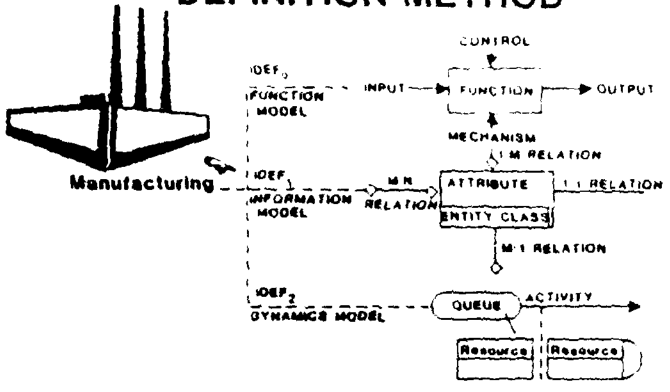
INSTRUCTIONAL OBJECTIVE: To introduce the IDEF$_0$ function modeling methodology.

NARRATION: "HERE WE HAVE CLEANED UP OUR IDEF$_0$ MODEL DIAGRAM FOR YOU TO ILLUSTRATE THAT:

IDEF IS USED TO PRODUCE A FUNCTION MODEL PERSPECTIVE, A BLUEPRINT, A STRUCTURED DESCRIPTION OF WHAT IS BEING PERFORMED.

YOU MAY FURTHER DECOMPOSE EACH OF THESE FUNCTIONS TO PROVIDE A BREAKDOWN TO ANY DESIRED LEVEL OF DETAIL, THEREBY PROVIDING A FUNCTIONAL ARCHITECTURE OR FRAMEWORK OF MANUFACTURING."

IDEF - A SYSTEM DEFINITION METHOD



59-1 20

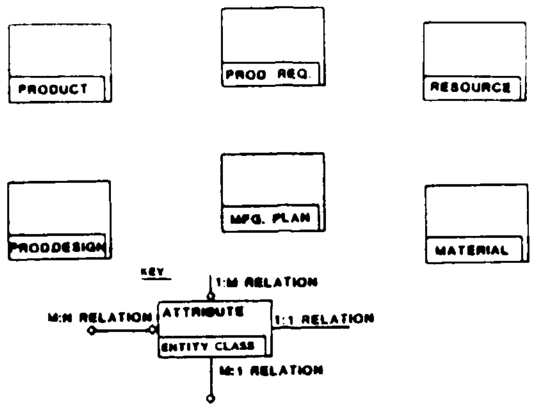
INSTRUCTIONAL OBJECTIVE: To introduce the $IDEF_1$ information modeling methodology.

NARRATION: "THE $IDEF_1$ INFORMATION MODEL PROVIDES AN IN-DEPTH DESCRIPTION OF INFORMATION BY FOCUSING ON THE STRUCTURE OF INFORMATION IN SUPPORT OF WHAT IS BEING PERFORMED.

"WE FEEL THAT THIS MODELING PERSPECTIVE IS ABSOLUTELY ESSENTIAL TO THE INTEGRATION OF $IDEF_0$ FUNCTION MODELS AND THE DEVELOPMENT OF AN INTEGRATED DATABASE.

"THE $IDEF_1$ INFORMATION MODELS ARE PROVING TO BE ICAM'S KEY SYSTEM INTEGRATION TOOL."

IDEF$_1$ -- INFORMATION MODEL



59-1 21

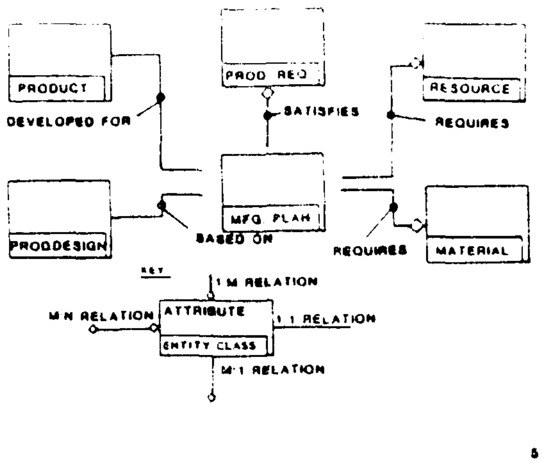
INSTRUCTIONAL OBJECTIVE: To introduce the IDEF$_1$ information modeling methodology.

NARRATION: "AN IDEF$_1$ INFORMATION MODEL CAN ANSWER SPECIFIC QUESTIONS REGARDING ANY INFORMATION ELEMENT (ENTITY CLASS) - SOMETIMES THE IDEF$_1$ MODEL ANSWERS QUESTIONS NOT DEFINABLE IN IDEF$_0$ FUNCTION MODELS.

"PLEASE AGAIN NOTE THAT WE HAVE PROVIDED A MODEL KEY ON EACH OF THESE PRESENTATIONS TO FACILITATE YOUR UNDERSTANDING. THE IDEF$_1$ PRIMITIVES ARE ENTITIES, ATTRIBUTES, AND RELATIONS.

"LET'S EXAMINE THE RELATIONS BETWEEN OUR MANUFACTURING PLAN AND THE OTHER ENTITIES SHOWN."

IDEF$_1$ -- INFORMATION MODEL



INSTRUCTIONAL OBJECTIVE: To introduce the IDEF$_1$ information modeling methodology.

NARRATION: "WHAT IS THE RELATION OF ALL THE OTHER INFORMATION ELEMENTS SHOWN TO THE 'MANUFACTURING PLAN' ENTITY CLASS?

EACH 'PRODUCT' HAS A SPECIFIC 'MANUFACTURING PLAN.'

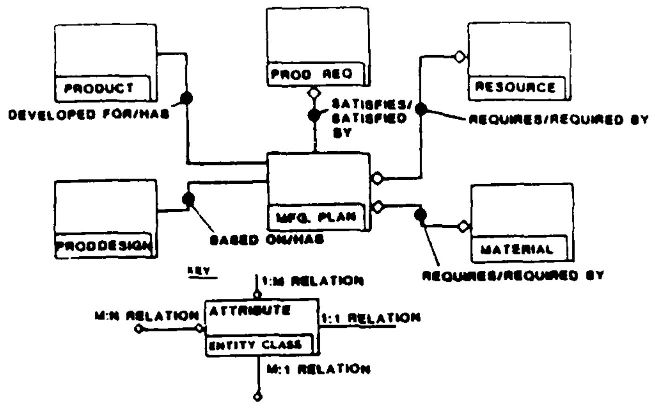
EACH DESIGN HAS A SPECIFIC 'MANUFACTURING PLAN.'

MANY PRODUCT REQUIREMENTS MAY BE SATISFIED BY THE 'MANUFACTURING PLAN.'

MANY 'RESOURCES' ARE REQUIRED BY THE 'MANUFACTURING PLAN.'

MANY 'MATERIALS' ARE REQUIRED BY THE 'MANUFACTURING PLAN.'"

IDEF$_1$ -- INFORMATION MODEL



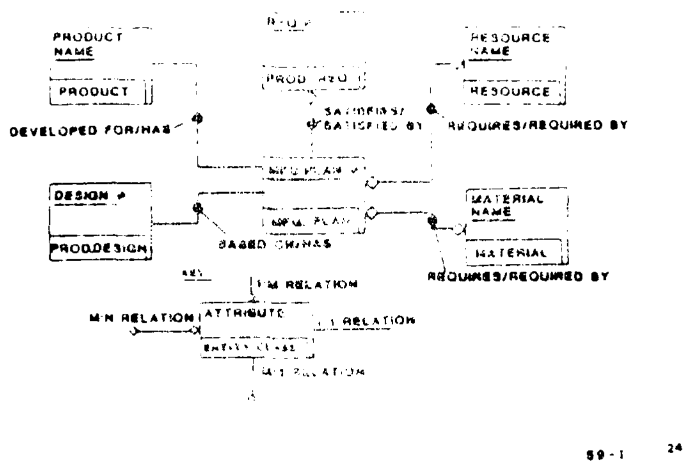
69-1 23

INSTRUCTIONAL OBJECTIVE: To introduce the IDEF$_1$ information modeling methodology.

NARRATION: "FOLLOWING THE SAME ANALYSIS TECHNIQUE WE HAVE NOW COMPLETED THE RELATION DIAGRAMMING FOR THE RELATION CLASSES SHOWN."

(REVIEW EACH USING 'MANUFACTURING PLAN' AS 'CENTER.')

IDEF$_1$ — INFORMATION MODEL



INSTRUCTIONAL OBJECTIVE: To provide an introduction to the IDEF$_1$ information modeling methodology.

NARRATION: "LET'S EXAMINE SOME OF THE CHARACTERISTICS OR ATTRIBUTE CLASSES OF THESE ENTITY CLASSES WHICH ARE NECESSARY TO BE MAINTAINED.

(REVIEW ATTRIBUTE CLASSES.)

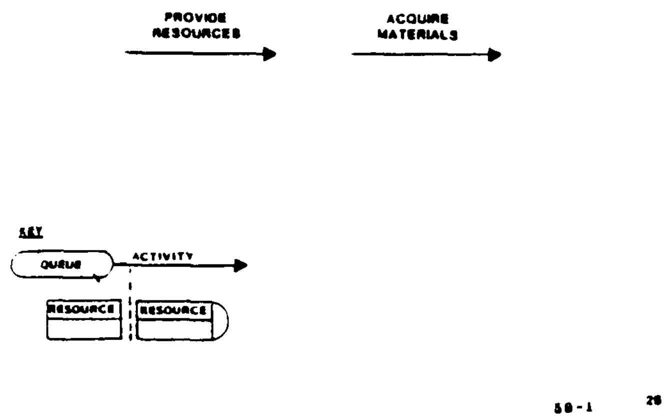
"IDEF$_1$ IS USED TO PRODUCE AN INFORMATION MODEL PERSPECTIVE, A 'DATA DICTIONARY', AND A STRUCTURED DESCRIPTION OF THE BASIC INFORMATION ELEMENTS.

"THE MODEL DEFINES, CROSS-REFERENCES, RELATES, AND CHARACTERIZES INFORMATION TO THE LEVEL OF DETAIL NECESSARY TO SUPPORT AND INTEGRATE THE MANUFACTURING ENVIRONMENT.

"IDEF$_1$ MODELS ARE ESSENTIAL TO COMMUNICATE THE INTERRELATIONSHIP OF INFORMATION AND TO PLAN INTEGRATED COMPUTER AIDED MANUFACTURING.

"IDEF$_1$ MODELS PROVIDE THE BASIS TO ANALYZE THE COMMON, SHARED, AND PRIVATE INFORMATION NEEDS OF THE MANUFACTURING ENVIRONMENT."

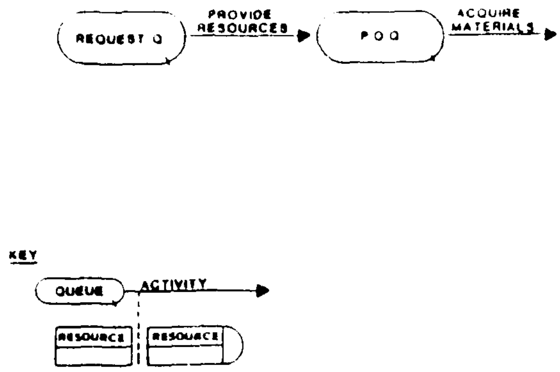
$IDEF_2$ — DYNAMICS MODEL



INSTRUCTIONAL OBJECTIVE: *To introduce the $IDEF_2$ dynamics modeling methodology.*

NARRATION: "THE $IDEF_2$ DYNAMICS MODEL REPRESENTS THE TIME DEPENDENT CHARACTERISTICS OF MANUFACTURING. IT IS USED TO DESCRIBE AND ANALYZE THE BEHAVIOR OF FUNCTIONS AND INFORMATION INTERACTIONS OVER TIME."

IDEF$_2$ → DYNAMICS MODEL



38-1 20

INSTRUCTIONAL OBJECTIVE: To introduce the IDEF$_2$ dynamics modeling methodology.

NARRATION: "IDEF$_2$ MODELS ANSWER SPECIFIC QUESTIONS ABOUT ANY OBJECT OR INFORMATION AS IT PASSES THROUGH THE MANUFACTURING ENVIRONMENT.

FOR EXAMPLE:

WHAT ACTIVITIES DOES THE MANUFACTURING PLAN FLOW THROUGH? 'PROVIDE RESOURCES' <u>AND</u> 'ACQUIRE MATERIALS.'"

AD-A144 732 INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM) ARCHITECTURE PART 3 VOLUME..(U) SOFTECH INC WALTHAM MA A W SNODGRASS SEP 83 1080-37 5/6

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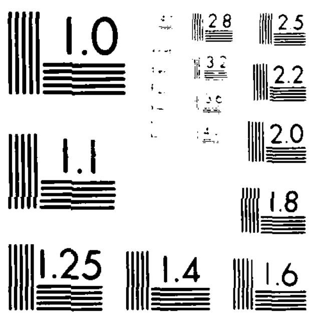
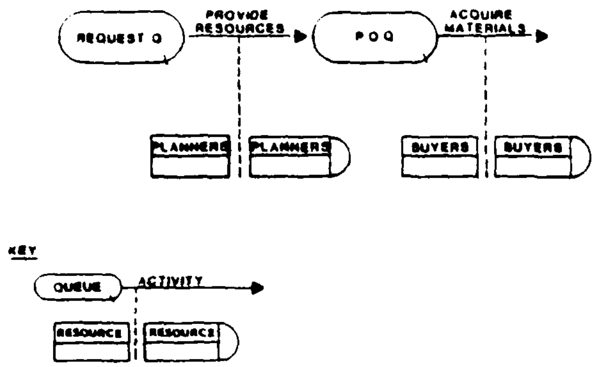


RESOLUTION TEST CHART

$IDEF_2$ — DYNAMICS MODEL



58-1 27

INSTRUCTIONAL OBJECTIVE: *To introduce the $IDEF_2$ dynamics modeling methodology*

NARRATION: "WHAT TIME IS REQUIRED TO ACCOMPLISH THESE ACTIVITIES?

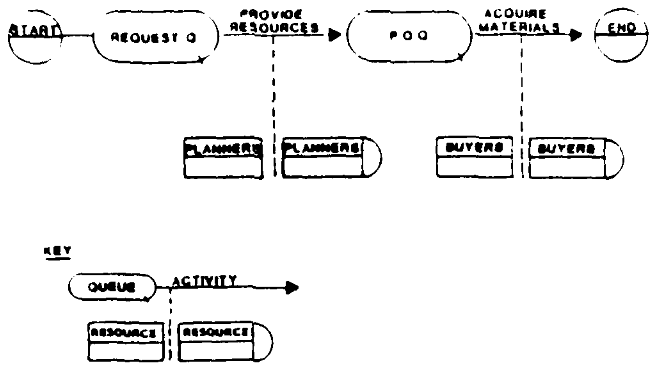
WHAT TIME IS CONSUMED IN QUE WAITING TO BE PROCESSED BY THE ACTIVITIES?

WHAT RESOURCES ARE ALLOCATED, UTILIZED, AND DEALLOCATED BY THE ACTIVITIES?

"ONCE THESE QUESTIONS HAVE BEEN ANSWERED, BECAUSE OF TIME RELATIVE INFORMATION ASSOCIATED WITH EACH QUESTION, FURTHER QUESTIONS MAY BE ANSWERED REGARDING PERFORMANCE OF FLOW - SUCH AS:

WHAT IS THE TOTAL PROCESSING TIME OF THE MANUFACTURING PLAN? - WHAT IS THE TOTAL TIME A MANUFACTURING PLAN IS WAITING IN QUE TO BE PROCESSED? - WHAT IS THE UTILIZATION OF RESOURCES AND WHAT STATISTICS ARE ASSOCIATED WITH THESE TIMES.

IDEF$_2$ -- DYNAMICS MODEL



58-1 28

INSTRUCTIONAL OBJECTIVE: To introduce the IDEF$_2$ dynamics modeling methodology.

NARRATION: "IDEF$_2$ THEREFORE IS USED TO PRODUCE A DYNAMICS MODEL, A 'SCENARIO' - A STRUCTURED DESCRIPTION OF THE TIME ORIENTED BEHAVIOR OF FUNCTIONS AND INFORMATION, AND PREVIOUS QUANTITATIVE INFORMATION AS TO THEIR SEQUENCE, DURATION, AND FREQUENCY AT A LEVEL OF DETAIL NECESSARY TO ANALYZE HOW MANUFACTURING IS PERFORMED. (I.E. COMMUNICATE FUNCTION/INFORMATION INTERRELATION - ANALYZE RESOURCE UTILIZATION (THROUGHPUT TIME COSTS)."

HOW DOES IDEF RELATE TO ARCHITECTURE ?

INSTRUCTIONAL OBJECTIVE: To provide an understanding of the relationship between ICAM IDEF methodology and the resulting manufacturing architecture

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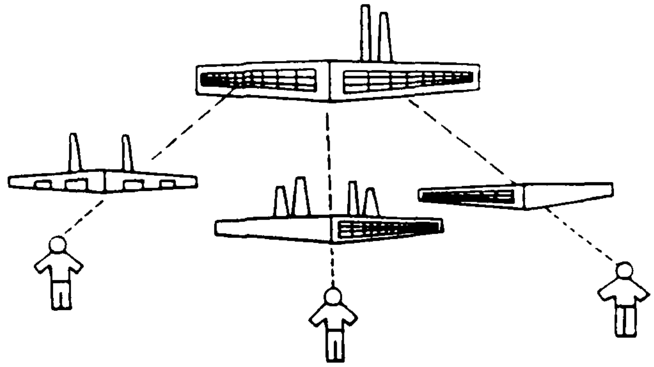
NARRATION: (PASS OUT ARCHITECTURE BOOKS AND NODE TREES.)

"THE HANDOUTS YOU HAVE JUST RECEIVED INCLUDE AN EXTRACT FROM AN ICAM 'ARCHITECTURE OF MANUFACTURING' REPORT. THE GENERIC DIAGRAMS AND RESULTING ARCHITECTURE PROVIDED WERE DEVELOPED BY A COALITION OF AEROSPACE COMPANIES AND OTHER ORGANIZATIONS FOR THE AIR FORCE. THIS PACKAGE IS REFERRED TO AS MFGO. THE CORRESPONDING ICAM DESIGN ARCHITECTURE IS REFERRED TO AS DESO.

"THE MANUFACTURING ARCHITECTURE NODE TREE PROVIDES A PICTORIAL REPRESENTATION OF THE $IDEF_0$ DIAGRAMS PROVIDED IN THE HANDOUTS.

"WHENEVER WE REFER TO THE ICAM MANUFACTURING ARCHITECTURE THROUGHOUT THE REST OF THIS PRESENTATION, WE ARE REFERRING TO THESE DOCUMENTS AND ANTICIPATED UPDATING DOCUMENTS TO BE PUBLISHED BY THE AIR FORCE IN THE FUTURE."

ARCHITECTURE
STANDARD FOR COMMUNICATION



INSTRUCTIONAL OBJECTIVE: To provide an understanding of the fact that the generic manufacturing architecture provides a standard for communication.

NARRATION: "THE GENERIC ICAM MANUFACTURING ARCHITECTURE HAS BEEN AND IS BEING DEVELOPED THROUGH COALITIONS OF AEROSPACE CONTRACTORS.

"EACH COALITION PARTICIPANT MODELED HIS OWN 'FACTORY VIEW' OF THE ARCHITECTURE.

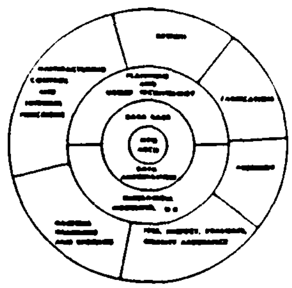
"THESE INDIVIDUAL FACTORY VIEWS WERE THEN COMPOSITED INTO THE GENERIC MANUFACTURING ARCHITECTURE.

"WHEN YOU UTILIZE THE GENERIC ARCHITECTURE PLAN AND DEVELOP YOUR MANUFACTURING TECHNOLOGY MODERNIZATION PROGRAM, THE PROCESS IS REVERSED.

"THE GENERIC ARCHITECTURE PROVIDES A STANDARD FOR COMMUNICATION, UNDERSTANDING, AND ANALYSIS."

ICAM

INTEGRATED
COMPUTER-AIDED MANUFACTURING



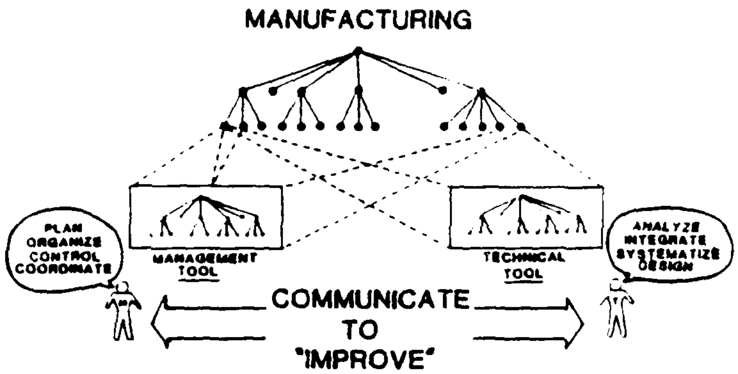
INSTRUCTIONAL OBJECTIVE: To provide a review of the ICAM logo and its pictorial representation of the generic manufacturing architecture.

NARRATION: "THE ICAM LOGO WE REVIEWED EARLIER SHOWS THE ICAM MANUFACTURING GENERIC ARCHITECTURE AS THE CENTER PIECE OF THE ICAM PROGRAM.

"THE $IDEF_1$ INFORMATION ARCHITECTURE TARGETS DIRECTLY INTO THE SURROUNDING INTEGRATION RING OF DATA BASE AND DATA AUTOMATION.

"THAT'S ONE OF THE REASONS THE AIR FORCE REQUIRES A MANAGEMENT INFORMATION SYSTEM (MIS) PLAN AS A PART OF THE MANUFACTURING TECHNOLOGY MODERNIZATION PROGRAM."

ARCHITECTURE



INSTRUCTIONAL OBJECTIVE: To provide an understanding of the fact that the generic manufacturing architecture provides a communication tool between management and technical personnel at all levels.

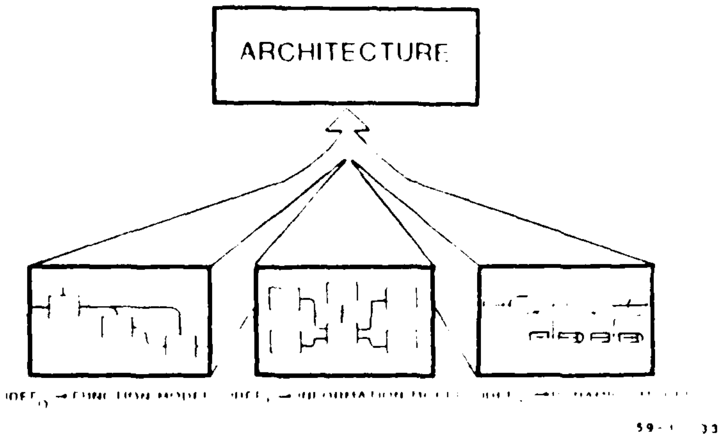
NARRATION: "IN SUMMARY, THE MANUFACTURING ARCHITECTURE PROVIDES BOTH A MANAGEMENT TOOL AND A TECHNICAL TOOL TO IMPROVE UNDERSTANDING AND COMMUNICATION.

"MANAGEMENT CAN USE THE ARCHITECTURE TO PLAN, ORGANIZE, AND CONTROL THE INTEGRATION OF NEW MANUFACTURING TECHNOLOGY.

"TECHNICAL PERSONNEL CAN USE THE ARCHITECTURE TO ANALYZE, INTEGRATE, SYSTEMATIZE AND DESIGN THE INTEGRATION OF NEW TECHNOLOGY.

"AND MAYBE MOST IMPORTANT, TO IMPROVE COMMUNICATION BETWEEN EACH OTHER!!!"

ARCHITECTURE



INSTRUCTIONAL OBJECTIVE: To provide an understanding that all <u>three</u> $IDEF_0$, $IDEF_1$, and $IDEF_2$ modeling methodologies constitute the generic manufacturing architecture.

NARRATION: "INDIVIDUALLY AND COLLECTIVELY:

1) THE MFG0/$IDEF_0$ FUNCTION MODEL
'A BLUEPRINT OF FUNCTIONS.'

2) THE MFG1/$IDEF_1$ INFORMATION MODEL
'A BLUEPRINT OF FUNCTIONS.'

<u>AND</u>

3) THE MFG2/$IDEF_2$ DYNAMICS MODEL
'A SCENARIO OF FUNCTION/INFORMATION INTERACTION.'

FORM THE ICAM <u>ARCHITECTURE</u>

EACH OF THE MODELS REPRESENT A DISTINCT BUT RELATED VIEW OF MANUFACTURING.

EACH USES A *STRUCTURED IDEF METHOD TO* BETTER UNDERSTAND, COMMUNICATE, AND ANALYZE EXISTING AND FUTURE MANUFACTURING.

EACH SUPPORTS THE DEVELOPMENT OF STATE-OF-THE-ART MANUFACTURING TECHNOLOGY AND INTEGRATION OF THAT TECHNOLOGY INTO EXISTING MANUFACTURING."

ICAM OBJECTIVE

IDEF AND ARCHITECTURE ARE TOOLS ....

