

SHIP PRODUCTION COMMITTEE  
FACILITIES AND ENVIRONMENTAL EFFECTS  
SURFACE PREPARATION AND COATINGS  
DESIGN/PRODUCTION INTEGRATION  
HUMAN RESOURCE INNOVATION  
MARINE INDUSTRY STANDARDS  
WELDING  
INDUSTRIAL ENGINEERING  
EDUCATION AND TRAINING

September 1982  
NSRP 0009

# **THE NATIONAL SHIPBUILDING RESEARCH PROGRAM**

## **Proceedings of the IREAPS Technical Symposium**

### **Paper No. 14: Computer Integrated Shipbuilding: A Framework for Technology Modernization**

U.S. DEPARTMENT OF THE NAVY  
CARDEROCK DIVISION,  
NAVAL SURFACE WARFARE CENTER

# Report Documentation Page

*Form Approved*  
*OMB No. 0704-0188*

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE <b>SEP 1982</b>	2. REPORT TYPE <b>N/A</b>	3. DATES COVERED <b>-</b>			
4. TITLE AND SUBTITLE <b>The National Shipbuilding Research Program, Proceedings of the IREAPS Technical Symposium Paper No. 14: Computer Integrated Shipbuilding: A Framework for Technology Modernization</b>		5a. CONTRACT NUMBER			
		5b. GRANT NUMBER			
		5c. PROGRAM ELEMENT NUMBER