NOT OBJECTIVES

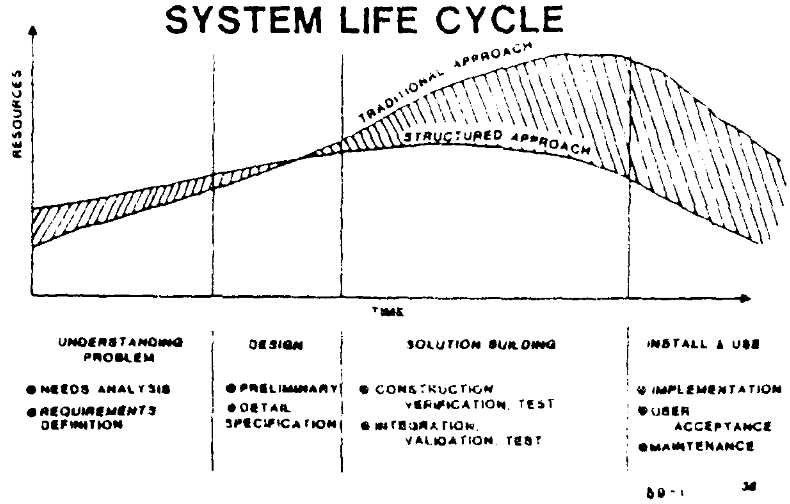
INSTRUCTIONAL OBJECTIVE: To provide an understanding that IDEF and architecture are a tool.

NARRATION: "LET'S KEEP IN MIND:

IDEF AND ARCHITECTURE ARE TOOLS --

NOT OBJECTIVES!!"

IDEF → ARCHITECTURE
SYSTEM LIFE CYCLE



INSTRUCTIONAL OBJECTIVE: To provide an understanding of the relationship between ICAM IDEF/architecture and the ICAM system life cycle concept.

NARRATION: "WE UTILIZE THE IDEF SYSTEM DEFINITION METHODOLOGIES AND RESULTING ARCHITECTURE TO BETTER UNDERSTAND 'AS IS' PROBLEM AND DESIGN THE 'TO BE' SOLUTION.

"THIS APPROACH PROVIDES THE COMPUTER SYSTEM USERS WITH THE ABILITY TO DEFINE AND ARTICULATE THEIR REQUIREMENTS TO COMPUTER PEOPLE.

"THE STRUCTURED APPROACH OF BUILDING MODELS MAY INCREASE EARLY PROGRAM COSTS BUT IT WILL REDUCE OVERALL PROGRAM COSTS AND TIME SPAN.

(POINT TO SHADED AREAS OF CHART AS APPROPRIATE.)

"IT IS OUR BELIEF THAT ADDITIONAL EXPENDITURES OF RESOURCES EARLY IN THE PROGRAM 'UNDERSTANDING THE PROBLEM' AND 'DESIGNING THE SOLUTION' WILL MORE THAN OFFSET THE TRADITIONAL APPROACH COSTS EXPERIENCED IN THE PAST."

IDEF IS THE **METHOD**

ARCHITECTURE IS THE **MEANS**

PRODUCTIVITY IS THE **OBJECTIVE**

88-1 38

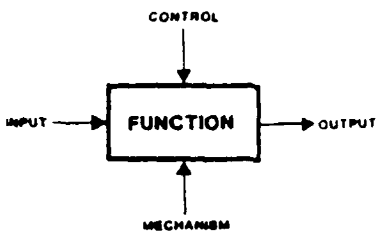
INSTRUCTIONAL OBJECTIVE: To provide an understanding of the relationship of IDEF, architecture, and productivity.

NARRATION: "IDEF IS THE METHOD!!

ARCHITECTURE IS THE MEANS!!

PRODUCTIVITY IS THE OBJECTIVE!!"

IDEF$_0$



AUTHORING
CONCEPTS AND PROCEDURES

TITLE SLIDE: *IDEF$_0$ Authoring Concepts and Procedures*

COURSE OBJECTIVE: To teach an understanding of the authoring concepts and procedures involved in IDEF$_0$ function modeling.

NARRATION: "AN IDEF$_0$ FUNCTION MODEL GRAPHICALLY SHOWS OBJECTS AND/OR INFORMATION PERFORMED BY MEN AND/OR MACHINES THAT ENABLE YOU TO UNDERSTAND A SYSTEM."

AUTHORING CONCEPTS AND PROCEDURES | LEARNING OBJECTIVES

1. UNDERSTAND $IDEF_0$ (FUNCTION MODEL) GRAPHIC SYNTAX, I.E. SYMBOLS

2. UNDERSTAND THE BASIC CONCEPTS OF $IDEF_0$

3. UNDERSTAND THE DIFFERENT USES THAT DATA CAN PLAY IN FUNCTION MODELING WITH $IDEF_0$:
   a. INPUTS
   b. CONTROLS
   c. OUTPUTS
   d. MECHANISMS

4. UNDERSTAND $IDEF_0$ (FUNCTION MODEL) DIAGRAM DECOMPOSITION

5. UNDERSTAND AUTHORING AND REFINING $IDEF_0$ (FUNCTION MODEL) DIAGRAMS.

59-2 2

NARRATION: "COURSE LEARNING OBJECTIVES:

TO ENABLE YOU TO UNDERSTAND $IDEF_0$ FUNCTION MODELING IN TERMS OF:

1) BASIC CONCEPTS
2) GRAPHIC SYMBOLS
3) FUNCTIONS AND DATA
4) DIAGRAMS AND DECOMPOSITION
5) AUTHORING AND REFINING $IDEF_0$ FUNCTION MODEL DIAGRAMS"

AUTHORING CONCEPTS | DEFINITIONS AND EXAMPLES

DEFINITIONS	EXAMPLES IN IDEF$_0$
SYNTAX I.E. SYMBOLS: • STRUCTURAL COMPONENTS OR "SYMBOLS" • RULES THAT DEFINE RELATIONS AMONG THE COMPONENTS	SYMBOLS: • BOXES • ARROWS RULES: • "USE ONLY 3-6 BOXES IN A DIAGRAM LAYOUT"
SEMANTICS I.E. CONCEPTS: • MEANING OF SYNTACTIC COMPONENTS • INTERPRETATION OF SYNTACTIC RULES	CONCEPTS: • FUNCTIONS BOXES • INTERFACE-CONSTRAINTS ARROWS • "USE ONLY 3-6 BOXES IN A DIAGRAM LAYOUT" • LESS THAN 3 BOXES -NOT ENOUGH DETAIL • MORE THAN 6 BOXES -CLUTTERS AND DETRACTS FROM READABILITY

59-2 3

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the basic concepts of IDEF$_0$ function modeling.

CONCEPT: IDEF$_0$ function modeling communicates by using symbols put together in a structured way to give meaning.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture Part II, Volume IV - Function Modeling Manual (IDEF$_0$)

SEE: "SYNTAX," Section 6, #6.6.1, Pg. 106

"SEMANTICS," Section 6, #6.6.1, Pg. 106

NARRATION: SYNTAX AND SEMANTICS

"IN THE IDEF$_0$ CONTEXT SYNTAX RELATES TO THE ORDER OF SYMBOLS AND RULES USED TO COMMUNICATE INFORMATION IN IDEF$_0$ FUNCTION MODELING.

"IN THE IDEF$_0$ CONTEXT SEMANTICS REFERS TO THE 'MEANING' OF THE IDEF$_0$ SYMBOLS AND RULES."

AUTHORING CONCEPTS | FUNCTION

"FUNCTION"

DEFINITION:

- AN ACTIVITY, ACTUAL PROCESS, OPERATION
- A DESCRIPTION OF "WHAT HAPPENS" IN A PARTICULAR ENVIRONMENT – WHAT IT MEANS TO DO SOMETHING
- FUNCTIONS THAT ARE DONE BY PEOPLE, MACHINES, COMPUTERS, ETC.

CHARACTERISTICS:

- ACTIVE VERB OR VERB PHRASE
- OCCURS OVER TIME
- RECOGNIZABLE RESULTS

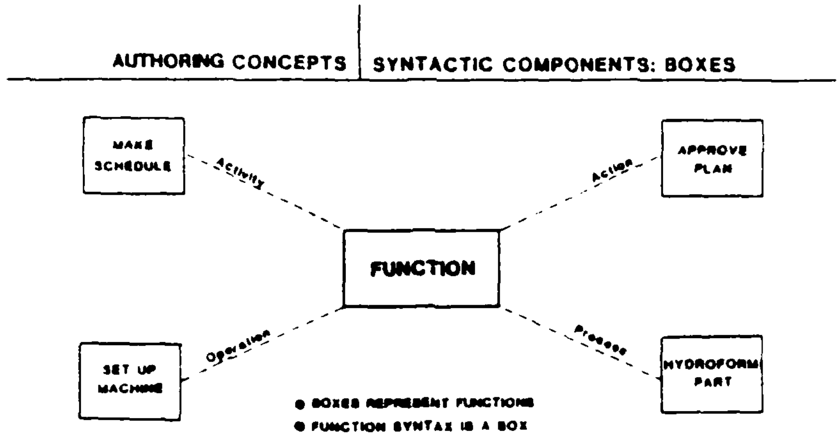
59-2

INSTRUCTIONAL OBJECTIVE: To teach an understanding of "function" in the IDEF0 context.

CONCEPT: A function is a coordinated activity, process action, or operation used to accomplish a specific end.

NARRATION: "THE DEFINITION OF A FUNCTION IN IDEF$_0$ MODELING IS: AN ACTIVITY, ACTION, PROCESS, OR OPERATION THAT DESCRIBES WHAT HAPPENS IN A PARTICULAR ENVIRONMENT, THAT IS A DESCRIPTION OF WHAT IT MEANS TO DO SOMETHING. THESE FUNCTIONS ARE DONE BY PEOPLE, MACHINES, COMPUTERS.

"WE NAME A FUNCTION WITH AN ACTIVE VERB AND A VERB PHRASE. A FUNCTION IS AN ACTIVITY, ACTION, PROCESS, OR OPERATION THAT OCCURS OVERTIME, AND IT PRODUCES RECOGNIZABLE RESULTS."



INSTRUCTIONAL OBJECTIVE: To teach an understanding of "boxes" as symbols representing functions in the $IDEF_0$ function modeling methodology.

CONCEPT: If we have a standard symbolic way of representing functions we can begin to model functions.

NARRATION: "A <u>FUNCTION</u> IS ALWAYS REPRESENTED GRAPHICALLY WITH A BOX IN THE $IDEF_0$ FUNCTION MODEL DIAGRAM.

<u>REINFORCEMENT</u>:

"A FUNCTION CAN BE AN ACTIVITY, AN OPERATION, AN ACTION, OR A PROCESS."

AUTHORING CONCEPTS | DATA

DEFINITION:

- INFORMATION / PHYSICAL OBJECTS

CHARACTERISTICS:

- NOUN OR NOUN PHRASE

RELATIONSHIP TO FUNCTION:

- UNDERGO CHANGES BY FUNCTION
- DETERMINE OR AFFECT FUNCTION
- RESULT FROM FUNCTION
- CARRY OUT FUNCTION

59-2

INSTRUCTIONAL OBJECTIVE: To teach an understanding of data definition characteristics, and relationships in $IDEF_0$ function modeling.

CONCEPT: Data is information or physical objects involved in an activity, process, action, or operation.

NARRATION: "DATA IS THE INFORMATION AND THE PHYSICAL OBJECTS THAT ARE RELATED TO FUNCTIONS.

"DATA IS NAMED WITH A NOUN OR NOUN PHRASE: EXAMPLE;

- o RAW MATERIALS
- o PRODUCT
- o WORK ORDER"

AUTHORING CONCEPTS | DATA: PRIOR TO/RESULTING FROM ACTIVATION OF FUNCTION

DATA PRIOR TO ACTIVATION OF FUNCTION	FUNCTION	DATA RESULTING FROM ACTIVATION OF FUNCTION
• PRODUCT MANUFACTURING REQUIREMENTS	• PLAN FOR MANUFACTURE	• MANUFACTURING PLAN
• PRODUCT SPECIFICATIONS	• PRODUCE PRODUCT	• PRODUCT
• RAW MATERIALS • BLUEPRINTS • WORK ORDERS • INSTRUCTIONS	• MAKE PART	• FABRICATED PARTS • SCRAP

INSTRUCTIONAL OBJECTIVE: To teach an understanding of data prior to and resulting from an activation of a function.

CONCEPT: Something happens to data as a result of a function's activation.

NARRATION: "WHEN THE FUNCTION (POINT TO IT) 'PLAN FOR MANUFACTURE' IS ACTIVATED, THE REQUIREMENTS FOR MANUFACTURING A PRODUCTION RESULTS IN A MANUFACTURING PLAN.

"WHEN THE FUNCTION, 'PRODUCE PRODUCT' (POINT TO IT) IS ACTIVATED, THE PRODUCT SECIFICATIONS RESULT IN A PRODUCT.

"WHEN THE FUNCTION, 'MAKE PART' (POINT TO IT) IS ACTIVATED, THE RAW MATERIALS, BLUE PRINTS, WORK ORDERS, AND INSTRUCTIONS RESULT IN FABRICATED PARTS AND LEFTOVERS."

AUTHORING CONCEPTS | USES OF DATA: INPUTS, CONTROLS, OUTPUTS AND MECHANISMS

INPUT: DATA WHICH UNDERGOES A CHANGE AND IS TRANSFORMED

CONTROL: DATA WHICH INFLUENCES OR DETERMINES THE FUNCTION OUTPUT (S)

OUTPUT: DATA WHICH RESULTS FROM A FUNCTION: DATA CREATED BY A FUNCTION

MECHANISM: DATA WHICH CARRIES OUT A FUNCTION

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the different uses of data in $IDEF_0$ function modeling.

CONCEPT: Data as information or physical objects has four differing uses in $IDEF_0$ function modeling.

NARRATION: "DATA CAN BE USED AS AN INPUT, A CONTROL, AN OUTPUT, OR A MECHANISM EACH RELATED IN A SPECIFIC ROLE TO A FUNCTION."

(GIVE DEFINITIONS ON FOIL.)

AUTHORING CONCEPTS | DATA ROLES IN IDEF$_0$

INPUT(S)	CONTROL(S)	FUNCTION	OUTPUT(S)
• PROCURABLE ITEMS	• PRODUCT DESIGN	• MANUFACTURE PRODUCT	• PRODUCT
• RAW MATERIALS	• BLUEPRINT • WORKORDER • INSTRUCTIONS	• MAKE PART	• FABRICATED PART • SCRAP
• EXPERIENCE & CAPABILITY INFORMATION	• RESOURCE REQUIREMENTS	• ESTIMATE RESOURCE NEEDS	• RESOURCE PLANS

"INPUT" DATA — "OUTPUT" DATA

INSTRUCTIONAL OBJECTIVE: To teach an understanding of data in terms its functions as input data, control data, and output data in IDEF$_0$ function modeling.

CONCEPT: Information plays four differing roles in IDEF$_0$ function modeling

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture Part II, Volume IV - Function Modeling Manual (IDEF$_0$)

SEE: "BOX/ARROW RELATIONSHIP," Section 3, #3.3.1, pg. 22

NARRATION: "EXAMPLES OF SOME OF DATA'S USES IN THE FUNCTION, 'MANUFACTURE PRODUCT' THE PHYSICAL OBJECTS, PROCURABLE ITEMS ARE INPUTS BECAUSE THEY UNDERGO A TRANSFORMATION. (SAME FOR RAW MATERIALS, EXPERIENCE AND CAPABILITY INFORMATION.) PRODUCT DESIGN IS A CONTROL TO FUNCTION, MANUFACTURING PRODUCT BECAUSE IT DETERMINES THE RESULTING PRODUCT (SAME FOR BLUE PRINT, WORK ORDER, INSTRUCTIONS.)

"THE OUTPUT PRODUCT OF THE FUNCTION MANUFACTURING PRODUCT IS THE RESULT OF THE PROCESS OF MANUFACTURING PRODUCT AND INFLUENCE OF INPUTS AND CONTROLS ON THAT FUNCTION."

AUTHORING CONCEPTS | MECHANISM

DEFINITION:

- THE MEANS BY WHICH A FUNCTION IS DONE
- THE ORIGIN, SOURCE, OR AGENT THAT ENABLES A FUNCTION TO BE ACCOMPLISHED

CHARACTERISTICS:

- NOUN OR NOUN PHRASE
- TYPICALLY A PERSON, MACHINE, OR COMPUTER

89-4 10

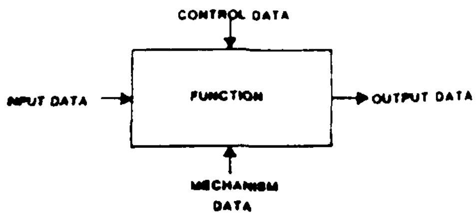
INSTRUCTIONAL OBJECTIVE: To teach an understanding of data in terms of its function as a mechanism.

CONCEPT: Functions need a means by which they can accomplish their objectives.

NARRATION: "THE MECHANISM OF A FUNCTION IS ALWAYS THE MEANS BY WHICH A FUNCTION'S OBJECTIVE IS ACCOMPLISHED. AN EXAMPLE WOULD BE A TEAM, PEOPLE -- A LATHE, A MACHINE, OR SYSTEM 2000 -A COMPUTER."

AUTHORING CONCEPTS | SYNTACTIC COMPONENTS: ARROWS

- ARROWS REPRESENT DATA
- ARROWS ALWAYS CONNECT TO A BOX



- DATA SYNTAX IS AN ARROW

60-4 11

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the data symbols and syntax used in $IDEF_0$ function modeling.

CONCEPT: By using standard symbols put together in a structured way to describe data symbolically, we can communicate the uses of data in $IDEF_0$ function modeling.

NARRATION: "INPUT DATA, CONTROL DATA, OUTPUT DATA, AND MECHANISM DATA ARE ALL REPRESENTED BY ARROWS CONNECTED TO OTHER FUNCTIONS (CALLED ICOM CODES).

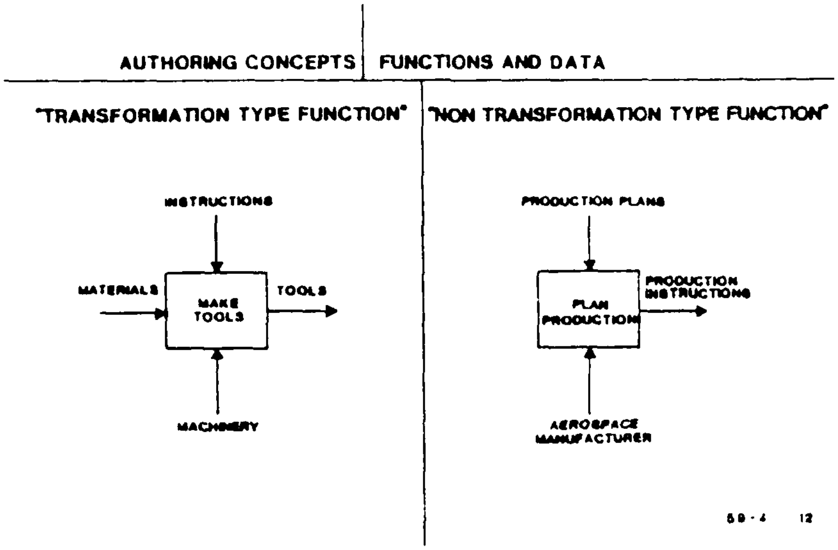
I INPUT - ALWAYS GOES IN FROM THE LEFT SIDE OF FUNCTION BOX

C CONTROL - ALWAYS GOES IN FROM THE TOP OF FUNCTION BOX

O OUTPUT - ALWAYS GOES OUT FROM THE RIGHT SIDE OF FUNCTION BOX

M MECHANISM - ALWAYS GOES IN FROM THE BOTTOM OF THE FUNCTION BOX

THE INPUT DATA (ON THE LEFT) ARE TRANSFORMED INTO OUTPUT DATA (ON THE RIGHT). CONTROL DATA (ON THE TOP) GOVERN THE WAY IN WHICH THE FUNCTION IS DONE. MECHANISM DATA (ON THE BOTTOM) INDICATE THE MEANS BY WHICH THE FUNCTION IS PERFORMED."

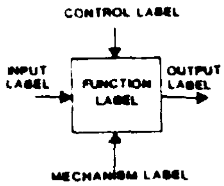


INSTRUCTIONAL OBJECTIVE: To teach an understanding of the graphic symbols used in modeling functions and data in $IDEF_0$ function modeling.

CONCEPT: There is a standard symbolic means for representing functions and data in $IDEF_0$ function modeling.

NARRATION: "ON THE LEFT IS A MANUFACTURING EXAMPLE WITH THE FUNCTION NAMED AS "MAKE TOOLS," A VERB PHRASE; AND THE DATA ARROWS NAMED BY NOUNS; MATERIALS, INSTRUCTIONS, TOOLS MACHINERY - LEARN TO READ THEM CLOCKWISE, ALWAYS STARTING WITH THE LEFT ... (INPUT). ON THE RIGHT IS A MANUFACTURING EXAMPLE - THERE IS NO INPUT DATA ... THE OUTPUT 'PRODUCTION INSTRUCTIONS' RESULTS FROM THE INTERFACE OF PRODUCTION PLANS AND AEROSPACE MANUFACTURER."

AUTHORING CONCEPTS | LABELS



- LABELS ARE WORDS THAT NAME FUNCTIONS AND DATA
- FUNCTION LABELS ARE VERBS OR VERB PHRASES AND ARE PUT IN THE CENTER OF THE FUNCTION BOX
- DATA LABELS ARE NOUNS OR NOUN PHRASES
- DATA LABELS ARE ASSOCIATED WITH INPUT, CONTROL, OUTPUT, AND MECHANISM ARROWS
- DATA LABELS ARE PLACED AS NEAR TO THEIR RESPECTIVE ARROWS AS POSSIBLE

THE CHOICE OF WORDS IN NAMING LABELS IS CRITICAL !

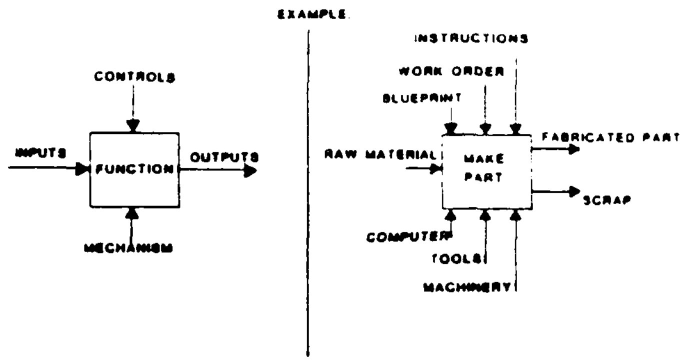
88-3 13

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the function of labels in $IDEF_0$ function modeling.

CONCEPT: In order to maintain a standard for communication, $IDEF_0$ function modeling employs names (called labels) for all function boxes and data arrows.

NARRATION: "ALL FUNCTION BOXES MUST BE LABELED WITH VERBS OR VERB PHRASES, AND ALL DATA ARROWS MUST BE LABELED WITH NOUNS OR NOUN PHRASES."

AUTHORING CONCEPTS | FUNCTIONS, DATA AND LABELS



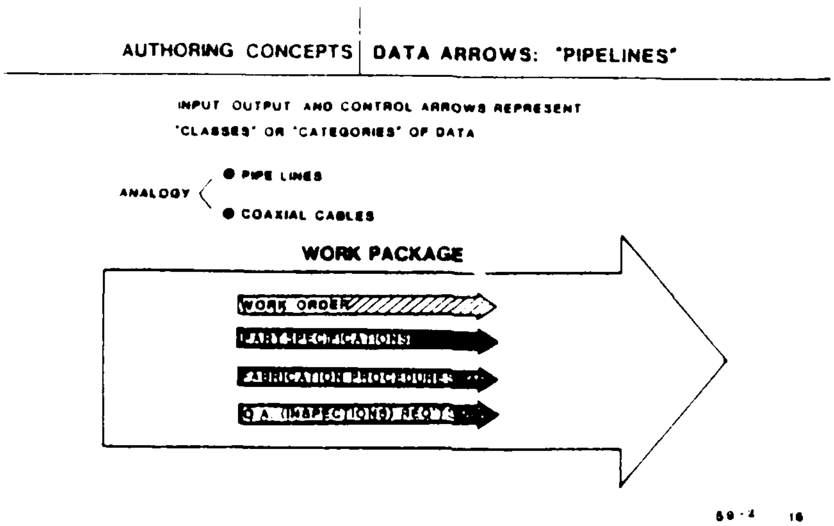
59-4 14

INSTRUCTIONAL OBJECTIVE: To teach an understanding of $IDEF_0$ graphic symbols and syntax for functions, data, and labels in the $IDEF_0$ modeling methodology.

CONCEPT: Functions, data, and labels all work together to communicate their interrelationships in graphic terms.

NARRATION: LEFT: "$IDEF_0$ NOTATION, READ CLOCKWISE STARTING WITH INPUT, CONTROLS, OUTPUT, AND MECHANISMS.

RIGHT: "LABELS TELL US THE NAMES OF THE FUNCTION BOXES AND THE DATA ARROWS."

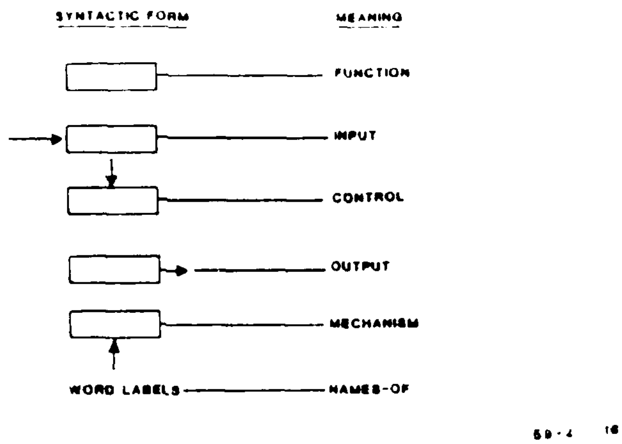


INSTRUCTIONAL OBJECTIVE: To teach an understanding of how data arrows can represent more than one category of related data.

CONCEPT: More than one kind of data can pass through the same data arrow.

NARRATION: "THINK OF THE ARROWS REPRESENTING DATA AS HOLLOW PIPE LINES THAT CAN CARRY MORE THAN ONE KIND OF RELATED INFORMATION AT ONE TIME, OR A COAXIAL CABLE THAT CARRIES A MULTIPLEX SIGNAL."

AUTHORING CONCEPTS | SYNTAX COMPONENTS: REVIEW



INSTRUCTIONAL OBJECTIVE: To review syntactic components.

DIRECTIONS: COVER AND REVEAL ONE AT A TIME.

AUTHORING CONCEPTS | EXERCISE

INSTRUCTIONS: BASED ON THE NARRATIVE IDENTIFY TERMS WHICH DESCRIBE FUNCTIONS, INPUTS, CONTROLS, OUTPUTS AND MECHANISMS. LIST THE TERMS IN THE APPROPRIATE SPACES BELOW

NARRATIVE: BUILD A MODEL AIRPLANE, GIVEN A KIT WHICH CONTAINS MATERIALS AND INSTRUCTIONS. THE KIT INCLUDES THE FOLLOWING ITEMS

- PRINTED PAMPHLET WITH STEP-BY-STEP INSTRUCTIONS
- GLUE
- RUBBER BAND (FOR PROPULSION)
- BALSA WOOD
- PAINT
- DECAL
- APPLICATORS FOR PAINT AND GLUE

FUNCTIONS	INPUTS	CONTROLS	OUTPUTS	MECHANISMS

17

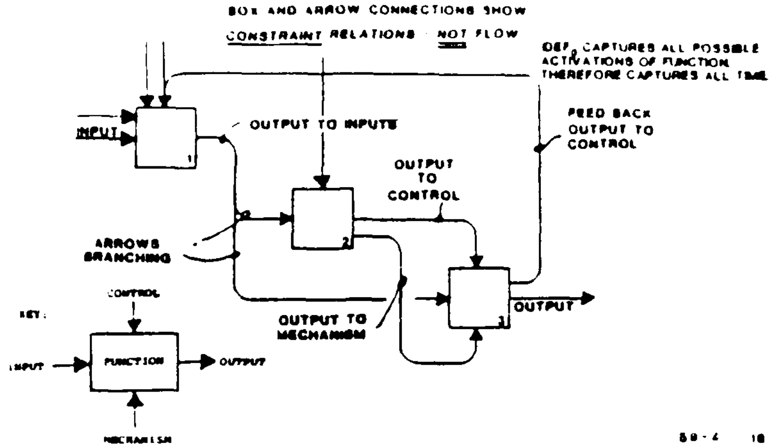
A8-2

INSTRUCTIONAL OBJECTIVE: To give an exercise in $IDEF_0$ authoring concepts to reinforce what has been taught.

DIRECTIONS: ORGANIZE THE MODEL AIRPLANE KIT ITEMS INTO:

- o FUNCTIONS
- o INPUTS
- o CONTROLS
- o OUTPUTS
- o MECHANISMS

AUTHORING CONCEPTS | BOX AND ARROW RELATIONS: CONSTRAINTS



INSTRUCTIONAL OBJECTIVE: To teach an understanding of box and arrow meanings and their relations in an $IDEF_0$ function model diagram.

CONCEPT: Data constrains functions in a specific way according to the $IDEF_0$ function modeling methodology.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture Part II, Volume IV - Function Modeling Manual ($IDEF_0$)

SEE: "BOX/ARROW RELATIONSHIP," Section 3, #3.3.1, pg. 24

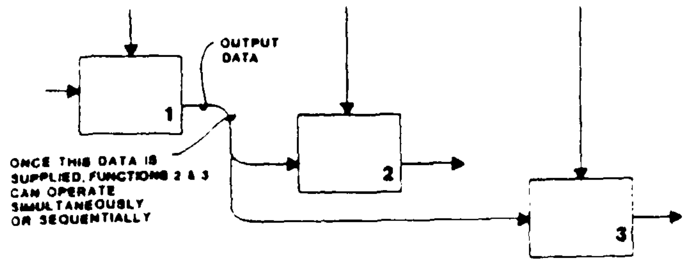
NARRATION: "LOOK AT THE KEY: INPUT, CONTROL, OUTPUT, AND MECHANISM.

"ABOVE IS A SIMPLE $IDEF_0$ FUNCTION MODEL DIAGRAM SHOWING THE POSSIBLE ACTIVATION OF THREE FUNCTIONS, REPRESENTED BY BOXES NUMBERED 1, 2, AND 3, AND DATA REPRESENTED BY ARROWS.

"THESE ARE THE DIFFERENT WAYS ARROWS ARE USED WITH BOXES TO SHOW CONSTRAINTS ... INPUT (POINT), OUTPUT (POINT), OUTPUT TO INPUTS (POINT), OUTPUT TO CONTROL (POINT), OUTPUT TO MECHANISM (POINT), FEEDBACK OUTPUT TO CONTROL."

AUTHORING CONCEPTS | ARROWS: "BRANCHING"

OUTPUT CAN BRANCH AND BE USED BY TWO FUNCTIONS
SIMULTANEOUSLY OR SEQUENTIALLY



• WITHOUT LABELS WE CANNOT TELL HOW THE BRANCH OCCURS

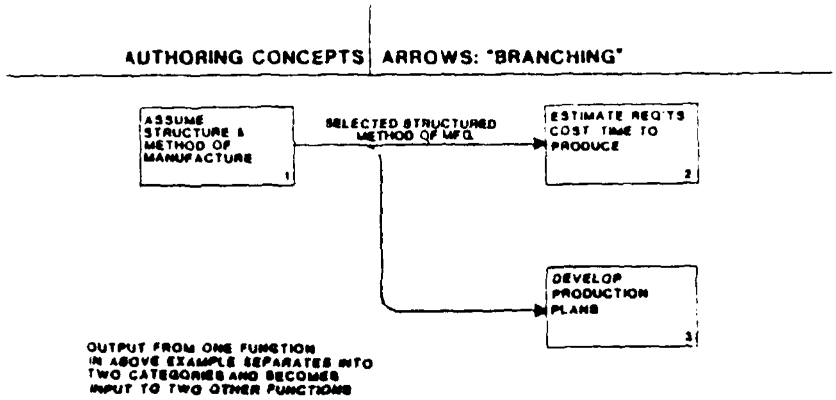
59-4 19

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the way output data arrows can branch.

CONCEPT: The same output data is sometimes used by two functions.

NARRATION: "IN THIS EXAMPLE WE SEE THAT THE SAME OUTPUT PRODUCED FROM A FUNCTION (BOX 1) IS USED BY FUNCTION #2 AND FUNCTION #3.

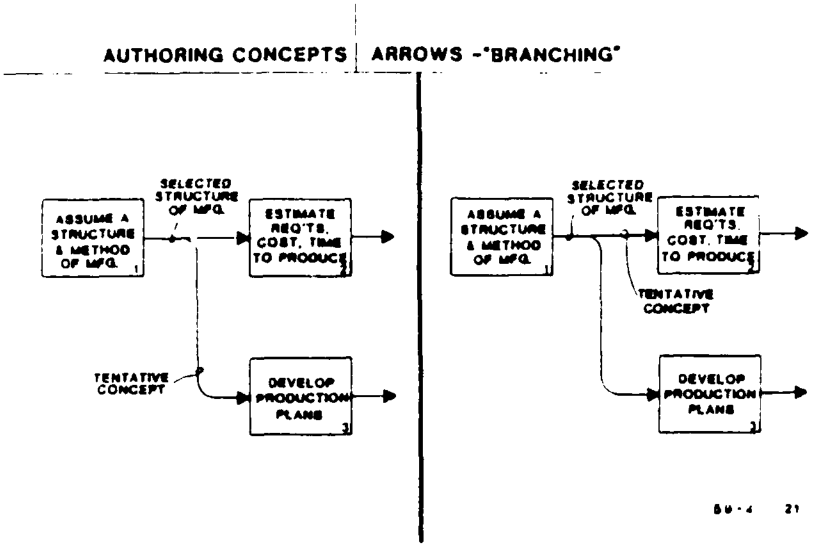
"THE LABELS TELL US HOW THE BRANCHING OF INFORMATION OCCURS."



INSTRUCTIONAL OBJECTIVE: To show a manufacturing example of an output branching and to reinforce branching concept.

CONCEPT: The same output data is sometimes used by two functions.

NARRATION: "IN THIS MANUFACTURING EXAMPLE, THE OUTPUT FROM FUNCTION #1, ASSUME STRUCTURE AND METHOD OF MANUFACTURING (POINT TO IT) WHICH IS SELECTED STRUCTURED METHOD OF MANUFACTURING (POINT TO IT) BECOMES OUTPUT TO TWO OTHER FUNCTIONS, ESTIMATE REQUIREMENTS, COST, TIME TO PRODUCE, (POINT TO IT) AND DEVELOP PRODUCTION PLANS."



INSTRUCTIONAL OBJECTIVE: To show a manufacturing example of arrows branching and to reinforce branching concept.

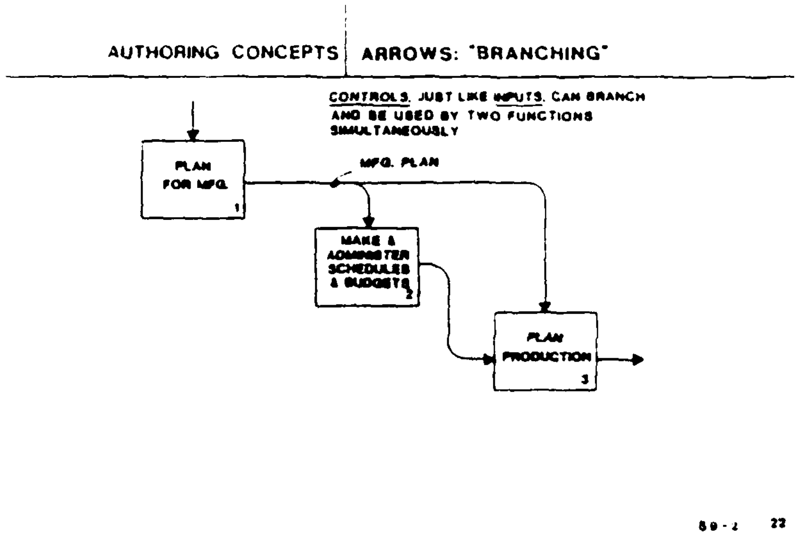
CONCEPT: The same output data is sometimes used by two functions.

NARRATION: "IN THESE EXAMPLES, THE SAME OUTPUT BRANCHES OFF INTO TWO DIFFERING CATEGORIES OF INFORMATION AND IS LABELED ACCORDINGLY.

(POINT TO EXAMPLES AND EXPLAIN DIFFERENCE)

(LEFT SIDE) ... OUTPUT FROM FUNCTION #1, ASSUME A STRUCTURE OF MANUFACTURING BRANCHES INTO TWO DIFFERING CATEGORIES "SELECTED STRUCTURE OF MANUFACTURING GOES INTO FUNCTION #2, ESTIMATE REQUIREMENTS, COST, TIME TO PRODUCE; WHILE 'TENTATIVE CONCEPT' GOES INTO FUNCTION #3, DEVELOP PRODUCTION PLANS."

(SAME KIND OF EXPLANATION FOR RIGHT SIDE)



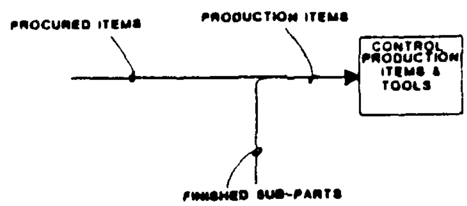
INSTRUCTIONAL OBJECTIVE: To teach an understanding of the way control data arrows can branch.

CONCEPT: The same control data is sometimes used by two functions.

NARRATION: "THE OUTPUT 'MANUFACTURING PLAN' FROM FUNCTION #1, PLAN FOR MANUFACTURING BECOMES A CONTROL TO FUNCTION #2 AND FUNCTION #3 AND CAN BRANCH JUST LIKE INPUTS."

AUTHORING CONCEPTS | ARROWS - 'JOINING'

EXAMPLE.



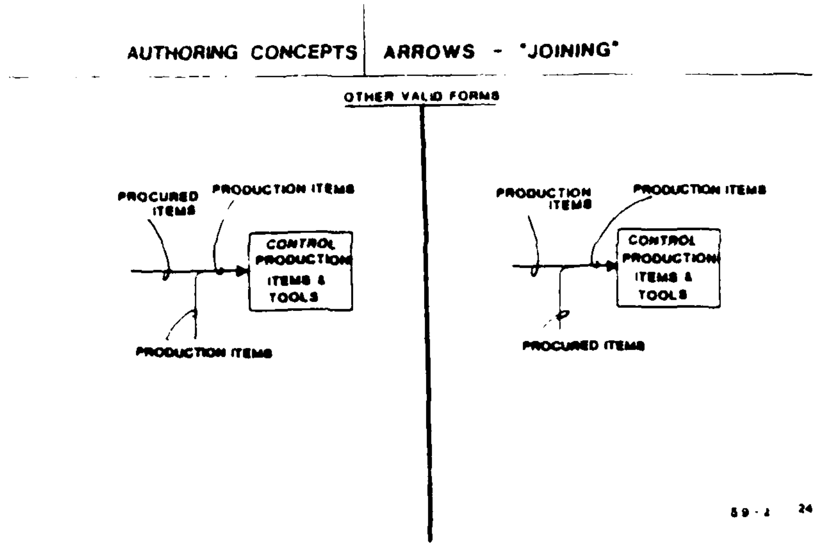
59-2 23

INSTRUCTIONAL OBJECTIVE: To teach an understanding of how data arrows can join together.

CONCEPT: Two categories of input data arrows can join together to become input to one function.

NARRATION: "IN THIS MANUFACTURING EXAMPLE, THE INPUTS OF 'PRODUCTION ITEMS' (POINT TO THEM) AND 'FINISHED SUB-PARTS' JOIN TOGETHER TO BECOME THE INPUT KNOWN AS 'PROCURED ITEMS.'

"THE LABELS TELL US HOW THE JOINING OCCURS."

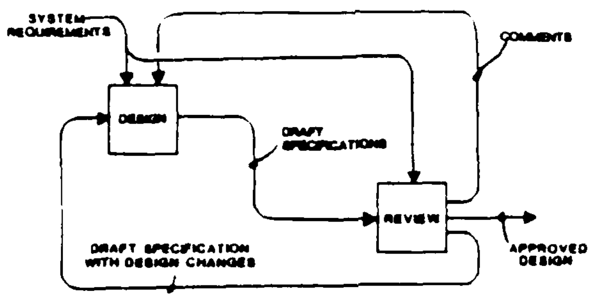


INSTRUCTIONAL OBJECTIVE: To show a manufacturing example of how arrows can join together.

CONCEPT: Two categories of input data arrows can join together to become input to one function.

NARRATION: "THESE MANUFACTURING EXAMPLES SHOW HOW TWO CATEGORIES OF INPUT DATA CAN JOIN TOGETHER TO BECOME INPUT TO ONE FUNCTION."

AUTHORING CONCEPTS | ARROWS-"FEEDBACK"



INSTRUCTIONAL OBJECTIVE: To teach an understanding of how data that feeds back is represented graphically with arrows in $IDEF_0$ function modeling.

CONCEPT: Certain data may become altered after discussion with involved personnel and feedback to become reprocessed.

NARRATION: "IN THIS MANUFACTURING EXAMPLE 'COMMENTS' FROM THE REVIEW FUNCTION FEEDBACK TO THE DESIGN FUNCTION AS A CONTROL (POINT TO IT) WHILE 'DRAFT SPECIFICATIONS WITH DESIGN CHANGES' FEEDBACK FROM THE REVIEW FUNCTION TO THE DESIGN FUNCTION AS AN INPUT (POINT TO IT).

- o CONTROL DATA FEEDBACK ARROWS ALWAYS GO OUT AND OVER.
- o INPUT DATA FEEDBACK ARROWS ALWAYS GO OUT AND UNDER."

AUTHORING CONCEPTS | DECOMPOSITION

- FUNCTIONS ARE COMPRISED OF SUBFUNCTIONS
- DECOMPOSITION IS AN "EXPLOSION" OF DETAIL (LEVEL BY LEVEL)
- DATA CONSISTENCY IS REQUIRED (LEVEL BY LEVEL)
- ESTABLISHES MODEL HIERARCHY AND NODE NUMBERING

59-2 20

INSTRUCTIONAL OBJECTIVE: To teach an understanding of $IDEF_0$ function model decomposition.

CONCEPT: Decomposition is a breakdown process. Decomposition always proceeds from higher to lower levels to uncover detail.

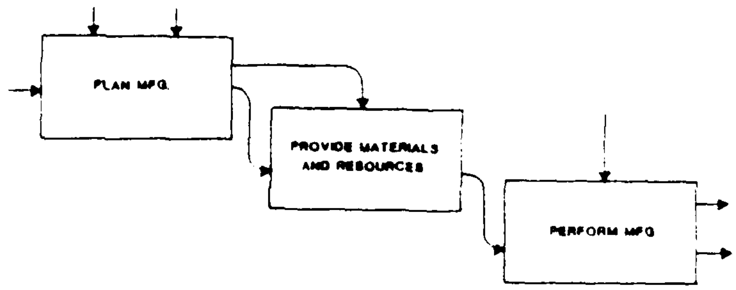
REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture-Part II, Volume IV - Function Modeling Manual ($IDEF_0$)

SEE: "Communication by Gradual Exposition of Detail." Section 2, #2.3.2, pg. 12

NARRATION: "DECOMPOSITION IS A BREAKDOWN OF A PROCESS, OPERATION, ACTION, OR ACTIVITY FROM THE TOP-DOWN."

(TALK TO CHART)

AUTHORING CONCEPTS | DECOMPOSITION



INSTRUCTIONAL OBJECTIVE: To teach an understanding of $IDEF_0$ function model decomposition.

CONCEPT: A function contains sub-functions in lower levels of decomposition.

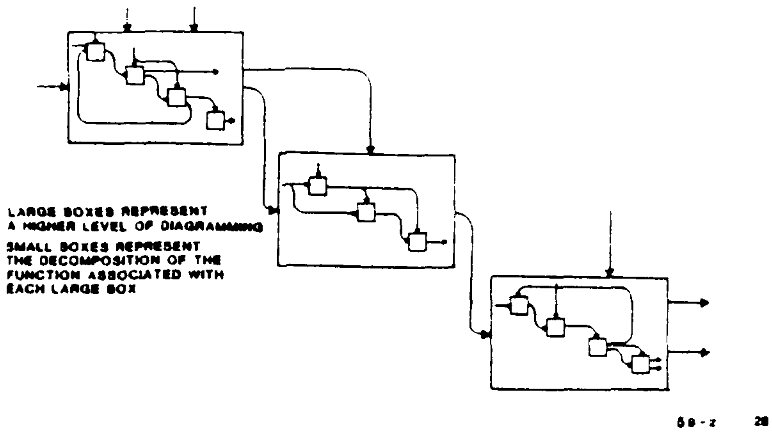
REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture Part II, Volume IV - Function Modeling Manual ($IDEF_0$)

SEE: "Communication by Gradual Exposition of Detail." Section 2, #2.3.2, pg. 12

NARRATION: "THESE ARE THE SUBFUNCTIONS CONTAINED IN A TOP-DOWN-STRUCTURE BREAKDOWN OF THE FUNCTION:

MANUFACTURE PRODUCT"

AUTHORING CONCEPTS | DECOMPOSITION



INSTRUCTIONAL OBJECTIVE: To teach an understanding of $IDEF_0$ function model decomposition.

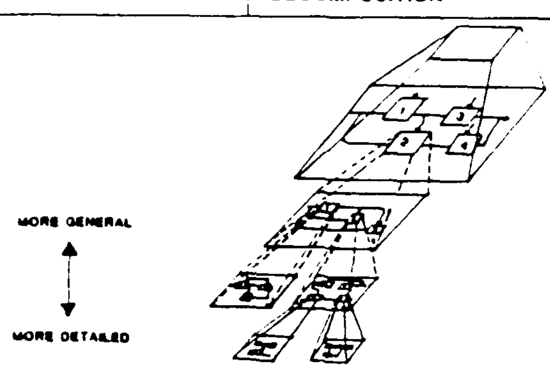
CONCEPT: Decomposition always occurs in a general to detailed manner.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture-Part II, Volume IV - Function Modeling Manual ($IDEF_0$)

SEE: "Communication by Gradual Exposition of Detail." Section 2, #2.3.2, pg. 12

NARRATION: "DIAGRAM REPRESENTATION OF TOP-DOWN-STRUCTURE BREAKDOWN ALWAYS PROCEEDS FROM A MORE GENERAL TO MORE DETAILED VIEW IN WHICH LARGER BOXES REPRESENT A HIGHER LEVEL OF DIAGRAMMING AND SMALLER BOXES REPRESENT THE DECOMPOSITION OF THE FUNCTION ASSOCIATED WITH EACH LARGER BOX."

AUTHORING CONCEPTS | DECOMPOSITION



INSTRUCTIONAL OBJECTIVE: To teach an understanding of $IDEF_0$ function model decomposition.

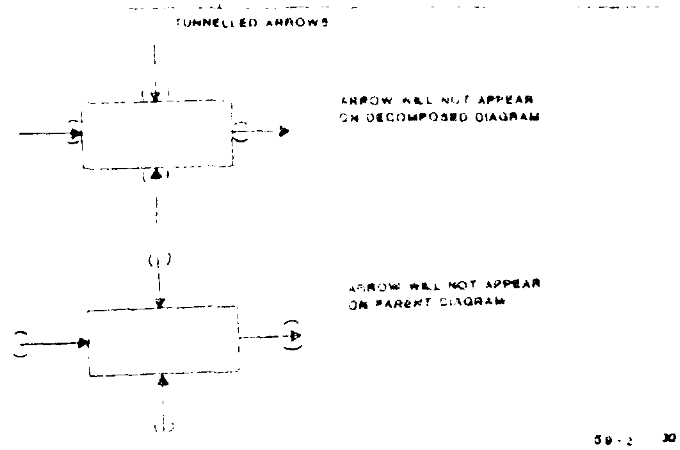
CONCEPT: Decomposition always occurs in a general to detailed manner.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture-Part II, Volume IV - Function Modeling Manual ($IDEF_0$)

SEE: "Communication by Gradual Exposition of Detail." Section 2, #2.3.2, pg. 12

NARRATION: "TOP-DOWN-STRUCTURE BREAKDOWN ALWAYS PROCEEDS FROM A MORE GENERAL TO A MORE DETAILED VIEW."

AUTHORING CONCEPTS DECOMPOSITION



INSTRUCTIONAL OBJECTIVE: To teach an understanding of what happens to certain data in the decomposition process.

CONCEPT: Tunnelled arrows indicate that the data conveyed by these arrows is not relevant to a particular level of detail.

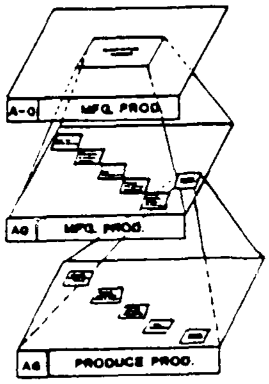
REFERENCE: AFWAL-TR-81-4023 <u>INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM)</u>, Architecture-Part II, Volume IV - Function Modeling Manual (IDEF$_0$)

SEE: "Tunnelled Arrows," Section 3, #3.2.5, pg. 38

NARRATION: "SOMETIMES WE WANT TO SHOW AS MUCH DATA AS POSSIBLE ON THE HIGHEST LEVEL DIAGRAM. IF WE FIND THAT OUR PROJECT SCOPE IS NOT CONCERNED WITH ALL THE DATA WE HAVE INDICATED, WE HAVE A CONVENTION FOR SHOWING DATA AT HIGHER LEVELS AND DROPPING IT ALTOGETHER OR HAVING IT DISAPPEAR AND REAPPEAR LATER AT A LOWER LEVEL OF DECOMPOSITION."

AUTHORING CONCEPTS | DECOMPOSITION

A MODEL ORGANIZES DIAGRAMS INTO A
STRUCTURED DECOMPOSITION



INSTRUCTIONAL OBJECTIVE: To show examples of decomposition in a manufacturing environment.

CONCEPT: Decomposition always occurs in a top-down manner, proceeding from a more general to a more detailed level.

NARRATION: "IN A MANUFACTURING CONTEXT MORE GENERAL PROCEEDS FROM AN A-0 CONTEXT (THE WHOLE SYSTEM) TO THE A0 CONTEXT (FIRST LEVEL OF DECOMPOSITION) TO THE A1 - A6 (SECOND LEVEL OF DECOMPOSITION)."

AUTHORING CONCEPTS | NODE NUMBER

INDICATES

- DIAGRAM, TEXT, FEO, GLOSSARY
- LEVEL OF HIERARCHY (DECOMPOSITION)
- PARENT DIAGRAM
- LOCATION IN PARENT DIAGRAM

32

INSTRUCTIONAL OBJECTIVE: To teach an understanding of how Node numbers function in $IDEF_0$ function modeling.

CONCEPT: We need a way to differentiate among different levels of decomposition.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture-Part II, Volume IV - Function Modeling Manual ($IDEF_0$)

SEE: "Node Number," Section 3, #3.2.1.1, pg. 32

NARRATION: "NODE NUMBERS HELP TO MAINTAIN CONSISTENCY OF FUNCTION MODEL DIAGRAMS FOR BOTH MODELERS AND REVIEWERS."

AUTHORING CONCEPTS | NODE NUMBER

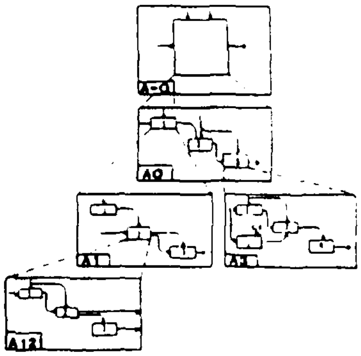
NODE NUMBER CORRESPONDS TO POSITION IN HIERARCHY

A-0: TOP LEVEL (CONTEXT)

A0 : FIRST LEVEL

A1, A3 } PARTIAL DECOMPOSITION OF A0

A12 = PARTIAL DECOMPOSITION OF A1



80-4 33

INSTRUCTIONAL OBJECTIVE: To show example of how node numbers are used in $IDEF_0$ function model diagrams.

CONCEPT: Each function box has its own number identifying it in the sequence of decomposition.

NARRATION: "IN THIS EXAMPLE A-0 REPRESENTS THE TOP LEVEL. ALL OTHER LEVELS ARE DECOMPOSITIONS OF SUBSEQUENT LEVELS AND ALWAYS PROCEED FROM MORE GENERAL TO A MORE DETAILED LEVEL OF DECOMPOSITION."

AUTHORING PROCEDURES | PROCESS

- DEFINE CONTEXT, VIEWPOINT AND PURPOSE
- BOUND THE CONTEXT
- COLLECT DATA
- LIST DATA AND FUNCTIONS
- CLUSTER DATA AND FUNCTIONS
- SKETCH DATA AND ARROWS (LAYOUT)
- REFINE LAYOUT
- CONSTRUCT FEO'S, TEXT, AND GLOSSARY WHERE NEEDED

59-2 34

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the process involved in $IDEF_0$ function modeling.

PROCEDURE: (Follow steps outlined on chart.)

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture-Part II, Volume IV - Function Modeling Manual ($IDEF_0$)

SEE: "Authoring Process," Section 6 (All)

NARRATION: "THE AUTHORING PROCESS ENTAILS FOLLOWING THE SPECIFIED AUTHORING PROCEDURES OUTLINED ON THIS CHART."

(TALK TO CHART)

AUTHORING PROCEDURES | **ORIENTATION OF MODELS**

DEFINITIONS

- CONTEXT (SUBJECT)
  THE SCOPE OR BOUNDARIES OF THE SUBJECT MATTER
- VIEWPOINT (BIAS)
  THE PERSPECTIVE FROM WHICH A SUBJECT IS ANALYZED
- PURPOSE (OBJECTIVE)
  THE REASON(S) A MODEL IS CREATED; THE WAYS THAT IT COULD BE USED

59-4 38

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the sequence and orientation of models.

PROCEDURE: Orientation of models includes defining context, viewpoint, and purpose.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture-Part II, Volume IV - Function Modeling Manual (IDEF0)

SEE: "Orientation of Models," Section 6 (A11)

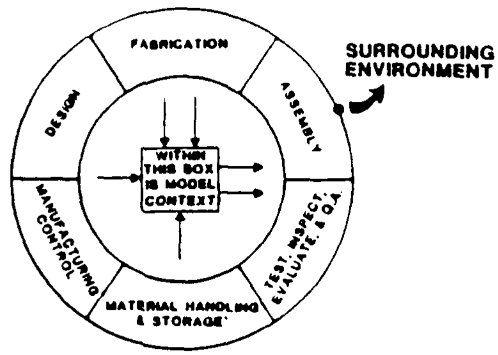
NARRATION: (TALK TO CHART)

"THE CONTEXT, OR SUBJECT IS THE SCOPE, OR BOUNDARIES OF THE SUBJECT MATTER BEING MODELED."

"THE VIEWPOINT, OR BIAS IS THE PERSPECTIVE FROM WHICH A SUBJECT IS ANALYZED."

"THE PURPOSE, OR OBJECTIVE IS THE REASON OR REASONS WHY THE FUNCTION MODEL IS CREATED, THAT IS, THE WAYS THAT THE FUNCTION MODEL COULD BE USED.

AUTHORING PROCEDURES | BOUND THE CONTEXT



THE INPUTS, CONTROLS, OUTPUTS, AND MECHANISMS DEFINE THE INTERFACE BETWEEN THE MODEL CONTEXT AND THE SURROUNDING ENVIRONMENT.

89-4 36

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the "context" information into which every $IDEF_0$ function model fits.

PROCEDURE: Decide context (subject) definition from surrounding environment.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture-Part II, Volume IV - Function Modeling Manual ($IDEF_0$)

SEE: "Bound the Context," Section 6 (All)

NARRATION: "MODEL CONTEXT DEPENDS ON THE DEFINED PURPOSE OF THE FUNCTION MODEL AND THE WAYS IN WHICH THE FUNCTION MODEL INPUTS, CONTROLS, OUTPUTS, AND MECHANISMS INTERFACE WITH THE SURROUNDING ENVIRONMENT."

AUTHORING PROCEDURES | DATA COLLECTION

HOW

- READ RELEVANT REFERENCE MATERIAL
- INTERVIEW EXPERTS
- OBSERVE THE SYSTEM IN PROGRESS

80-4 37

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure of collecting data for $IDEF_0$ modeling.

PROCEDURE:
1) Read relevant reference material
2) Interview experts
3) Observe the system in progress

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture-Part II, Volume IV - Function Modeling Manual ($IDEF_0$)

SEE: "Data Collection," Section 7 (All)

NARRATION: "DATA COLLECTION INVOLVES READING RELEVANT REFERENCE MATERIAL, SUCH AS ORGANIZATIONAL CHARTS, INTERVIEWING EXPERTS, AS WELL AS, OBSERVING THE SYSTEM IN PROGRESS."

AUTHORING PROCEDURES | **DATA COLLECTION**

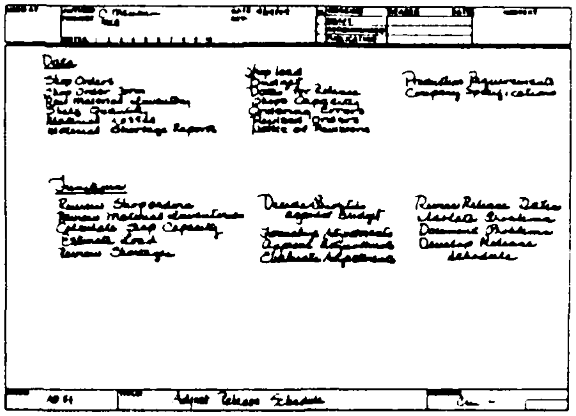
WHAT:

- **DEFINITIONS**
- **FUNCTIONS**
- **DATA**

INSTRUCTIONAL OBJECTIVE: To teach an understanding of what kind of data to collect for $IDEF_0$ modeling.

PROCEDURE: Collect definitions of terms. Collect names of functions and subfunctions being modeled and collect data involved with functions and subfunctions being modeled.

NARRATION: "DATA COLLECTION IS GATHERING DEFINITIONS OF TERMS, FUNCTIONS, AND DATA."

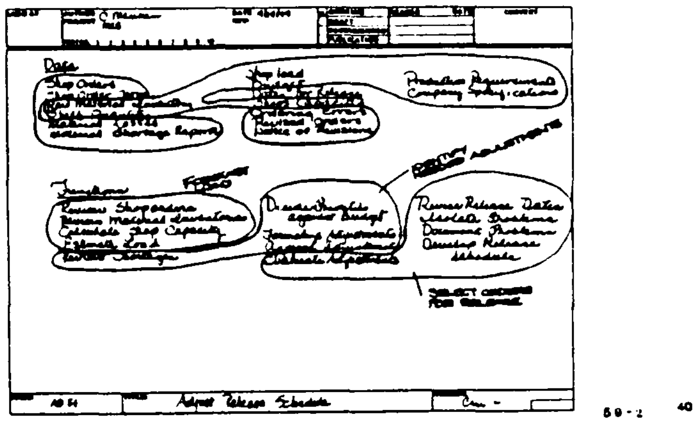


INSTRUCTIONAL OBJECTIVE: To teach an understanding of how to list data and functions.

PROCEDURE: List data and functions.

NARRATION: "LISTING DATA AND FUNCTIONS IS ORGANIZING THE DATA COLLECTION GATHERED FROM READING RELEVANT REFERENCE MATERIAL, INTERVIEWING EXPERTS, AND OBSERVING THE SYSTEM IN PROGRESS."

AUTHORING PROCEDURES | CLUSTER DATA AND FUNCTIONS



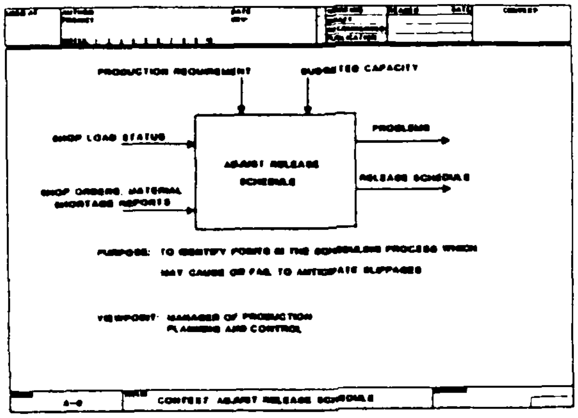
INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure used for gathering data used in $IDEF_0$ function modeling.

PROCEDURE: Cluster data and functions.

NARRATION: "CLUSTER DATA INTO INPUT DATA, CONTROL DATA, AND OUTPUT DATA.

"CLUSTER SUBFUNCTIONS INTO RESPECTIVE FUNCTION CATEGORIES."

AUTHORING PROCEDURES | A-0 DIAGRAM



INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure for diagramming the information in the A-0 level (the whole function).

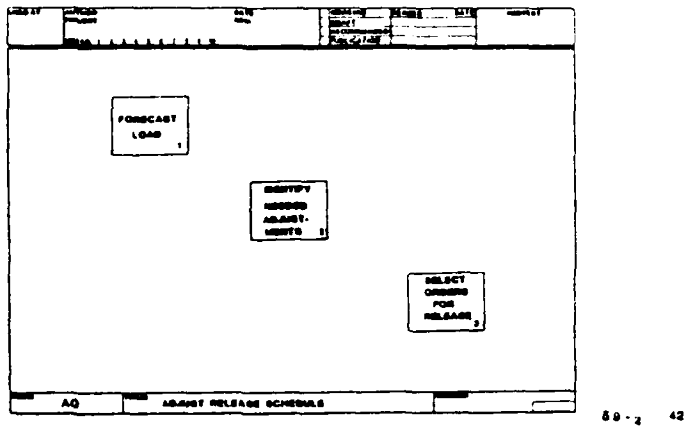
PROCEDURE: Organize data and functions into diagram form according to $IDEF_0$ function model methodology.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual ($IDEF_0$)

SEE: "A-0 Diagram," Section 6, #6.1.2, Pg. 85

NARRATION: "THE A-0 LEVEL DIAGRAM REPRESENTS THE WHOLE FUNCTION BEING MODELED COMPLETE WITH ITS INPUT, CONTROLS, OUTPUTS, AND MECHANISMS (NOT SHOWN ON THIS DIAGRAM). CAN ANYONE NAME SOME MECHANISMS BY WHICH THE ADJUST RELEASE SCHEDULE FUNCTION IS ACCOMPLISHED?"

AUTHORING PROCEDURES | **LAY OUT DIAGRAM**



INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure for laying out the A0 diagram (the next lower level of subfunctions involved in the whole system).

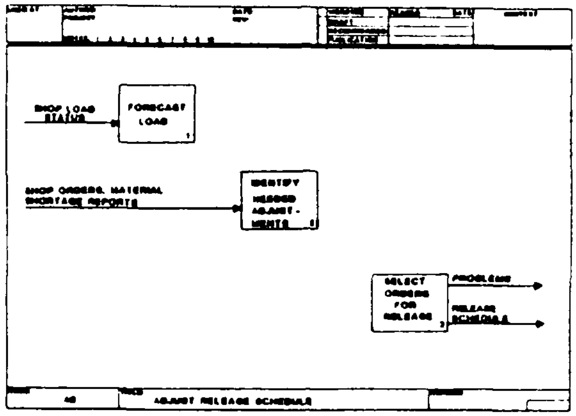
PROCEDURE: Determine next lower level of subfunctions involved in the whole function being modeled and lay out the function boxes from left to right.

REFERENCE: AFWAL-TR-81-4023/<u>INTEGRATED COMPUTER AIDED MANUFACTURING</u> (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual (IDEF$_0$)

SEE: "Generate Function Boxes," Section 6, #6.2.1, Pg. 90

NARRATION: "FROM THE INFORMATION GATHERED ABOUT THE FUNCTION BEING MODELED DETERMINE NEXT LOWER LEVEL OF SUBFUNCTIONS, AND ARRANGE THEM IN THEIR FUNCTION BOXES FROM TOP LEFT TO LOWER RIGHT."

AUTHORING PROCEDURES | LAY OUT DIAGRAM



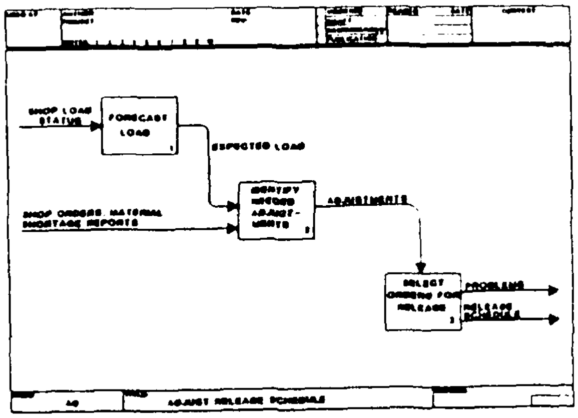
59-2 43

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure for adding input data and output data to subfunctions of the A0 level of decomposition.

PROCEDURE: Diagram inputs and outputs associated with their subfunctions.

NARRATION: "AFTER THE SUBFUNCTIONS HAVE BEEN LAID OUT, GO BACK TO THE DATA LIST THAT'S BEEN CLUSTERED AND ADD INPUTS AND OUTPUTS ASSOCIATED WITH THEIR RESPECTIVE SUBFUNCTIONS."

AUTHORING PROCEDURES | LAY OUT DIAGRAM

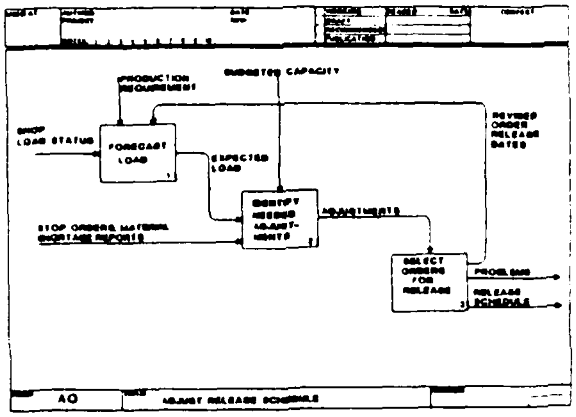


INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedures for adding output data to the subfunctions of the A0 level of decomposition.

PROCEDURE: Diagram controls from data list and cluster.

NARRATION: "NEXT, ADD ANY <u>CONTROLS</u> ASSOCIATED WITH THE SUBFUNCTIONS."

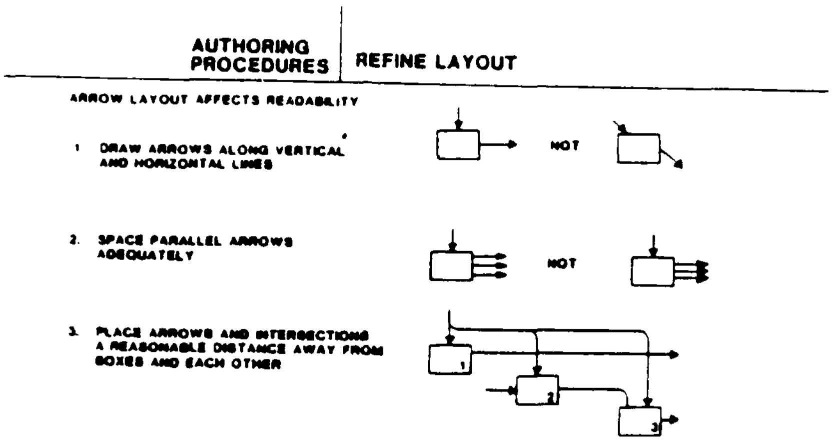
AUTHORING PROCEDURES | LAY OUT DIAGRAM



INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedures for adding feedback in the A0 level of decomposition.

PROCEDURE: Diagram feedback output data arrow to control data.

NARRATION: "IN IDEF$_0$ MODELING, CHANGES OR REVISIONS TO THE FUNCTION BEING MODELED ARE ACCOMMODATED BY WAY OF FEEDBACK. FEEDBACK OUTPUT DATA ARROWS TO CONTROL DATA ALWAYS GO UP AND OVER."



INSTRUCTIONAL OBJECTIVE: To teach an understanding of how to diagram correctly with arrow notation in $IDEF_0$ function modeling.

PROCEDURE: Follow "do's" and avoid "do not's" outlined in the following procedures for refining layout.

NARRATION: (TALK TO CHART)

AUTHORING PROCEDURES | REFINE LAYOUT

4. CONNECT OPEN-ENDED (PARENT) ARROWS TO SHOW ALL THE PLACES AFFECTED

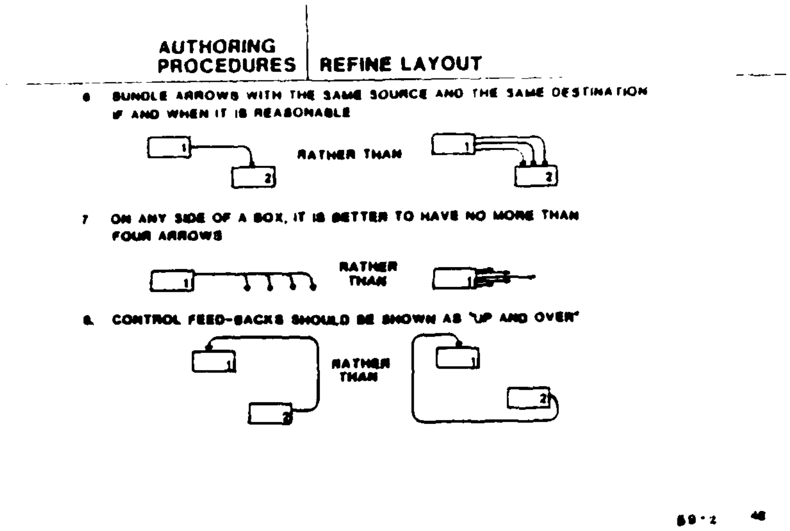
5. DON'T USE THE KEY WORDS (DATA, FUNCTION, OUTPUT, ETC.) IN LABELING ARROWS AND BOXES

58-2 47

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure for refining $IDEF_0$ model diagram layout.

PROCEDURE: Follow "do's" and avoid "do not's" in placing data arrows in their respective function boxes.

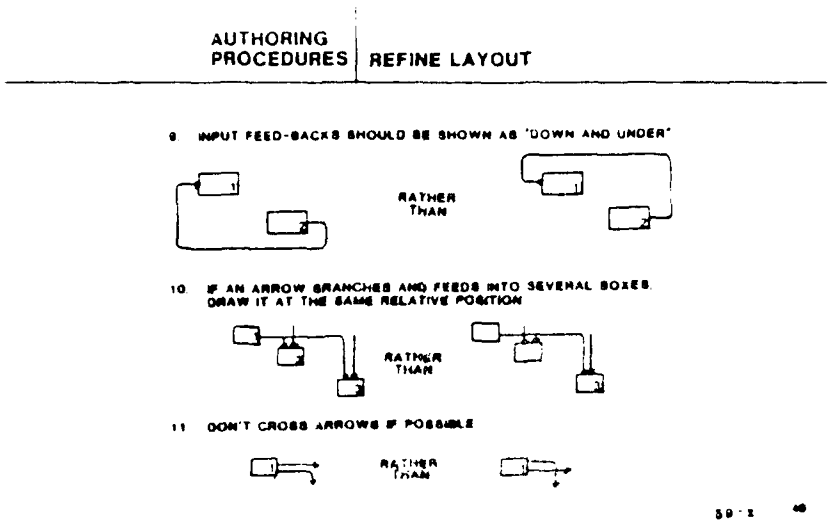
NARRATION: (TALK TO CHART)



INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure for refining IDEF0 model diagram layout.

PROCEDURE: Follow "do's" and avoid "do not's" in order to simplify arrow notation for better communication.

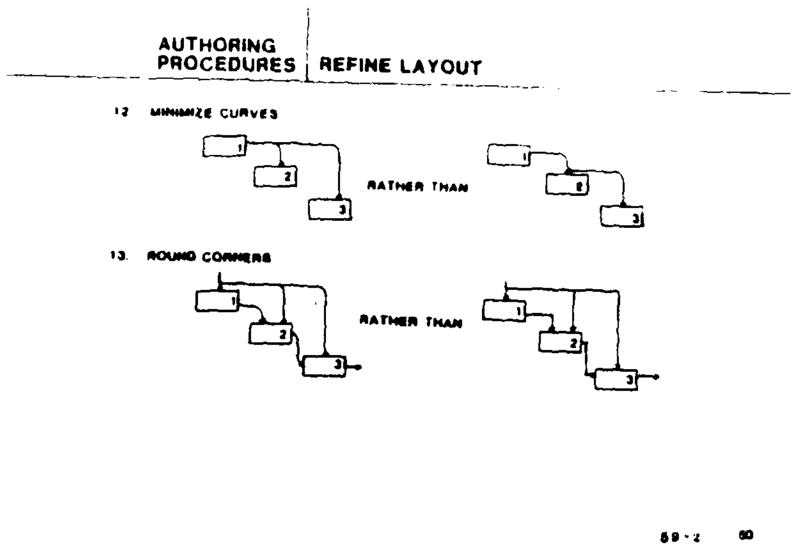
NARRATION: (TALK TO CHART)



INSTRUCTIONAL OBJECTIVE: *To teach an understanding of the procedure* for refining IDEF0 function model diagrams.

PROCEDURE: Follow "do's" and avoid "do not's" in order to simplify arrow notation for better communication.

NARRATION: (TALK TO CHART)

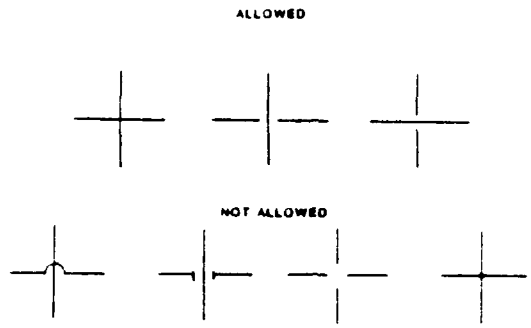


INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedures used in refining an $IDEF_0$ function model diagram layout.

PROCEDURE: Follow "do's" and avoid "do not's" in order to simplify arrow notation for better communication.

NARRATION: (TALK TO CHART)

AUTHORING PROCEDURES | REFINE LAYOUT



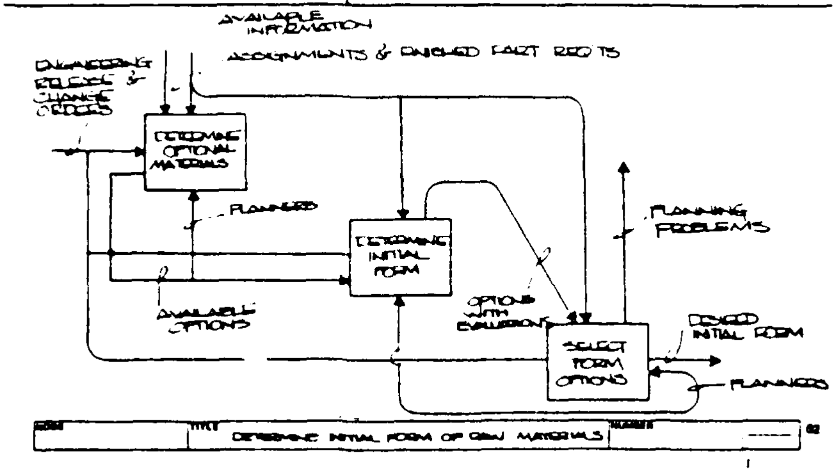
69 61

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure for refining $IDEF_0$ function model diagram layouts.

PROCEDURE: Follow allowed arrow notation and avoid arrow notation not allowed.

NARRATION: (TALK TO CHART)

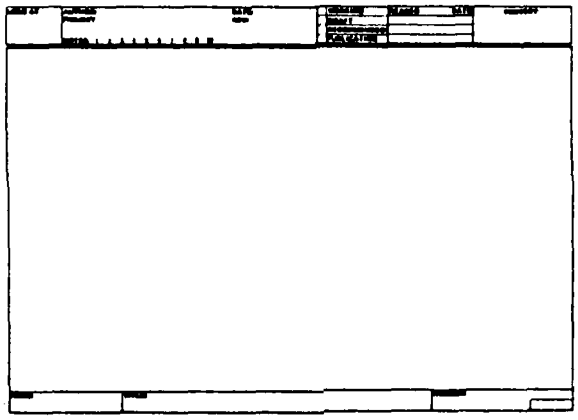
AUTHORING PROCEDURES | **REFINE LAYOUT EXERCISE**



INSTRUCTIONAL OBJECTIVE: To review standard arrow notation and *function box layout in* $IDEF_0$ *function* modeling.

DIRECTIONS: HAVE PARTICIPANTS REFINE THIS LAYOUT ON THE FORM INCLUDED THE HANDOUTS ACCORDING TO THE PROCEDURES JUST COVERED IN THE PRECEDING LESSONS.

AUTHORING PROCEDURES | **REFINE LAYOUT EXERCISE**



INSTRUCTIONAL OBJECTIVE: To review refine layout procedures.

DIRECTIONS: USE THIS FORM TO REFINE THE LAYOUT ON THE PRECEDING REVIEW EXERCISE.

AUTHORING PROCEDURES | **FEO** (FOR EXPOSITION ONLY)

A FEO:

- IS USED BY THE AUTHOR
  - TO ILLUSTRATE A POINT
  - TO CLARIFY A DIAGRAM
- IS A DIAGRAM THAT FALLS OUTSIDE THE STRICT HIERARCHY
- MAY CONTAIN MORE THAN SIX BOXES AND HAVE PARTIAL ARROW STRUCTURE i.e. VIOLATE $IDEF_0$ (FUNCTION MODEL) SYNTAX
- MAY USE OTHER METHODOLOGIES i.e. PERT, CPM, etc.

59-_ 64

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the function and use of a F.E.O. Diagram.

PROCEDURE: Produce a F.E.O. for any $IDEF_0$ function model that requires clarificlation.

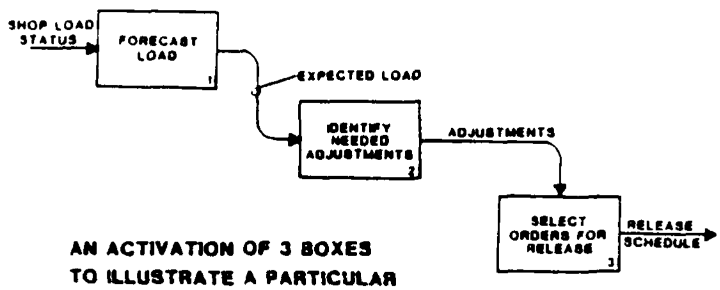
REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual ($IDEF_0$)

SEE: "Creating Supporting Materials," Section 6, #6.1.5, Pg. 87

NARRATION: "A F.E.O. IS A SPECIAL KIND OF $IDEF_0$ FUNCTION MODEL DIAGRAM, USED: FOR EXPOSITION ONLY."

(TALK TO CHART)

AUTHORING PROCEDURES | FEO (FOR EXPOSITION ONLY) EXAMPLE



AN ACTIVATION OF 3 BOXES TO ILLUSTRATE A PARTICULAR SCENARIO.

58-2

INSTRUCTIONAL OBJECTIVE: F.E.O. (continued) to give a manufacturing example of a F.E.O.

PROCEDURE: Produce a F.E.O. for any $IDEF_0$ function model that requires clarification.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual ($IDEF_0$)

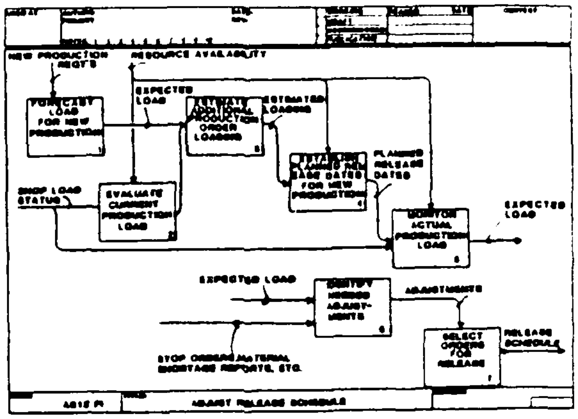
SEE: "Creating Supporting Materials," Section 6, #6.1.5, Pg. 87

NARRATION: "THIS IS AN EXAMPLE OF A F.E.O. IN A MANUFACTURING CONTEXT.

"THIS F.E.O. DIAGRAM HAS ONLY A PARTIAL ARROW STRUCTURE USED TO ILLUSTRATE CERTAIN INPUTS, CONTROLS, AND OUTPUTS OF A PARTICULAR FUNCTION THAT THE AUTHOR WISHES TO CLARIFY."

(TALK TO CHART)

AUTHORING PROCEDURES | FEO (FOR EXPOSITION ONLY) EXAMPLE



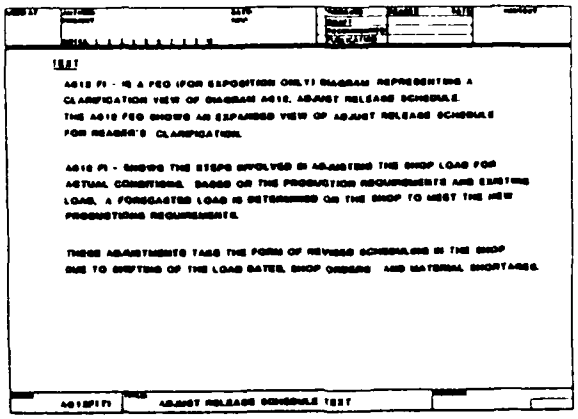
INSTRUCTIONAL OBJECTIVE: F.E.O. (continued) to give a manufacturing example of a F.E.O.

PROCEDURE: Produce a F.E.O. for any $IDEF_0$ function model that requires clarification.

NARRATION: "THIS IS ANOTHER EXAMPLE IN A MANUFACTURING CONTEXT."

(TALK TO CHART)

AUTHORING PROCEDURES | **TEXT**


TEXT

A612 F1 - IS A FEO (FOR EXPOSITION ONLY) DIAGRAM REPRESENTING A CLARIFICATION VIEW OF DIAGRAM A612, ADJUST RELEASE SCHEDULE. THE A612 FEO SHOWS AN EXPANDED VIEW OF ADJUST RELEASE SCHEDULE FOR READER'S CLARIFICATION.

A612 F1 - SHOWS THE STEPS INVOLVED IN ADJUSTING THE SHOP LOAD FOR ACTUAL CONDITIONS. BASED ON THE PRODUCTION REQUIREMENTS AND EXISTING LOAD, A FORECASTED LOAD IS DETERMINED ON THE SHOP TO MEET THE NEW PRODUCTIONS REQUIREMENTS.

THESE ADJUSTMENTS TAKE THE FORM OF REVISED SCHEDULING IN THE SHOP DUE TO SHIFTING OF THE LOAD DATES, SHOP ORDERS AND MATERIAL SHORTAGES.

A612F1 | ADJUST RELEASE SCHEDULE TEXT

69-2 67

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the function and use of "text" in $IDEF_0$ function modeling.

PROCEDURE: Produce a text for a diagram that gives a brief overview of the diagram.

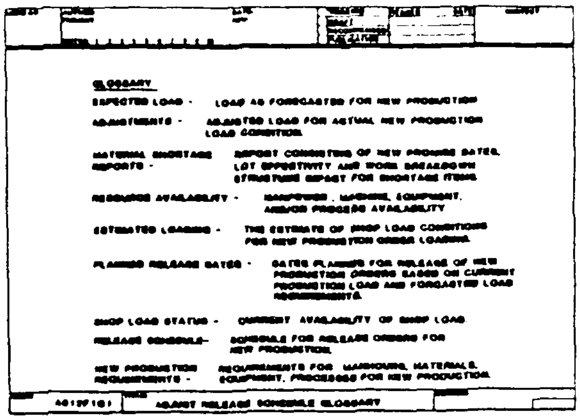
REFERENCE: <u>AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING</u> (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual ($IDEF_0$)

SEE: "Creating Supporting Materials," Section 6, #6.1.5, Pg. 87

NARRATION: "ANY TEXT THAT ACCOMPANIES A DIAGRAM IS BRIEF, LESS THAN ONE PAGE IN LENGTH, AND PRESENTS AN OVERVIEW OF THE $IDEF_0$ FUNCTION BEING MODELED.

"THE PURPOSE OF THE TEXT IS FOR CLARIFICATION AND IS INTENDED TO FILL IN ANY MISSING INFORMATION NOT COMMUNICATED BY THE $IDEF_0$ MODEL DIAGRAM."

AUTHORING PROCEDURES | GLOSSARY



INSTRUCTIONAL OBJECTIVE: To teach an understanding of the function and use of the glossary to $IDEF_0$ function modeling.

PROCEDURE: List all terms that require clarification of definition.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual ($IDEF_0$)

SEE: "Creating Supporting Materials," Section 6, #6.1.5, Pg. 87

NARRATION: "THE PURPOSE OF THE GLOSSARY IS TO DEFINE TERMS AS THEY ARE USED IN ANY SPECIFIC $IDEF_0$ FUNCTION MODELING CONTEXT."

AUTHORING PROCEDURES | DECOMPOSITION

- AUTHOR A DIAGRAM
- VERIFY AND REFINE
- DECOMPOSE AND ITERATE

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure in decomposing an $IDEF_0$ function model.

PROCEDURE:

1) Author the specific level of the $IDEF_0$ function model.

2) Verify and refine that level of the $IDEF_0$ function model.

3) Decompose and iterate the $IDEF_0$ function model.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual ($IDEF_0$)

SEE: "Author Activities," Section 6, #6.1.7, Pg. 88

NARRATION: (TALK TO CHART)

"THE FIRST STEP IN $IDEF_0$ AUTHORING PROCEDURES IS TO AUTHOR A DIAGRAM, THEN TO THINK ABOUT, VERIFY, AND REFINE THE DIAGRAM IN ORDER TO COMMUNICATE THE INTENDED MESSAGE, AND FINALLY TO DECOMPOSE THE A-0 LEVEL AND ITERATE THE $IDEF_0$ FUNCTION MODEL BY THE KIT OR MEETING PROCESS."

AUTHORING PROCEDURES | DECOMPOSITION PROCESS

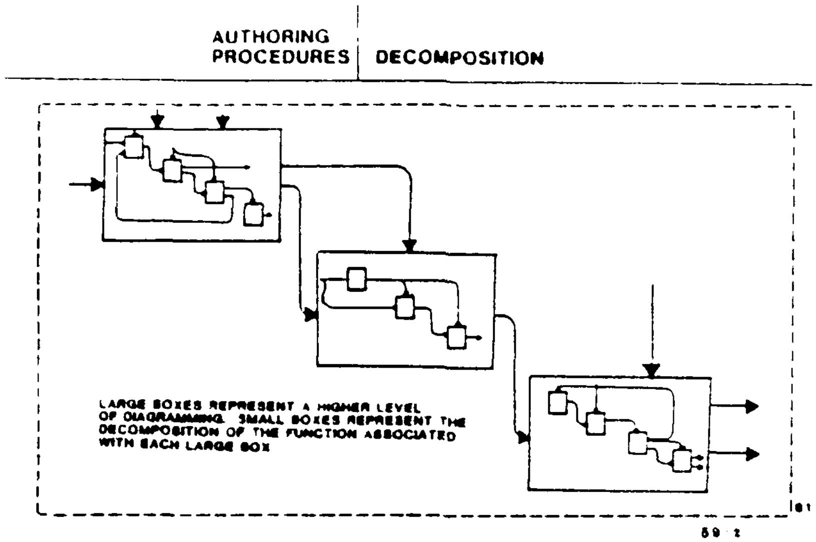
- CHOOSE BOX FOR DECOMPOSITION
- COLLECT DATA
- BOUND CONTEXT
- CLUSTER DATA AND FUNCTIONS
- SKETCH BOXES AND ARROWS (LAY OUT DIAGRAM)
- REFINE LAYOUT
- CONFIRM INTERFACE WITH PARENT
- SEND OUT KIT FOR REVIEW (VERIFY)

59 · 60

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedures for the decomposition process of $IDEF_0$ function modeling.

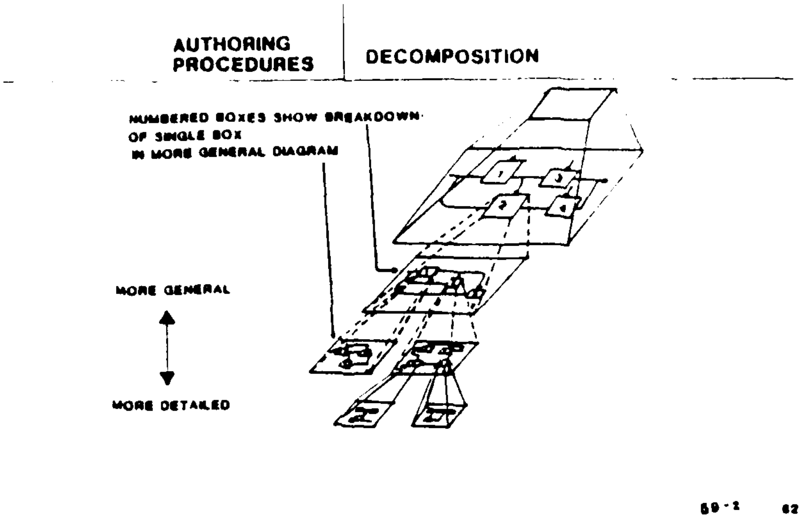
PROCEDURE: (As outlined on chart)

NARRATION: (FOLLOW THE STEPS OUTLINED ON THE CHART)



INSTRUCTIONAL OBJECTIVE:	*To teach an understanding of the procedures used in decomposing an* IDEF$_0$ function model.
PROCEDURE:	Start with A-0 level (the whole function) and break the A-0 level into its subfunctions.

NARRATION: (TALK TO CHART)

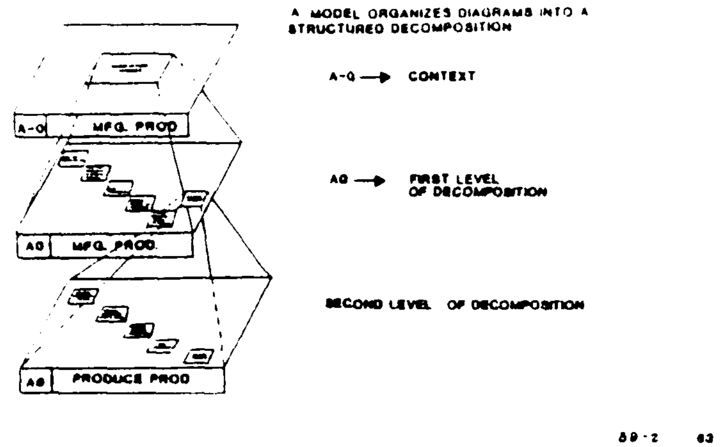


INSTRUCTIONAL OBJECTIVE: To teach an understanding of authoring decomposition procedures.

PROCEDURE: Decompose functions from a more general level to a more detailed level of decomposition.

NARRATION: "ALL DECOMPOSITIONS PROCEED FROM THE A-0 LEVEL TO NEXT LOWER LEVELS OF DETAIL."

AUTHORING PROCEDURES | DECOMPOSITION



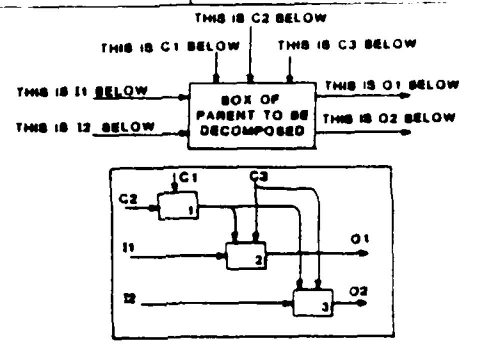
INSTRUCTIONAL OBJECTIVE: To teach an understanding of authoring decomposition procedures.

PROCEDURE: Proceed from the A-0 context to the first level of decomposition, and then to the second level of decomposition.

NARRATION: "THIS IS AN EXAMPLE OF THE DECOMPOSITION PROCESS IN A MANUFACTURING ENVIRONMENT."

(TALK TO CHART)

AUTHORING PROCEDURES | DECOMPOSITION



ICOM CODES ARE WRITTEN ON THE DECOMPOSED DIAGRAM
AS THEY APPEAR ON THE PARENT DIAGRAM

59-2 64

INSTRUCTIONAL OBJECTIVE: To teach an understanding of authoring decomposition procedures.

PROCEDURE: Keep track of ICOM notation throughout the decomposition process.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual (IDEF0)

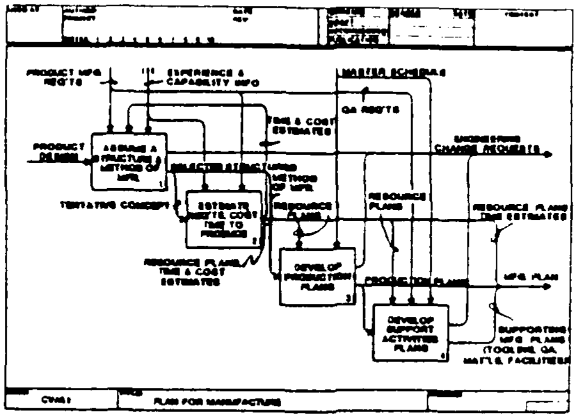
SEE: "Coding Boundary Arrows" Section 3, #3.2.3, Pg. 37

NARRATION: (TALK TO CHART)

"REMEMBER THE ICOM CODES:

I = INPUT
C = CONTROL
O = OUTPUT
M = MECHANISM"

AUTHORING PROCEDURES | DECOMPOSITION



INSTRUCTIONAL OBJECTIVE: To teach an understanding of authoring decomposition procedures by using a manufacturing example.

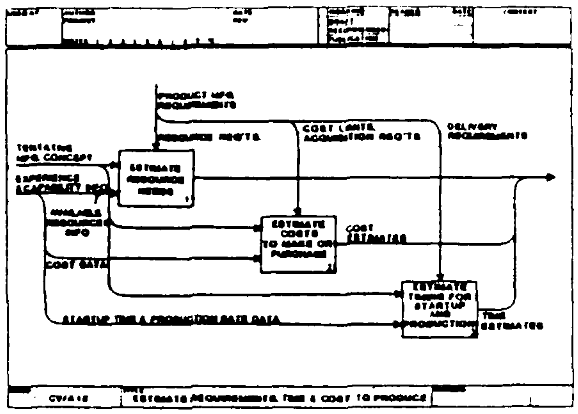
PROCEDURE: Keep track of ICOM notation throughout the decomposition process by using <u>ICOM codes</u>.

NARRATION: "THIS IS A MANUFACTURING EXAMPLE OF HOW THE USE OF <u>ICOM CODES</u> ARE USED TO HELP CLARIFY THE UNDERSTANDING OF THE $IDEF_0$ FUNCTION MODEL THROUGHOUT THE DECOMPOSITION PROCESS.

"MECHANISMS ARE NOT FREQUENTLY SHOWN IN GENERIC MODELS BECAUSE THIS IS WHERE THE DIFFERENCES OCCUR AMONG AEROSPACE MANUFACTURERS.

"BUT, THE MECHANISMS ARE USUALLY SHOWN IN THE LOWEST LEVEL OF DECOMPOSITION."

AUTHORING PROCEDURES | DECOMPOSITION

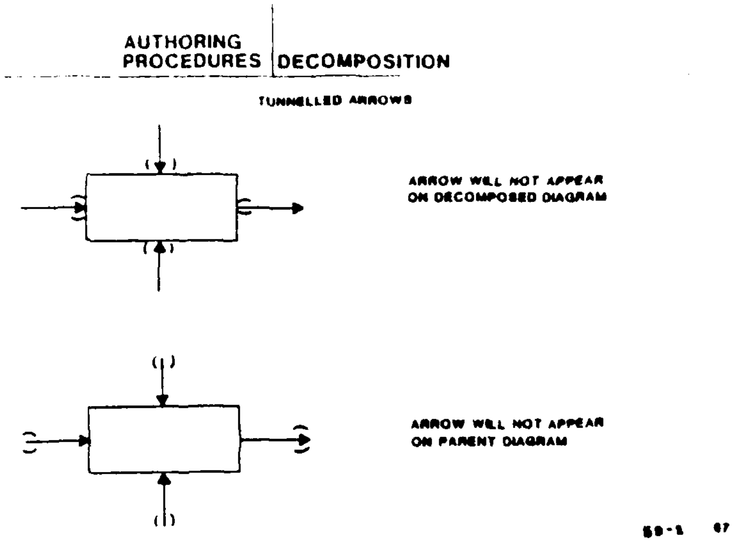


B9-2 46

INSTRUCTIONAL OBJECTIVE: To teach an understanding of authoring decomposition procedures by using a manufacturing example.

PROCEDURE: Keep track of the ICOM notation throughout the decomposition process by using ICOM codes.

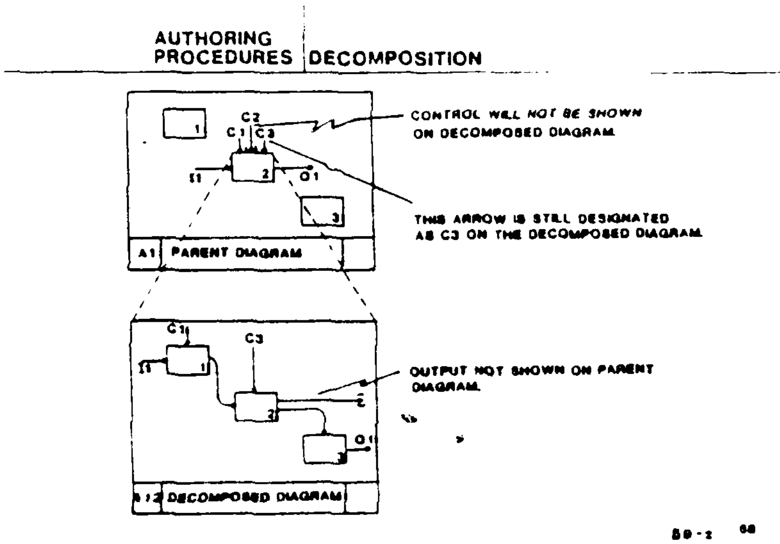
NARRATION: "THIS IS A FURTHER MANUFACTURING EXAMPLE OF HOW THE USE OF ICOM CODES ARE USED TO HELP CLARIFY THE UNDERSTANDING OF THE IDEF$_0$ FUNCTION MODEL THROUGHOUT THE DECOMPOSITION PROCESS."



INSTRUCTIONAL OBJECTIVE: To teach an understanding of what happens to certain data in the decomposition process.

PROCEDURE: Tunnelled arrows are utilized to vary the data detail at the appropriate model level.

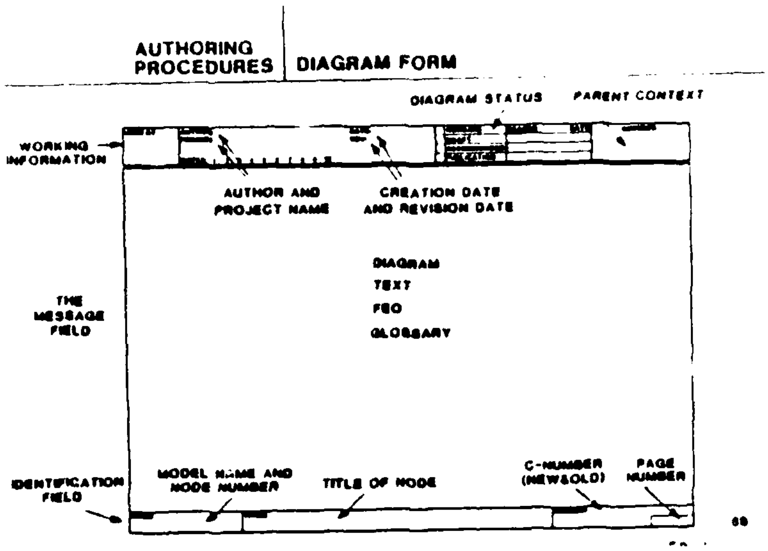
NARRATION: "SOMETIMES WE WANT TO SHOW AS MUCH DATA AS POSSIBLE ON THE HIGHEST LEVEL DIAGRAM. IF WE FIND THAT OUR PROJECT SCOPE IS NOT CONCERNED WITH ALL THE DATA WE HAVE INDICATED, WE HAVE A CONVENTION FOR SHOWING DATA AT HIGHER LEVELS AND DROPPING IT ALTOGETHER OR HAVING IT DISAPPEAR AND REAPPEAR LATER AT A LOWER LEVEL OF DECOMPOSITION."



INSTRUCTIONAL OBJECTIVE: To teach an understanding of authoring decomposition procedures.

PROCEDURE: Follow tunnelled arrow notation throughout the decomposition process.

NARRATION: (TALK TO CHART)



INSTRUCTIONAL OBJECTIVE: To teach an understanding of the diagram form used in $IDEF_0$ authoring procedures.

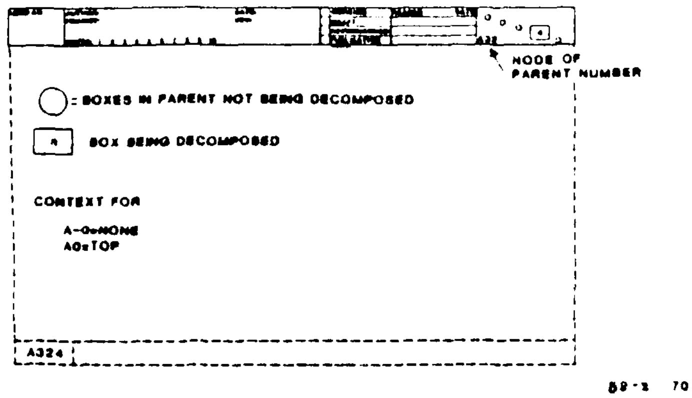
PROCEDURE: Fill in appropriate information in spaces provided.

NARRATION: "DIAGRAM <u>FORM</u> PROVIDES:

1) STANDARDIZATION
2) CONSISTENCY

FOR COMMUNICATION."

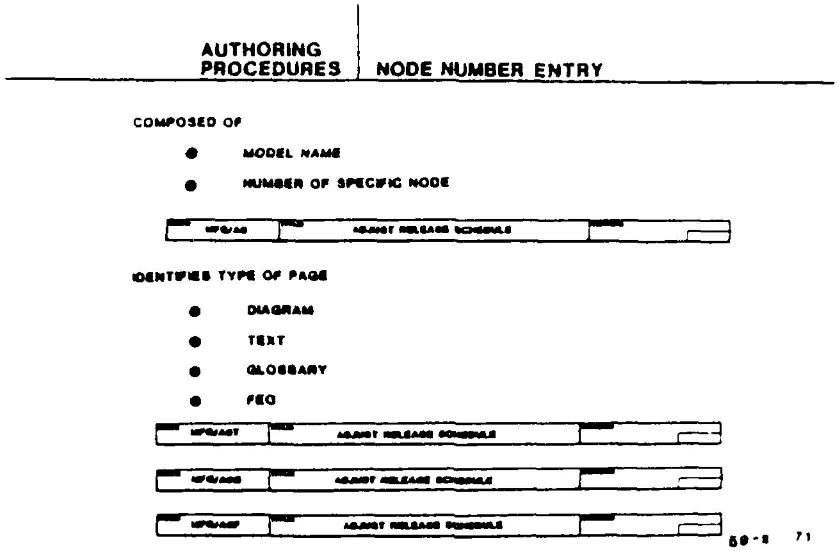
AUTHORING PROCEDURES | CONTEXT ENTRY



INSTRUCTIONAL OBJECTIVE: To teach an understanding of <u>context entry</u> diagram form in $IDEF_0$ authoring procedures.

PROCEDURE: Use standard $IDEF_0$ form with context entry at top right hand corner of form.

NARRATION: (TALK TO CHART)



INSTRUCTIONAL OBJECTTIVE: To teach an understanding of the node number entry diagram form in IDEF0 authoring procedures.

PROCEDURE: Use standard IDEF0 form with node number entry under "node" section at lower left hand corner and "title" at lower center of diagram form.

NARRATION: (TALK TO CHART)

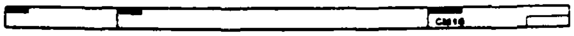
AUTHORING PROCEDURES | C-NUMBER ENTRY

CREATION NUMBER IS REFERRED TO AS C NUMBER

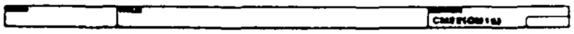
COMPOSED OF

- TWO OR THREE LETTERS OF AUTHOR'S INITIALS
- FOLLOWED BY A NUMBER SEQUENTIALLY ASSIGNED BY AUTHOR

PRIMARY MEANS OF REFERENCE TO A SHEET FOUND IN THE LOWER LEFT CORNER OF THE NUMBER FIELD



IF A DIAGRAM REPLACES A PREVIOUS DIAGRAM, THE ORIGINAL C-NUMBER IS WRITTEN IN PARENTHESES FOLLOWING THE NEW C-NUMBER



89-x 72

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the creation-number entry diagram form in $IDEF_0$ authoring procedures.

PROCEDURE: Use standard $IDEF_0$ form with "C-number entry" located at the lower right hand corner of the form.

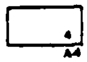
NARRATION: (TALK TO CHART)

AUTHORING PROCEDURES | REFERENCE EXPRESSION

TO FIND THE DETAILS OF A BOX, USE THE REFERENCE EXPRESSION TO IDENTIFY THE NODE NUMBER OF THE DECOMPOSED BOX.

REFERENCE EXPRESSION APPEARS

- OUTSIDE THE BOX
- BELOW THE BOX NUMBER



IF NO REFERENCE APPEARS, THE BOX HAS NOT YET BEEN DECOMPOSED.

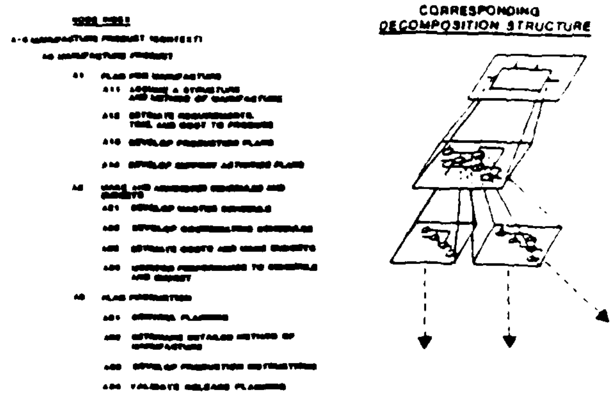
88·2 73

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the use of reference expression diagram form in $IDEF_0$ authoring procedures.

PROCEDURE: List reference expression to clarify the decompositions.

NARRATION: (TALK TO CHART)

AUTHORING PROCEDURES | DOCUMENTATION- NODE INDEX



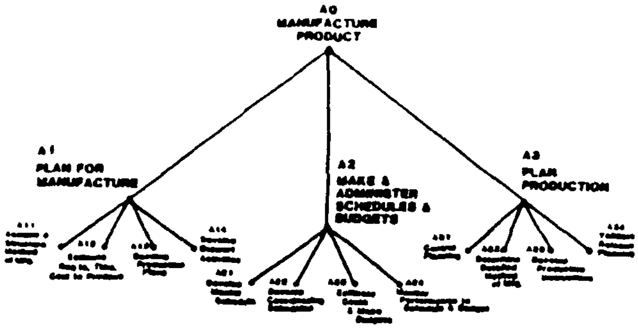
59-2 74

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the documentation node index used in $IDEF_0$ function modeling.

PROCEDURE: Diagram the functions involved in the decomposition process in a list form according to node index.

NARRATION: (TALK TO CHART)

AUTHORING PROCEDURES | **DOCUMENTATION - NODE TREE**



INSTRUCTIONAL OBJECTIVE: To teach an understanding of the documentation node tree used in $IDEF_0$ function modeling.

PROCEDURE: Diagram the functions involved in the decomposition process in node tree form.

NARRATION: "THIS IS A MANUFACTURING EXAMPLE OF A NODE TREE USED TO DEVELOP AN UNDERSTANDING OF FUNCTION DECOMPOSITION IN $IDEF_0$ FUNCTION MODELING."

AUTHORING CONCEPTS AND PROCEDURES | AUTHORING EXERCISE

BASED ON THE FOLLOWING MODEL PURPOSE AND VIEWPOINT, CREATE AN A-0 AND A0 DIAGRAM OF YOUR JOB

PURPOSE: TO UNDERSTAND AND COMMUNICATE THE FUNCTION OF MY JOB (PUT YOUR JOB IN PERSPECTIVE BY IDENTIFYING THE ORGANIZATION(S) YOU ARE PART OF.)

VIEWPOINT: "MYSELF" (STATE YOUR BACKGROUND AND EXPERIENCE)

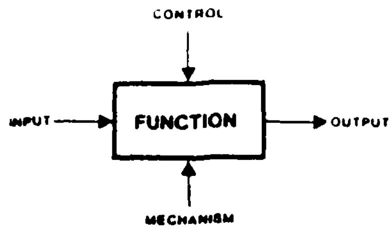
89-2 76

INSTRUCTIONAL OBJECTIVE: To review the $IDEF_0$ function modeling authoring concepts and procedures covered in this training manual.

DIRECTIONS: FOLLOW DIRECTIONS ON CHART USING $IDEF_0$ DIAGRAM FORMS OR SCRATCH PAPER. WE WILL DISCUSS ANY PROBLEMS INFORMALLY.

NARRATION: "AFTER THE EXERCISE IS COMPLETED TELL THE PARTICIPANTS THAT THIS EXERCISE HAS BEEN TO PROVOKE THOUGHT, TO PROVIDE PRACTICE, AND TO DEVELOP A BETTER UNDERSTANDING OF THE $IDEF_0$ MODELING METHODOLOGY. THE MODELS WILL NOT BE COLLECTED OR DISPLAYED."

IDEF$_0$



COMMENTING
CONCEPTS AND PROCEDURES

TITLE SLIDE: IDEF$_0$ Commenting Concepts and Procedures

COURSE OBJECTIVE: To teach an understanding of the commenting concepts and procedures involved in IDEF$_0$ function modeling.

NARRATION: "AN IDEF$_0$ FUNCTION MODEL GRAPHICALLY SHOWS OBJECTS AND/OR INFORMATION PERFORMED BY MEN AND/OR MACHINES THAT ENABLES YOU TO UNDERSTAND A SYSTEM.

"THIS SECTION OF OUR PROGRAM IS TO PROVIDE YOU WITH THE CONCEPTS AND PROCEDURES ESTABLISHED FOR IDEF$_0$ MODEL COMMENTING."

COMMENTING CONCEPTS & PROCEDURES | LEARNING OBJECTIVES

1. UNDERSTAND THE IMPORTANCE OF IDEF COMMENTING
2. UNDERSTAND THE IDEF KIT CYCLE
3. UNDERSTAND THE IDEF WALKTHROUGH MEETING PROCESS
4. UNDERSTAND THE IDEF LIBRARY FUNCTIONS

NARRATION: "COURSE LEARNING OBJECTIVES:

TO ENABLE YOU TO UNDERSTAND IDEF$_0$ FUNCTION MODELING, IN TERMS OF:

1) THE IMPORTANCE OF IDEF COMMENTING

2) THE IDEF KIT CYCLE

3) THE IDEF WALKTHROUGH MEETING PROCESS

4) THE IDEF LIBRARIAN FUNCTIONS"

COMMENTING CONCEPTS	COMMENTING

PRINCIPLES OF COMMENTING:

1. **UNDERSTANDING: WHAT IS THE AUTHOR SAYING ?**

2. **AGREEMENT : DO I AGREE WITH THE AUTHOR?**

5U-J 3

INSTRUCTIONAL OBJECTIVE: To teach an understanding of commenting principles in developing $IDEF_0$ function models.

CONCEPT: Commenting includes understanding and agreement relative to $IDEF_0$ function models.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual ($IDEF_0$)

SEE: "Commenter Guidelines," Section 5, #5.2.2.1, Pg. 65

NARRATION: "COMMENTING ON $IDEF_0$ FUNCTION MODEL DIAGRAMS INVOLVES AN UNDERSTANDING OF WHAT THE AUTHOR IS SAYING AND AN AGREEMENT WITH WHAT THE AUTHOR INTENDED TO SAY."

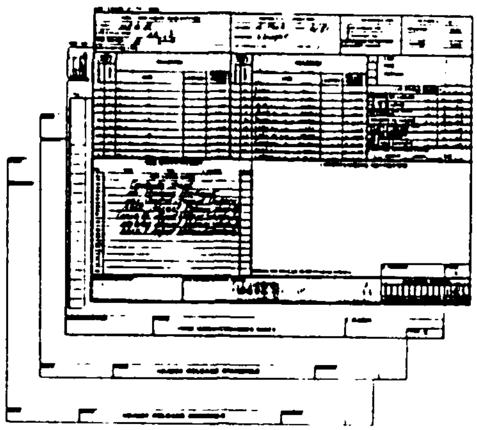
AUTHORING + COMMENTING = COMMUNICATION

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the role of communication in IDEF modeling.

CONCEPT: Understanding and agreement equal communication.

NARRATION: "$IDEF_0$ MODELING METHODOLOGY PROVIDES A STANDARD FOR COMMUNICATION. THE READER MUST FIRST UNDERSTAND WHAT IS BEING SAID. UNDERSTANDING IS A MATTER OF KNOWING THE RULES OF $IDEF_0$ FUNCTION MODELING AND CROSS REFERENCING THE INFORMATION COMMUNICATED BY THE MODEL WITH THOSE RULES."

COMMENTING CONCEPTS | **IDEF KIT**



INSTRUCTIONAL OBJECTIVE: To teach an understanding of the IDEF kit process.

CONCEPT: A standard of communication will provide a means for communicating in IDEF modeling.

NARRATION: "THE IDEF KIT CONCEPT PROVIDES STANDARD FORM FOR COMMUNICATION BY USING STANDARDIZED FORMS AND RULES AND PROCEDURES FOR DEVELOPING IDEF MODELS."

COMMENTING CONCEPTS | IDEF DIAGRAM COMMENTING PROCESS

ASPECTS TO LOOK FOR

- CLARITY
- CONSISTENCY
- CORRECT SYNTAX
- CORRECT SEMANTICS

BU-S 6

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the IDEF diagram commenting process.

CONCEPT: There are specific aspects in the IDEF diagram commenting process that lead to communication.

NARRATION: "DECIDE:

1) DID THE AUTHOR GO BY THE RULES OF THE METHODOLOGY?

2) DO YOU AGREE WITH WHAT THE AUTHOR IS COMMUNICATING?"

COMMENTING PROCEDURES | IDEF DIAGRAM COMMENTING PROCESS

MECHANICS

- (N) NOTES
- NOTE FIELD
- USE RED INK

ABOVE ALL → MAKE COMMENTS

- CLEAR
- BRIEF
- CONSTRUCTIVE

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedures involved in the IDEF diagram commenting process.

PROCEDURE: Make notes and use red ink.

NARRATION: "COMMENTING RULES ARE SIMPLE:

o USE RED INK (REVIEWER)

o NOTES

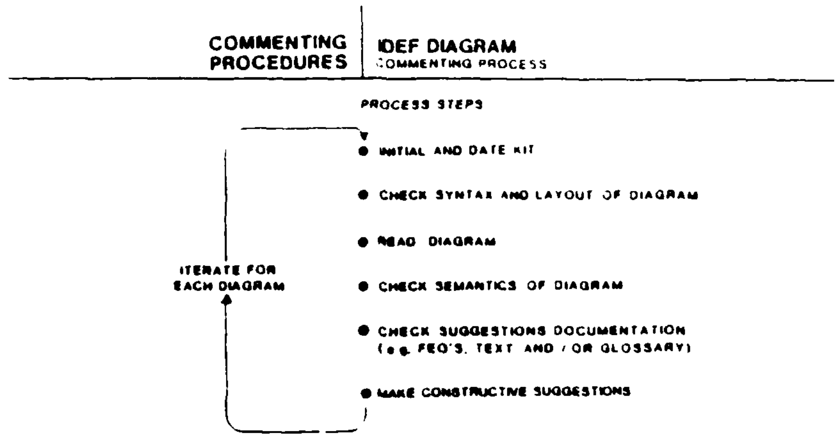
o NOTE FIELD

MAKE COMMENTS:

o CLEAR

o BRIEF

o CONSTRUCTIVE"



INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedures involved in the $IDEF_0$ diagram commenting process.

PROCEDURE: Follow the structured steps involved in the $IDEF_0$ diagram commenting process.

NARRATION: "FOLLOW THESE STEPS."

(TALK TO CHART)

COMMENTING CONCEPTS | TEXT/GLOSSARY COMMENTING

TEXT/GLOSSARY SHOULD HAVE

- BREVITY
- STRUCTURE
- CLARITY

TEXT/GLOSSARY SHOULD BE WRITTEN

- TO CLARIFY INFORMATION CONVEYED BY THE DIAGRAM

59-J 9

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the role of text and glossary in the IDEF diagram commenting process.

CONCEPT: In order to clarify information conveyed by the IDEF diagram some attempt must be made to explain the background and terminology used in the IDEF model.

NARRATION: "IDEF TEST AND GLOSSARY ARE MEANT TO PROVIDE:

1) CLARIFY

2) STRUCTURE

TO THE $IDEF_0$ MODEL."

COMMENTING CONCEPTS | FEO COMMENTING

A FEO (FOR EXPOSITION ONLY)
DON'T FORGET! A FEO

- IS ANY DIAGRAM THAT FALLS OUTSIDE THE STRICT HIERARCHY
- MAY CONTAIN MORE THAN SIX BOXES AND HAVE PARTIAL ARROW STRUCTURE
- IS USED BY THE AUTHOR
  - TO ILLUSTRATE A POINT
  - TO CLARIFY A DIAGRAM

A FEO ASKS:

- DO YOU UNDERSTAND ?
- DOES IT CLARIFY INFO FOR YOU ?
- DO YOU AGREE ?

5U-3 10

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the role of a F.E.O. diagram in the IDEF modeling methodology.

CONCEPT: A F.E.O. provides background information to an $IDEF_0$ function model diagram in addition to that provided by the text and glossary.

NARRATION: (TALK TO CHART)

AD-A144 732 INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM) 6/6
ARCHITECTURE PART 3 VOLUME..(U) SOFTECH INC WALTHAM MA
A W SNODGRASS SEP 83 1080-37
UNCLASSIFIED AFWAL-TR-82-4063-PT-3-VOL-8 F/G 13/8 NL

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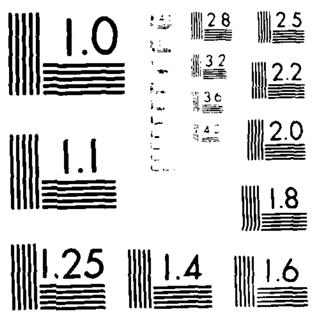


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

COMMENTING CONCEPTS | APPROACHES TO COMMENTING

- **IDEF KIT CYCLE**
- **IDEF WALKTHROUGH MEETING(S)**

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the approaches used in the IDEF model diagram commenting process.

CONCEPT: IDEF commenting includes an interaction among understanding, agreement, and updating of IDEF model information.

NARRATION: "UNDERSTANDING, AGREEMENT, AND UPDATING OF $IDEF_0$ FUNCTION MODELS INVOLVES:

- o THE IDEF KIT CYCLE
- o IDEF WALKTHROUGH MEETING(S)"

COMMENTING PROCEDURES | COMMENTING

USING KIT CYCLE AND WALKTHROUGH MEETING(S)

- CIRCULATE KITS THROUGH KIT CYCLE

AND / OR

- CONDUCT PERIODIC WALKTHROUGH MEETING(S)

59-J 12

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the commenting procedures used in the IDEF diagram commenting process.

PROCEDURE: Conduct IDEF kit cycle and/or conduct periodic walkthrough meeting(s).

NARRATION: (TALK TO CHART)

COMMENTING PROCEDURES | COMMENTING

KIT CYCLING ALTERNATIVES

- MAILING
- PERSONNEL MEETING

PRO'S AND CON'S

KIT CYCLE

- SAVES TRAVEL COSTS
- GOOD FOR INITIAL CONTACT
- SLOWER COMMENTING TURN-OVER TIME
- SLOWER TO GAIN CONSENSUS

WALKTHROUGH MEETING(S).

- QUICKER COMMENTING TURN -OVER TIME
- QUICKER TO GAIN CONSENSUS
- MORE TRAVEL COSTS
- GOOD FOR KIT FINALIZATION

50-3 13

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the commenting procedures used in the IDEF diagram commenting process.

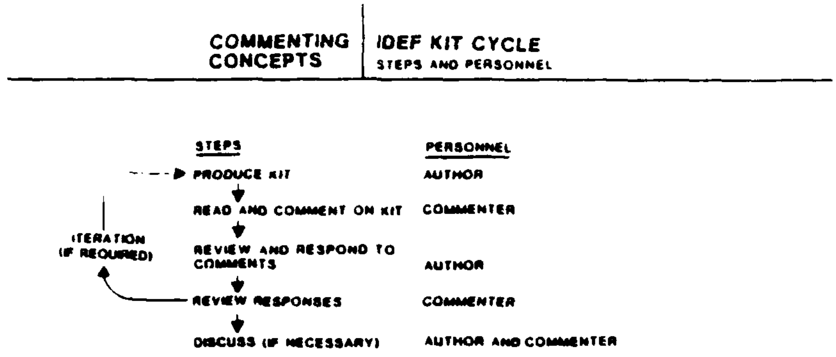
PROCEDURE:

o Use kit cycling alternatives

o Use IDEF kit cycle

o Use IDEF walkthrough meeting(s)

NARRATION: (TALK TO CHART)



INSTRUCTIONAL OBJECTIVE:	To teach an understanding of the steps and personnel involved in the IDEF kit cycle.
CONCEPT:	The IDEF kit cycle involves personnel and a structured set of steps to follow.
REFERENCE:	AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual (IDEF$_0$)
SEE:	"The IDEF Kit Cycle," Section 5, #5.2 (Figure 5-1), Pg. 62

NARRATION: (TALK TO CHART)

COMMENTING PROCEDURES | **IDEF KIT CYCLE**
DISCUSSION

DISCUSSION RULES

- ONLY IF NECESSARY
- DISCUSS POINTS OF DISAGREEMENT ONLY
- LIMIT TIME
- DECIDE ACTIONS
- RECORD RESULTS

5D-3 18

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the IDEF kit cycle discussion rules.

PROCEDURE: Follow IDEF kit cycle discussion rules.

NARRATION: (TALK TO CHART)

COMMENTING PROCEDURES | **IDEF KIT CYCLE**
AUTHOR RESPONDING

AUTHOR RESPONDS TO ALL COMMENTS

- UNDERSTAND COMMENTS
- "✓" IF AGREE
- "X" IF DISAGREE WITH EXPLANATION
- USE BLUE INK
- NOTE "LET'S TALK" - IF NECESSARY
- NOTE COMMENTS ON AUTHOR COPY
- RETURN KIT TO COMMENTER

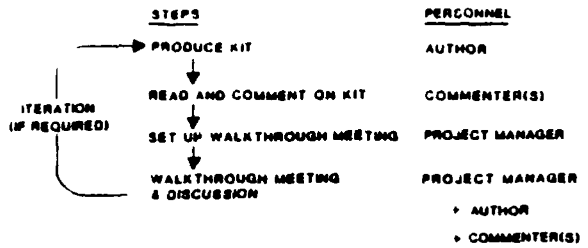
50-3 18

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the conventions used in IDEF kit cycle author responding.

PROCEDURE: Use IDEF kit cycle notation in commenting on $IDEF_0$ function model diagrams.

NARRATION: (TALK TO CHART)

COMMENTING PROCEDURES | **WALKTHROUGH MEETING**
STEPS AND PERSONNEL



INSTRUCTIONAL OBJECTIVE: To teach an understanding of the steps and personnel involved in the IDEF kit cycle walkthrough meeting.

PROCEDURE: Follow IDEF walkthrough meeting steps with involved personnel.

NARRATION: (TALK TO CHART)

COMMENTING PROCEDURES | **IDEF DIAGRAM**
WALKTHROUGH PROCESS

SIX STEPS

1 SCAN THE DIAGRAM
2 LOOK AT THE PARENT DIAGRAM
3 CONNECT THE PARENT BOX AND THE DETAIL DIAGRAM
4 EXAMINE THE INTERNAL ARROW PATTERN
5 READ THE TEXT AND GLOSSARY
6 SET THE STATUS OF THE DIAGRAM

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the IDEF diagram walkthrough process.

PROCEDURE: Follow IDEF diagram six steps in carrying out the IDEF walkthrough process.

NARRATION: (TALK TO CHART)

COMMENTING PROCEDURES | **IDEF KIT CYCLE**
ITERATION

AUTHOR REFINES DIAGRAM AND ITERATES

- INCORPORATES NECESSARY CHANGES
- ISSUES SUBSEQUENT KIT
- COMMENTERS REFER TO PREVIOUS KIT TO EVALUATE CHANGES

6U-J 19

INSTRUCTIONAL OBJECTIVE: To teach an understanding of IDEF kit cycle iteration.

PROCEDURE: Follow IDEF kit cycle iteration steps.

NARRATION: (TALK TO CHART)

COMMENTING CONCEPTS & PROCEDURES | LIBRARY FUNCTION

WHETHER YOU USE IDEF KIT CYCLE OR WALKTHROUGH MEETING PROCESS (OR BOTH)-

YOU MUST HAVE SOME LEVEL OF CONTROL FOR IDEF MODELING TO MANAGE THE COMMUNICATION PROCESS

B9-J 20

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the librarian function in IDEF modeling.

CONCEPT: The librarian function in the IDEF modeling methodology maintains the necessary control of the $IDEF_0$ function model information.

PROCEDURE:

- o Maintains files
- o Controls distribution of documented information
- o Copies, distributes, and tracks IDEF information

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual ($IDEF_0$)

SEE: "The IDEF Kit Cycle," Section 5, #5.2 (Figure 5-1), Pg. 62

NARRATION: (TALK TO CHART)

COMMENTING PROCEDURES | **IDEF KIT CYCLE**
LIBRARY FUNCTIONS

- MAINTAINS FILES
- CONTROLS DISTRIBUTION OF DOCUMENTED INFORMATION
- RECEIVES, COPIES, DISTRIBUTES, TRACKS AND TRANSFERS

59-J 21

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the IDEF kit cycle librarian functions.

PROCEDURE: The librarian function:

o Maintains files

o Controls distribution of documented information

o Copies, distributes, and tracks IDEF information

NARRATION: (TALK TO CHART)

COMMENTING CONCEPTS & PROCEDURES | **COMMENTING EXERCISE**

YOU PLAY THE ROLE OF A COMMENTER
AND LOOK FOR

- SYNTAX ERRORS
  (IDEF SYMBOLOGY AND RULES)
- SEMANTIC ERRORS
  (MISUNDERSTANDINGS OF THE INTENDED AUTHOR COMMUNICATION)
- DISAGREEMENTS WITH THE AUTHOR
  (AFTER YOU UNDERSTAND WHAT AUTHOR INTENDED)

THEN NOTE YOUR COMMENTS ON THE DIAGRAM FOLLOWING THE GUIDELINES JUST PROVIDED

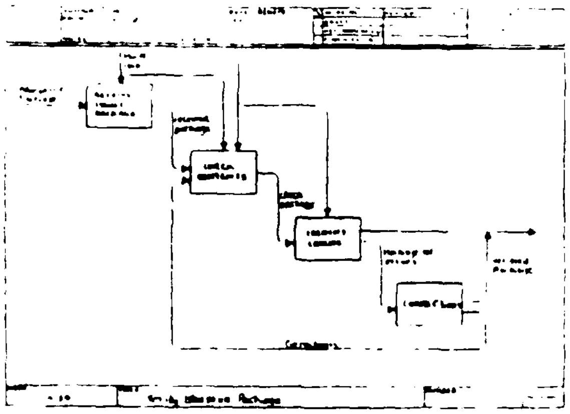
59-3 22

INSTRUCTIONAL OBJECTIVE: To give an exercise in $IDEF_0$ commenting concepts to reinforce what has been taught.

DIRECTIONS: PLAY THIS COMMENTER ROLE IN THE FOLLOWING EXERCISE.

(TALK TO CHART)

COMMENTING CONCEPTS & PROCEDURES | IDEF KIT CYCLE COMMENTING EXERCISE



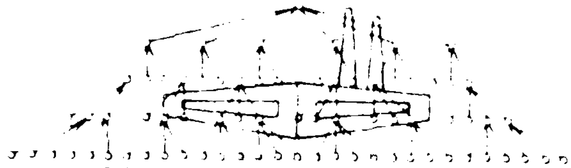
23

59-3

INSTRUCTIONAL OBJECTIVE: To give an exercise in IDEF kit cycle commenting concepts and procedures.

DIRECTIONS: COMMENT ON $IDEF_0$ FUNCTION MODEL DIAGRAM IN PRESENTATION HANDOUT MATERIALS ACCORDING TO THE STRUCTURED ROLE OF A COMMENTER.

ARCHITECTURE



A STRUCTURED APPROACH TO MANUFACTURING

TITLE SLIDE: Architecture - A Structured Approach to Manufacturing

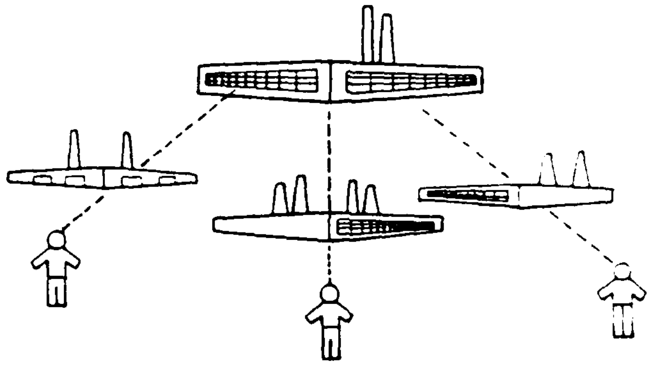
COURSE OBJECTIVE: To teach an understanding of the ICAM generic manufacturing architecture (MFGO) and its utilization as a Manufacturing Technology Modernization (TECH MOD) planning and analytical tool.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM) Architecture, Part II, Volume II - Architecture - A Structured Approach to Manufacturing

SEE: (ALL)

NARRATION: "TO IMPROVE PRODUCTIVITY, WE NEED (AMONG OTHER THINGS) A MEANS OF TRANSFORMING THE BLACK MAGIC OF MANUFACTURING TO A SCIENCE. EMBEDDED WITHIN MUST BE A COMMUNICATION STANDARD TO SERVE AS BOTH A TOOL FOR MANAGEMENT PLANNING AND CONTROL AND SYSTEM INTEGRATION. THE SUBJECT OF THIS PORTION OF OUR PRESENTATION, 'ARCHITECTURE - A STRUCTURED APPROACH TO MANUFACTURING' IS SUCH A MEANS. THE ARCHITECTURE IS FORMED BY A FUNCTION MODEL USING $IDEF_0$, AN INFORMATION MODEL USING $IDEF_1$, AND A DYNAMICS MODEL USING $IDEF_2$. EACH MODEL IS AN ARCHITECTURE UNTO ITSELF - REPRESENTING A DISTINCT BUT RELATED VIEW OF A SUBJECT, I.E., MANUFACTURING. THIS PRESENTATION WILL ILLUSTRATE USES OF THE ARCHITECTURE SUCH AS A MANAGEMENT AND TECHNICAL TOOL AND AS WELL, AN EDUCATIONAL TOOL. IT IS INTENDED THAT THESE ILLUSTRATIONS WILL STIMULATE FURTHER USES OF ARCHITECTURE AS YOU CONSIDER YOUR PARTICULAR APPLICATIONS."

STANDARD FOR COMMUNICATION



INSTRUCTIONAL OBJECTIVE: To provide an understanding that the manufacturing architecture provides a standard for communication relative to complex systems and organizations.

NARRATION: "MANUFACTURING IS A VERY COMPLEX ENVIRONMENT, I.E, MANY DISCIPLINES - PLANNING, QUALITY ASSURANCE, PRODUCTION, ETC.; MANY SYSTEMS - MANUFACTURING CONTROL, GENERATIVE PROCESS PLANNING, MRP, DNC, ETC. AND MANY TECHNOLOGIES - COMPUTERS, ROBOTICS, LASERS, ETC. BUT TO MAKE MATTERS MORE COMPLEX MANUFACTURING IS CARRIED OUT BY MANY PEOPLE RANGING FROM MANAGEMENT TO THE SHOP FLOOR WHICH ADDS TO THE COMPLEXITY BY ADDING MANY VIEWPOIINTS BASED UPON EXPERIENCE, RESPONSIBILITY, AND PURPOSE.

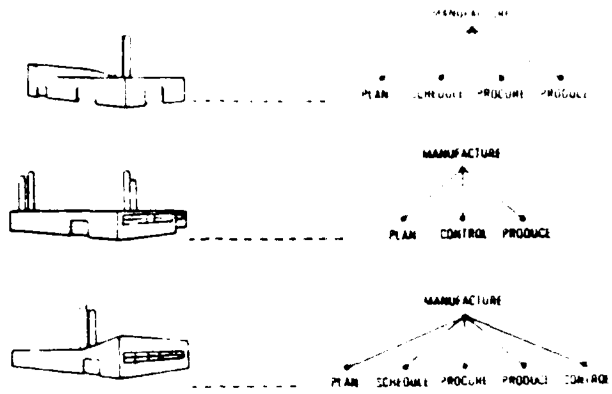
"WE NEED A MEANS TO BETTER COMMUNICATE:

1) TO APPRECIATE EACH OTHERS VIEWPOINT

2) DEAL WITH ALL ASPECTS OF MANUFACTURING ON A COMMON BASIS WHETHER IT INVOLVES DISCIPLINES, SYSTEMS OR TECHNOLOGIES.

TO FACILITATE COMMUNICATION, THE MEANS MUST BE A COMMON STANDARD, I.E., ARCHITECTURE OR FRAMEWORK."

STANDARD FOR COMMUNICATION



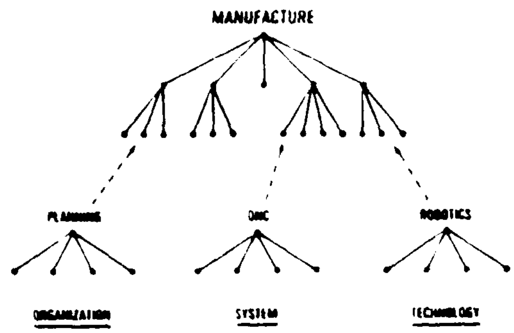
INSTRUCTIONAL OBJECTIVE: To provide an undertanding that the manufacturing architecture provides a standard for communication relative to complex systems and organizations.

NARRATION: "TO FACILITATE EXPRESSING DIFFERING VIEWPOINTS, WE NEED A STRUCTURED METHOD OR TECHNIQUE THAT ESTABLISHES A STANDARD FOR COMMUNICATION - IDEF - TO CHARACTERIZE MANUFACTURING BASED ON FUNCTIONS - INFORMATION - DYNAMICS.

REGARDLESS OF ORIENTATION BASED UPON RESPONSIBILITY OR FUNCTION, EVERYONE'S VIEWPOINT CAN BE EXPRESSED IN A STRUCTURED REPRESENTATION. THIS WILL OVERCOME MISUNDERSTANDING CAUSED BY INTERPRETATION OF THE WRITTEN OR SPOKEN WORD AND EXPOSE MORE CLEARLY WHAT IS BEING COMMUNICATED.

THE STANDARD FOR COMMUNICATION MUST REVERSE 'THE COMPOUNDING EFFECT' OF DIFFERING VIEWPOINTS WHICH BECAUSE OF POOR COMMUNICATION MAY APPEAR TO BE OPPOSING OR CONFRONTING. THIS WILL PROVIDE A 'SYNERGISTIC EFFECT' BY ENABLING US TO STRUCTURE OUR COMMUNICATION AND EXPOSE MORE CLEARLY OUR PERSPECTIVE RESULTING IN A COLLECTIVELY ENHANCED UNDERSTANDING OF MANUFACTURING."

STANDARD FOR COMMUNICATION



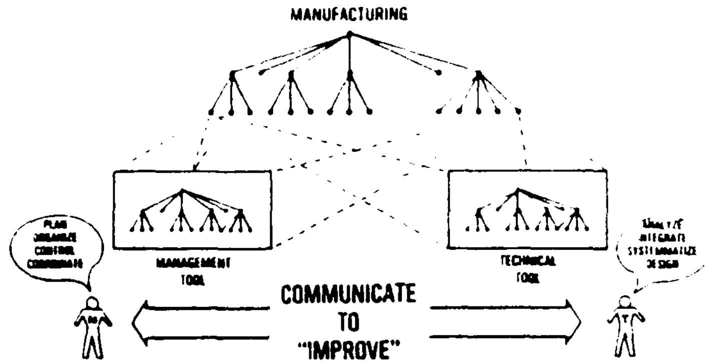
INSTRUCTIONAL OBJECTIVE: To provide an understanding that the *manufacturing architecture* provides a standard for communication relative to complex systems and organizations.

NARRATION: "WE NEED AN 'ARCHITECTURE' TO FACILITATE PUTTING VIEWPOINTS INTO PERSPECTIVE AND PROVIDE A COMMON BASIS UPON WHICH WE CAN DEAL WITH ALL ASPECTS OF MANUFACTURING, I.E., ORGANIZATION, SYSTEM, AND TECHNOLOGIES.

"THIS ARCHITECTURE MUST PROVIDE A FRAMEWORK, A ROAD MAP, A BLUEPRINT, A DICTIONARY FROM WHICH WE CAN DEPART FROM AND REFER BACK TO. THE KEY TO INCREASED MANUFACTURING PRODUCTIVITY IS TO DO IT SMARTER. TO DO IT SMARTER, WE MUST INTEGRATE AND TO INTEGRATE WE MUST BETTER UNDERSTAND HOW ALL THE 'PIECES' FIT TOGETHER. WE MUST UNDERSTAND BETTER OUR OWN DOMAIN AND HOW WE FIT INTO THE WHOLE.

"GIVEN THAT OUR OBJECTIVE IS IMPROVED MANUFACTURING PRODUCTIVITY, THE TASK WILL REQUIRE US TO INTEGRATE THE MANAGEMENT AND OPERATIONS OF MANUFACTURING. THIS MEANS NOT JUST TO INTEGRATE COMPUTERS TOGETHER BUT TO INTEGRATE WHAT COMPUTERS WILL ENABLE I.E., INTEGRATED ORGANIZATIONS, SYSTEMS, AND TECHNOLOGIES."

USES OF ARCHITECTURE



INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture utilization will result in improved communications.

NARRATION: "AN ARCHITECTURE OR FRAMEWORK CAN BE USED AS A MANAGEMENT TOOL AND AS A TECHNICAL TOOL. IT IS A MULTI-PURPOSE TOOL: MANAGEMENT IS CONCERNED WITH PLANNING, ORGANIZING, CONTROLLING, AND COORDINATING. THE TECHNICAL PEOPLE, WHO ARE CONSTRAINED BY MANAGEMENT, ARE CONCERNED WITH ANALYZING, INTEGRATING, SYSTEMATIZING, AND DESIGNING. BOTH MUST WORK TOGETHER TO IMPROVE MANUFACTURING AND COMMUNICATION IS IMPERATIVE.

"THEREFORE, THE TRUE CONTRIBUTION OF ARCHITECTURE IS THAT IT IS A MULTI-PURPOSE TOOL:

- o IT TRANSCENDS VIEWPOINT
- o IT TRANSCENDS SYSTEMS, TECHNOLOGIES, ORGANIZATIONS
- o IT IS A MANAGEMENT/TECHNICAL TOOL (MANAGE/OPERATE)
- o LAST BUT NOT LEAST, IT IS AN EDUCATIONAL TOOL

ARCHITECTURE IS A COMMON TOOL THAT EVERYONE CAN USE TO IMPROVE MANUFACTURING TOGETHER."

MANAGEMENT TOOL

- PRESENTATION MEDIUM
- ORGANIZATIONAL STRUCTURE
- PLANNING VEHICLE
- PROGRAM MANAGEMENT

INSTRUCTIONAL OBJECTIVE: To provide an understanding of how to use architecture as a management tool.

NARRATION: "AS A MANAGEMENT TOOL, AN ARCHITECTURE PROVIDES VISIBILITY INTO MANUFACTURING BY STRUCTURING A REPRESENTATION OF MANUFACTURING FUNCTIONS, INFORMATION, AND DYNAMICS.

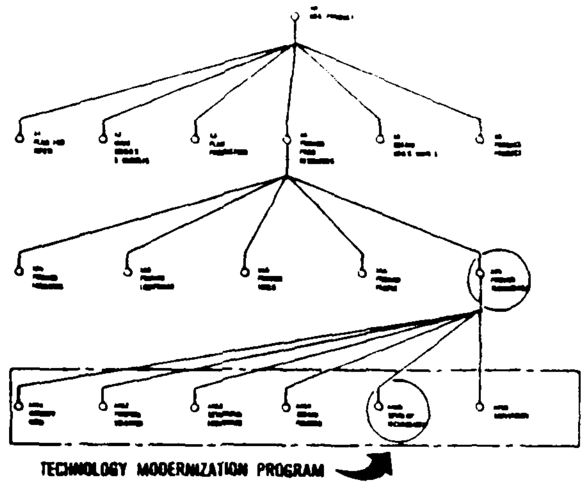
"IT IS AN EXCELLENT PRESENTATION MEDIUM FOR PROVIDING PERSPECTIVE AND FOCUS REGARDING THE SUBJECT OF THE PRESENTATION, I.E., GENERAL TO SPECIFIC 'ZOOM IN'.

"IT IS THE FRAMEWORK UPON WHICH AN ORGANIZATIONAL STRUCTURE/HIERARCHY BASED UPON RESPONSIBILITY CAN BE MORE EXPLICITLY DOCUMENTED, I.E., MAP ORGANIZATIONAL RESPONSIBILITIES TO FUNCTIONS, AND IDENTIFY OVERLAPS/VOIDS.

"IT IS A VEHICLE FOR PERFORMING PLANNING OF MULTI-YEAR CAD/CAM IMPROVEMENT. IT PROVIDES A FRAMEWORK FROM WHICH TO DEPICT CAD/CAM IMPROVEMENTS, ORGANIZATION RESTRUCTURING, AND THE LOGICAL PROGRESSION OF THE MULTI-YEAR IMPROVEMENT PROGRAM.

"LAST BUT NOT LEAST, IT IS AN EXCELLENT MEDIUM FOR ORGANIZING AND ADMINISTERING A CAD/CAM PROGRAM TO IMPLEMENT IMPROVEMENTS. THIS PROGRAM MANAGEMENT DEFINES ACTIVITIES, STRUCTURES THE PROGRAM, IDENTIFIES RESPONSIBILITIES, AND PROVIDES A FRAMEWORK FOR SUBSEQUENT PLANNING AND CONTROL."

PRESENTATION MEDIUM



INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be used as a presentation medium.

NARRATION: "THIS IS A FUNCTIONAL ARCHITECTURE NODE TREE EXAMPLE CREATED FROM THE IDEF$_0$ METHODOLOGY.

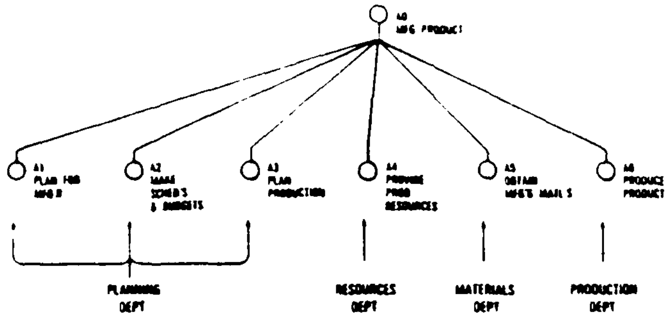
"THERE ARE OTHER REPRESENTATIONS, BUT NODE TREE IS MOST OFTEN USED. IT PROVIDES 'BIG PICTURE' OR ENVIRONMENT FROM WHICH ONE WANTS TO DRAW A PERSPECTIVE.

"FOR EXAMPLE: WHERE DOES A MANUFACTURING TECHNOLOGY MODERNIZATION PROGRAM OR CAD/CAM PROGRAM FIT INTO MANUFACTURING AS AN ORGANIZATION? WHAT FUNCTIONS DO THEY PERFORM?

"THIS CHART PORTRAYS AN APPROACH TO MODIFICATION OF THE GENERIC ARCHITECTURE TO ADD NODE A-45 WHICH PROVIDES TECHNOLOGY AND ITS SUBSEQUENT DECOMPOSITION AS SHOWN."

(TALK THROUGH A-45 NODE DECOMPOSITION)

ORGANIZATIONAL STRUCTURE



SU-1 8

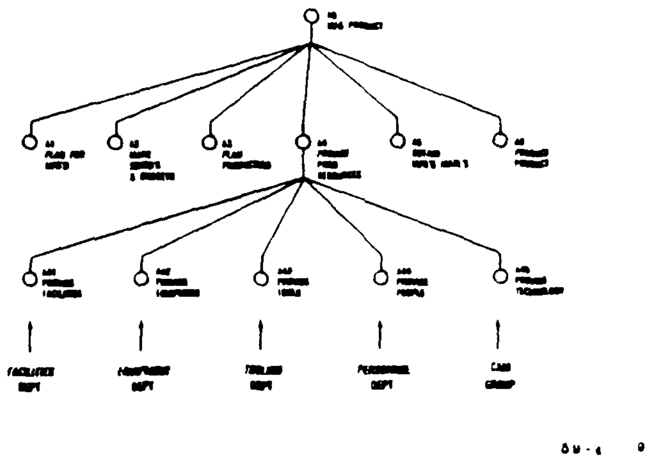
INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be utilized in planning organizational structure and responsibilities.

NARRATION: "A NODE TREE REPRESENTATION IS MOST OFTEN USED AS A PRESENTATION MEDIUM OF ARCHITECTURE BECAUSE IT PROVIDES THE 'BIG PICTURE' OR 'ENVIRONMENT' FROM WHICH ONE WANTS TO DRAW A PERSPECTIVE. THE ANNOTATING OF THE ARCHITECTURE CAN BE TOP-DOWN OR ONE MAY CHOOSE A PARTICULAR LEVEL. THE IMPORTANT CONCEPT TO KEEP IN MIND IS THAT THE TOP-DOWN DECOMPOSITION OF THE FUNCTION ARCHITECTURE IS NOT A TRUE ORGANIZATIONAL HIERARCHY BUT MERELY A LEVEL-BY-LEVEL DETAIL EXPOSITION OF FUNCTION AND DATA.

"AFTER A COMPLETE ANNOTATION OF ALL MANUFACTURING ORGANIZATIONS, THERE IS A NEW PERSPECTIVE FROM WHICH TO VIEW THE FUNCTION ARCHITECTURE - IT NOW DEPICTS THE 'ORGANIZATIONAL' MECHANISM FOR CARRYING OUT THE FUNCTIONS, AND MORE IMPORTANTLY, THE ORGANIZATIONS THAT ARE LINKED TOGETHER IN A STRUCTURED MANNER BASED ON WHAT THEY DO AND HOW THEY INTERRELATE WITH ONE ANOTHER. THE ARCHITECTURE MAY ALSO DEPICT VOIDS AND REDUNDANCIES BETWEEN ORGANIZATIONS.

"A WORD OF CAUTION - SOME DEPARTMENTS SUCH AS Q.A. MAY NOT HAVE A PARTICULAR NITCH AS THOSE ILLUSTRATED BUT MAY PORTRAY THE ENTIRE ARCHITECTURE. MORE CAREFUL STUDY MAY BE REQUIRED TO IDENTIFY HOW THEY INTERRELATE WITH THE REST OF MANUFACTURING."

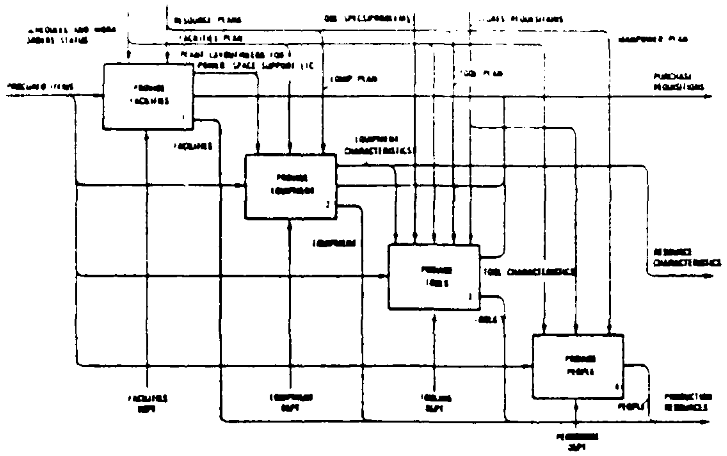
ORGANIZATIONAL STRUCTURE



INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be utilized in planning organizational structure and responsibilities.

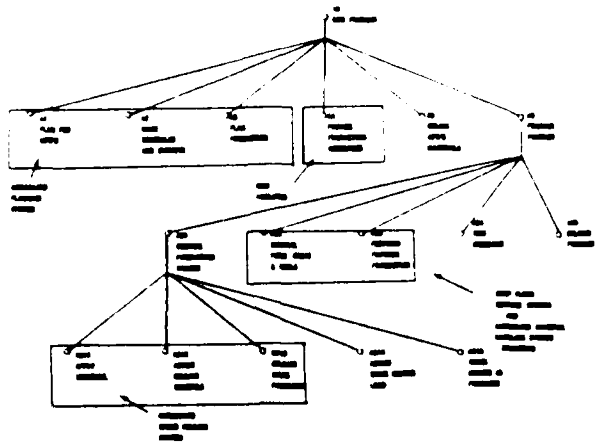
NARRATION: "THIS CHART FURTHER DECOMPOSES THE A-4 NODE 'PROVIDE PRODUCTION RESOURCES' TO A LEVEL WHEREIN ORGANIZATIONAL RESPONSIBILITIES CAN BE ANNOTATED AND DEFINED."

ORGANIZATIONAL STRUCTURE



INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be utilized in planning organizational structure and responsibilities.

NARRATION: "THIS $IDEF_0$ DIAGRAM SHOWS HOW THE ORGANIZATIONAL FUNCTIONS DEPICTED ON THE PRIOR CHART ACT AS MECHANISMS TO ACCOMPLISH THE FUNCTIONS SHOWN ON THE DIAGRAM THAT DEVELOPED THE NODE TREE."



INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture is used as a planning vehicle.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM) Architecture, Part II, Volume II - Architecture - A Structured Approach to Manufacturing

SEE: (ALL)

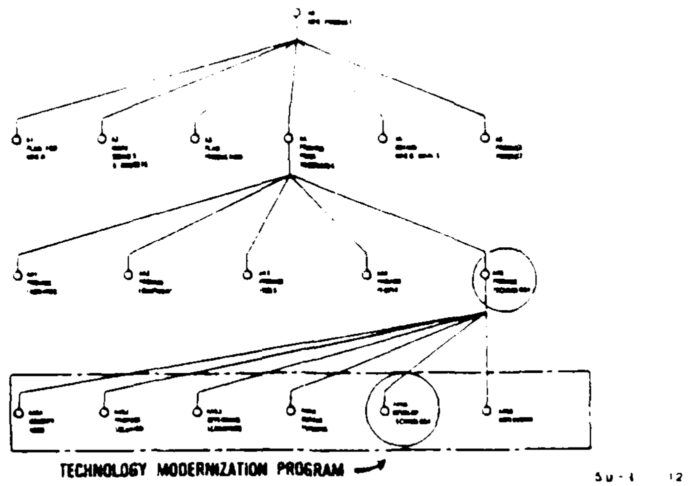
NARRATION: "THE FUNCTION ARCHITECTURE NODE TREE CAN ALSO BE USED AS A PLANNING VEHICLE FRAMEWORK FOR DEPICTING THE LOGICAL STEP-BY-STEP, YEAR-BY-YEAR, OR FUNCTION-BY-FUNCTION MODERNIZATION OF EXISTING MANUFACTURING, REORGANIZATION, NEW SYSTEMS OR TECHNOLOGY, NEW FACILITIES, ETC.

THE ARCHITECTURE CAN BE USED TO SUPPORT A CAD/CAM PLAN (FIVE YEAR, TEN YEAR, OR TWENTY YEAR) SHOWING THE IMPLEMENTATION PROGRESSION OF MODERNIZATION. THE IMPORTANCE OF USING THE ARCHITECTURE TO DEPICT THIS ORGANIZATION IS THE ADDITIONAL INFORMATION IT AFFORDS TO THE PLANNING EXERCISE. IT LINKS TOGETHER DISCRETE PROJECTS TECHNICALLY AND IN SEQUENCE OF IMPLEMENTATION.

EACH MODERNIZATION PROJECT WILL AFFECT FUNCTIONS IN MANUFACTURING AND, SINCE ALL THE FUNCTIONS ARE RELATED, THE IMPACTS OF THE MODERNIZATION CAN BE ASSESSED FOR ORGANIZATION IMPACTS, SYSTEMS/TECHNOLOGY IMPACTS, ETC.

THERE MAY ALSO BE AN OPTIMUM SEQUENCE FOR IMPLEMENTATION AND THESE ORGANIZATION AND SYSTEMS/TECHNOLOGY IMPACTS MAY EXPOSE THE MOST PRODUCTIVE SEQUENCE. IF NOT, BECAUSE BOTH CAN BE ASSESSED AGAINST THE ARCHITECTURE, THERE IS AT LEAST A BASIS TO EVALUATE OR DEPART FROM TO EVALUATE THE OPTIMUM SEQUENCE."

PROGRAM MANAGEMENT

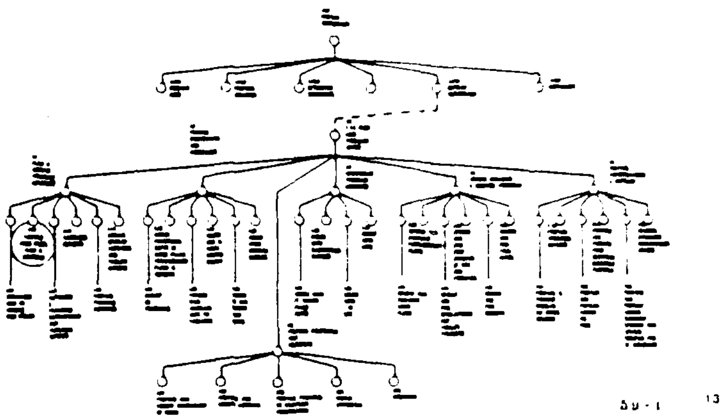


INSTRUCTINAL OBJECTIVE: To provide an understanding of how architecture can be utilized as a program management tool.

NARRATION: "THE FUNCTIONAL NODE TREE REPRESENTATION IS AGAIN SHOWN HERE AS A PROGRAM MANAGEMENT TOOL. IT CAN BE USED TO DEPART FROM MANUFACTURING PER SE TO A PROJECT OR PROGRAM WHICH WILL MODERNIZE OR IMPROVE MANUFACTURING."

PROGRAM MANAGEMENT

F-16 TECH MOD PROGRAM OFFICE ACTIVITIES

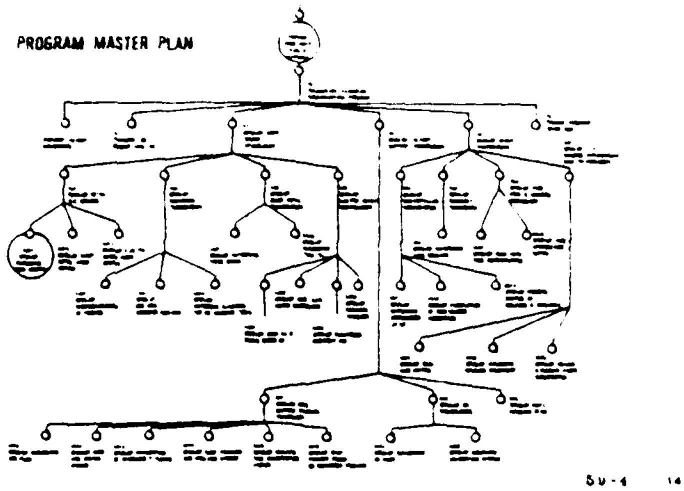


INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be utilized as a program management tool.

NARRATION: "ACTIVITIES (FUNCTIONS) ARE IDENTIFIED TO CARRY OUT THE PROGRAM."

(WALK THROUGH NODE TREE FOR F16 MANUFACTURING TECHNOLOGY MODERNIZATION PROGRAM OFFICE ACTIVITIES)

PROGRAM MANAGEMENT

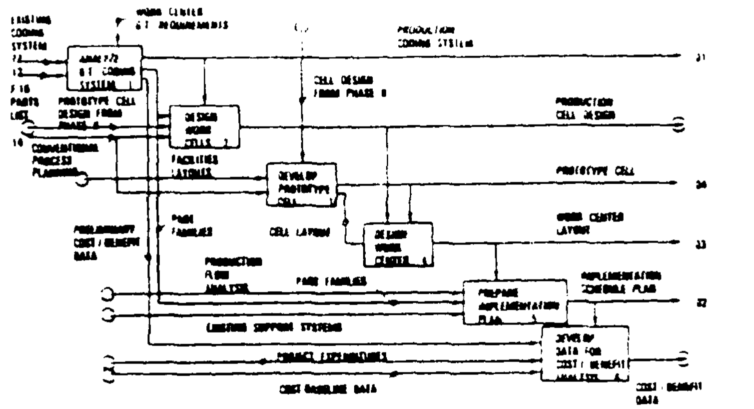


INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be utilized as a program management tool.

NARRATION: "THE PROGRAM MASTER PLAN/SCHEDULE IS DETAILED WHICH ADDRESSES THE TECHNICAL WORK TO BE PERFORMED AND IDENTIFIES THE PROJECTS WITHIN THE PROGRAM."

(TALK THROUGH NODE TREE GIVING EXAMPLES)

PROGRAM MANAGEMENT

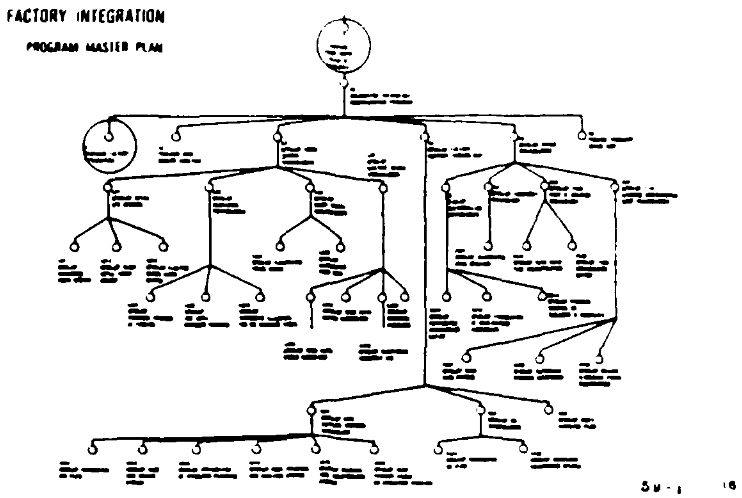


"TECHNICAL APPROACH"

INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be utilized as a program management tool.

NARRATION: "TECHNICAL APPROACH MODELS ARE DEVELOPED FOR EACH PROJECT TO STRUCTURE THE ACTIVITES OF EACH PROJECT ENGINEER/MANAGER. THIS ENSURES COMMONALITY AND PROVIDES MANAGEMENT VISIBILITY INTO WHAT THEY ARE DOING AND WHERE THEY ARE WHILE ADMINISTERING THE PROGRAM. THE TECHNICAL APPROACH MODEL IS ALSO A VERY IMPORTANT PROJECT TOOL FOR THE ENGINEER IN THAT IT PROVIDES A BASIS FOR THE ENGINEER TO IDENTIFY AND INVESTIGATE INTERFACES REGARDING DEVELOPMENT THROUGH IMPLEMENTATION AND OPERATION/USE OF HIS PARTICULAR PROJECT END ITEM/SYSTEM."

PROGRAM MANAGEMENT

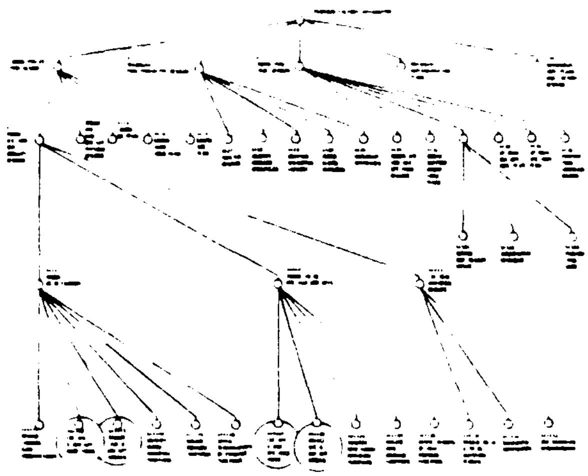


INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be utilized as a program management tool.

NARRATION: "PROBABLY THE MOST IMPORTANT ACTIVITY IN ANY MODERNIZATION PROGRAM IS 'INTEGRATION' - INTEGRATION, LIKE THE INDIVIDUAL PROJECT END ITEMS, MUST BE PLANNED FOR - BECAUSE IT IS THE SINGLE MOST IMPORTANT PROJECT WITHIN THE PROGRAM.'

PROGRAM MANAGEMENT

PLAN FOR FACTORY INTEGRATION



INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be utilized as a program management tool.

NARRATION: "THE PLAN FOR FACTORY INTEGRATION IS, AS STATED PREVIOUSLY, THE SINGLE MOST IMPORTANT PROJECT WITHIN THE PROGRAM. THE SUCCESS OF EACH OF THE PROJECTS, MEASURED IN PRODUCTIVITY IMPROVEMENT, DEPEND UPON IT."

(TALK THROUGH NODE TREE EXAMPLE)

TECHNICAL TOOL

- SYSTEM(S) / TECHNOLOGY(S) STRUCTURE AND INTERFACES
- SYSTEM(S) / TECHNOLOGY(S) – ORGANIZATION(S) INTERACTIONS
- SYSTEM(S) / TECHNOLOGY(S) DEVELOPMENT AND INTEGRATION

INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be utilized as a technical tool.

NARRATION: "AN ARCHITECTURE PROVIDES TECHNICAL PEOPLE WITH A MEDIUM WHICH TRANSCENDS SYSTEMS AND TECHNOLOGIES AND AFFORDS MANY DIVERSE DISCIPLINES A COMMON BASIS UPON WHICH TO COMMUNICATE A BETTER UNDERSTANDING OF WHO IS DOING WHAT, WHERE, AND TO WHOM.

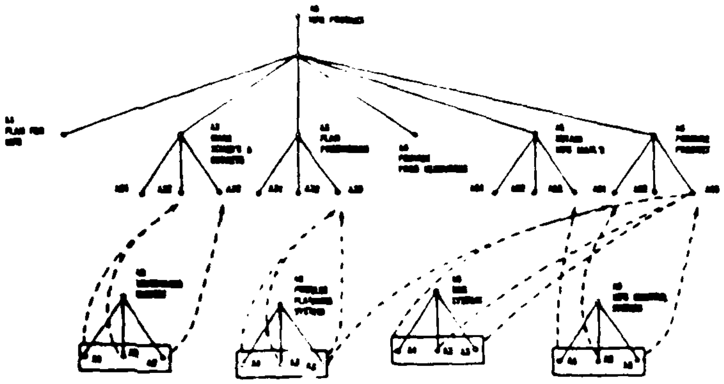
"IT IS A STRUCTURED FRAMEWORK OF THE 'WHAT' (MANUFACTURING) IN TERMS OF FUNCTIONS, INFORMATION, AND DYNAMICS TO BE USED AS A BASIS TO PORTRAY SYSTEMS AND TECHNOLOGIES AND WHERE THEY SUPPORT MANUFACTURING.

"ARCHITECTURE IS A FRAMEWORK FOR IDENTIFYING INTERFACES BETWEEN SYSTEMS AND TECHNOLOGIES OR THE LACK OF THE THEM.

"IT IS A FRAMEWORK FOR ESTABLISHING THE INTERACTION BETWEEN SYSTEMS/TECHNOLOGIES AND THE ORGANIZATIONS THAT USE AND MAINTAIN THEM.

"LAST BUT NOT LEAST, IT IS AN EXCELLENT TOOL TO USE IN CONCEPTUAL INTEGRATION OF NEW SYSTEMS."

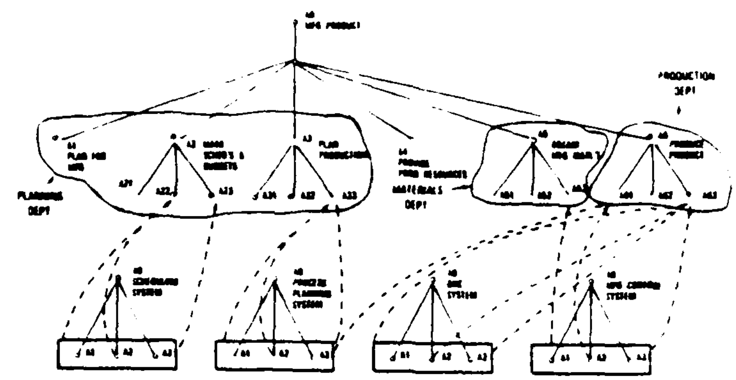
SYSTEM(S) / TECHNOLOGY(S) STRUCTURE AND INTERFACES



INSTRUCTIONAL OBJECTIVE: To provide an understanding of how an architecture can be utilized as a framework for system/technology structure and interfaces.

NARRATION: "THE FUNCTION ARCHITECTURE NODE TREE CAN BE USED AS A FRAMEWORK FOR SYSTEM/TECHNOLOGY STRUCTURE AND INTERFACES. THE ANNOTATION IS SIMILAR TO THAT FOR THE ORGANIZATIONAL STRUCTURE BUT IT BECOMES MORE NECESSARY TO MODEL EACH SYSTEM PRIOR TO LINKING IT TO THE ARCHITECTURE. AFTER A COMPLETE ANNOTATION OF ALL EXISTING SYSTEMS, THERE IS A NEW PERSPECTIVE FROM WHICH TO VIEW THE FUNCTION ARCHITECTURE - IT NOW DEPICTS THE 'SYSTEM' MECHANISMS FOR CARRYING OUT THE FUNCTIONS. MORE IMPORTANTLY, THE SYSTEMS ARE LINKED TOGETHER IN A STRUCTURED MANNER BASED ON WHAT THEY DO AND HOW THEY INTERRELATE WITH ONE ANOTHER. THE INTERRELATIONSHIPS WILL DEPICT VOIDS AND EXPOSE INTERFACES. THIS PROVIDES A BASIS FOR INVESTIGATING THESE INTERFACES."

SYSTEM(S) / TECHNOLOGY(S) – ORGANIZATIONS INTERFACES

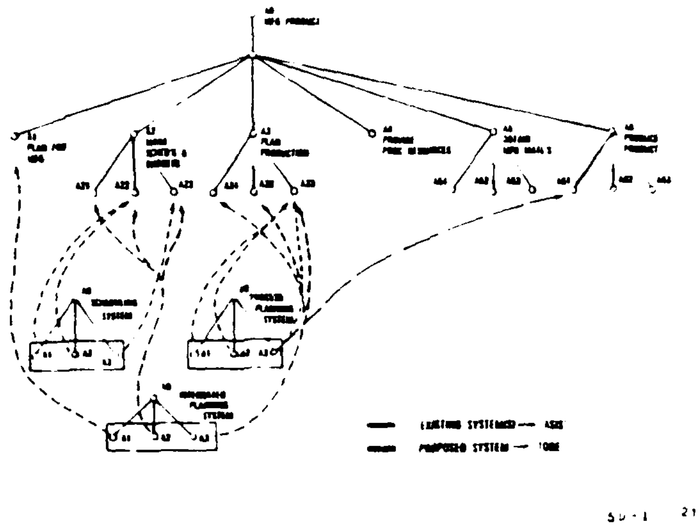


INSTRUCTIONAL OBJECTIVE: To provide an understanding of how an architecture can be utlized as a framework for system/technology organizational interfaces.

NARRATION: "THE FUNCTION ARCHITECTURE CAN ALSO BE USED AS A FRAMEWORK FOR UNDERSTANDING SYSTEM/TECHNOLOGY ORGANIZATIONAL INTERFACES."

(TALK THROUGH NODE TREE CHART)

SYSTEM(S) / TECHNOLOGY(S) DEVELOPMENT AND INTEGRATION

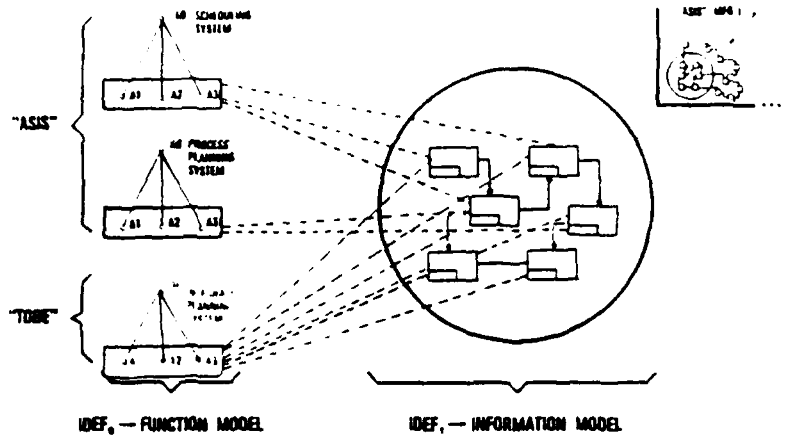


INSTRUCTIONAL OBJECTIVE: To provide an understanding of how an architecture can be utilized as a framework for system/technology development and integration.

NARRATION: "BOTH THE FUNCTION ARCHITECTURE AND INFORMATION ARCHITECTURE CAN BE USED AS A FRAMEWORK FOR SYSTEM/TECHNOLOGY DEVELOPMENT AND INTEGRATION."

(TALK THROUGH SYSTEM VERSUS CHART NODE TREE RELATIONSHIPS)

SYSTEM(S) / TECHNOLOGY(S) DEVELOPMENT
AND INTEGRATION

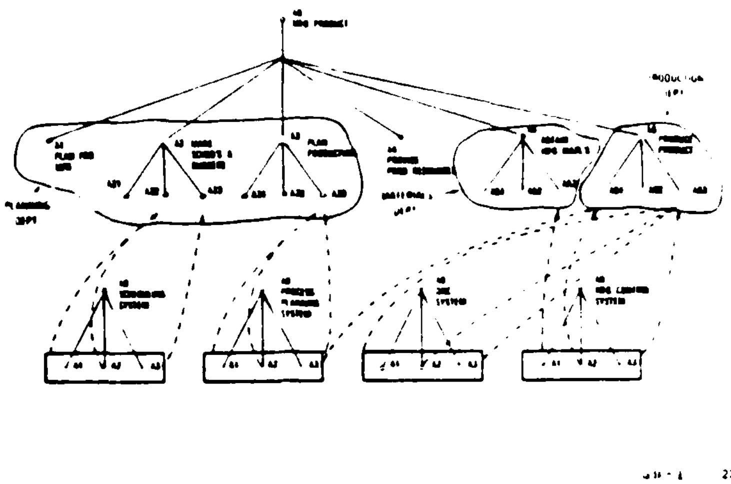


INSTRUCTIONAL OBJECTIVE: To provide an understanding of how an architecture can be utilized as a framework for system/technology development and integration.

NARRATION: "HERE WE SEE THE RELATIONSHIP OF THE 'AS IS' AND 'TO BE' SYSTEM/TECHNOLOGY IDEF$_0$ FUNCTION MODELS VERSUS THE IDEF$_1$ INFORMATION MODEL."

(TALK THROUGH CHART IDEF$_0$ SYSTEM MODELS VERSUS IDEF$_1$ INFORMATION MODEL)

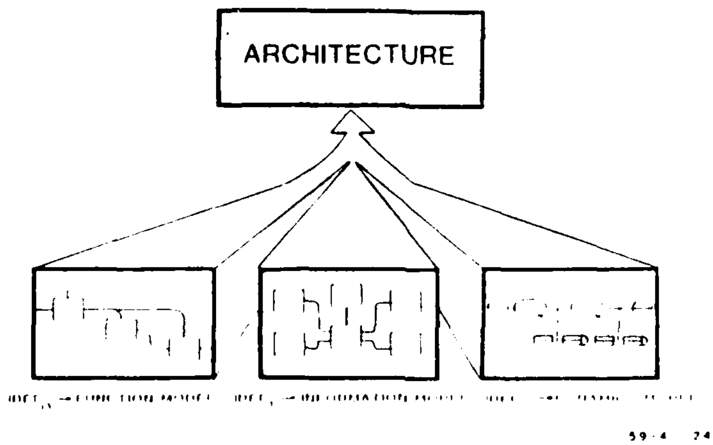
EDUCATIONAL TOOL



INSTRUCTIONAL OBJECTIVE: To provide an understanding of how an architecture can be utilized as an educational tool.

NARRATION: "THE FUNCTION ARCHITECTURE, AS AN EDUCATIONAL TOOL, CAN PROVIDE AN EXCELLENT BASIS FOR UNDERSTANDING WHAT IS BEING PERFORMED, WHO IS RESPONSIBLE FOR ITS PERFORMANCE, AND HOW IT IS PERFORMED. IT CAN ALSO SERVE AS A POINT OF DEPARTURE FOR THE INFORMATION ARCHITECTURE AND DYNAMICS ARCHITECTURE. BECAUSE ARCHITECTURE PROVIDES A STRUCTURED REPRESENTATION OF MANUFACTURING FUNCTIONS, INFORMATION AND DYNAMICS, IT IS EASIER TO COMPREHEND THAN TO PIECEMEAL EXPERIENCE FROM DIFFERENT AREAS OF MANUFACTURING AND INDIVIDUALLY TRY TO TIE IT ALL TOGETHER."

ARCHITECTURE



INSTRUCTIONAL OBJECTIVE: To provide a summary understanding that all three IDEF modeling methodologies are used to provide all levels of an organization with a common perspective.

NARRATION: "IN SUMMARY, ARCHITECTURE IS A STRUCTURED APPROACH TO MANUFACTURING - A MULTIPURPOSE TOOL. MANY USES HAVE YET TO BE IDENTIFIED. IT IS A COMMON MEANS BY WHICH TO COMMUNICATE A BETTER UNDERSTANDING.

"SOME DAY IT WILL BE TOTALLY DYNAMIC AND THE SHOP FLOOR WILL BE PHYSICALLY TIED TO IT. WHEN WE WANT TO CHANGE MANUFACTURING, WE WILL JUST 'TWEEK A KNOB' ON THE ARCHITECTURE AND THE SHOP FLOOR WILL RECONFIGURE TO ACCOMMODATE. - IN OTHER WORDS, THE PROVERBIAL 'ROSETTA STONE' FOR COMPUTER INTEGRATED MANUFACTURING (CIM)."

APPENDIX A
TECHNOLOGY TRANSFER TASK SUMMARY

PROTOTYPE PRESENTATIONS

DACOM conducted the "Practitioner's TECH MOD Workshop" as scheduled in Dayton on 7/8 July 1981. Thirty-six (36) Air Force and contractor personnel were in attendance at this session. Although it was DACOM's first formal workshop presentation, the material was well received. Capt. S. LeClaire agreed early in the session to maintain a marked copy of all of the presentation materials indicating recommeded changes to the presentation. Capt. LeClaire provided these comments to DACOM for incorporation immediately following the workshop. Most of the comments were editorial in nature and did not require significant changes in the material.

DACOM has subsequently used the Practitioner's TECH MOD Workshop material in several F-16 Subcontractor Industrial Technology Modernization (ITM) presentations with excellent results. In addition, the initial Executive Overview presentation was simultaneously used at the executive and mid-management level with good success.

DACOM also used the materials prepared under this contract, (augmented by commercial DACOM materials) to conduct a two-day seminar on the ICAM Architecture and IDEF0 Function Modeling Methodology on 27/28 April 1982 in London, England. This seminar was sponsored by Computer Integrated Manufacturing - International's (CAM-I) European office. More than twenty representatives of European industry, academia, and the media attended this session. DACOM coordinated <u>all</u> presentation materials utilized (including DACOM's commercial materials) with the Air Force ICAM Program Office in advance of the seminar. The attached letter was subsequently received from the ICAM Program Office formally documenting Air Force approval of this activity. As indicated in the attached letter, an announcement was also made at the seminar that the Air Force had released AFWAL-TR-81-4023 Volumes IV (Functional Modeling Manual - IDEF0) and VII (Composite Function Model of Manufacture Product - MFG0) for unlimited distribution. Data generated on IDEF1 and IDEF0 methodology, other than the summary data contained in the overview presentations, remains under government controlled distribution.

The Air Force has requested a formal "Executive Overview Prototype Demonstration" during the upcoming 9/11 June 1982 Project Priority 1104(2) coalition meeting to be held in Dayton, Ohio. DACOM stands ready to support this request as directed by SofTech and the Air Force.

RECOMMENDED FUTURE USES

It is recommended that the Air Force consider scheduling a meeting of the ICAM Program Office's Computer-Aided Manufacturing Advisory Group (CAMAG) to conduct an Executive Overview "Prototype Demonstration." These senior level industry executives and technical experts would provide an excellent forum for final review of the material.

It is further recommended that the ICAM Program Office consider establishing an "Executive Day" at each annual ICAM Industry Days Conference. This course of action is recommended in order to communicate the need for Computer Integrated Manufacturing (CIM) to the "executive integrators" as well as the "integratees" that normally attend the ICAM Industry Days sessions. A similar approach is being planned and coordinated by DACOM for the Society of Manufacturing Engineer's Computer and Automated Systems Association's (SME CASA) 1982 AUTOFACT Conference to be held in November 1982 in Philadelphia, Pennsylvania.

It is further recommended that the ICAM Program Office consider a formal Department of Defense (DoD) briefing relative to the availability of these and other ICAM project training materials. Attendees should include the key managers of the Army's Tri-service Electronics Computer-Aided Manufacturing (ECAM) Program, the Navy's Shipbuilding Technology Program (STP), and the various military Technology Modernization (TECH MOD) offices such as the Air Force's Aerospace Industries Modernization (AIM) Program Office and the Army's Industrial Productivity Improvement (IPI) Program Office. This approach would ensure maximum understanding and utlization of the training materials.

It is further recommended that the Manufacturing Technology Transfer Program training materials be made available to technical associations at no cost for use in conducting seminars, clinics, and workshops at attendee cost. (It must be recognized that this approach will undoubtedly bring increased pressure for formal Air Force release of the IDEF1 Information Modeling and IDEF2 Dynamics Modeling methodologies.

It is further recommended that the ICAM Program Office consider providing this material at no cost to various academic institutions across the country to be used in training students at all levels.

Unless otherwise directed by the Air Force, DACOM intends to fulfill its commitments made in its 18 March 1981 unsolicited proposal. DACOM committed therein to provide these courses to industry upon request with the course cost being born by industry.

RECOMMENDED FUTURE COURSE EXPANSION

It is requested that the Air Force authorize DACOM to proceed on the IDEF1 Information Architecture and Modeling Option contained in DACOM's 18 March 1981 unsolicited proposal. DACOM proposes to develop an IDEF1 Information Modeling "Practitioner's Presentation Manual" and a supporting Practitioner's "Train the Trainer's Manual." DACOM stands ready to negotiate this effort upon request.

It is further recommended that the ICAM Program Office consider taking a future similar approach in developing an IDEF2 Dynamics Modeling "Practitioner's Presentation Manual" and "Train the Trainer's Manual."

It is recommended that the ICAM Program Office consider developing training courses and materials to cover the work being accomplished in the 1105 Factory of the Future Conceptual CIM Framework and Implementation Strategy activities and the upcoming 8205 Integrated Decision Support System (IDSS) contract. Perhaps the two-level practitioner/executive overview approach utilized on this 1104(2) Manufacturing Technology Transfer Program would again be a desirable course of action.

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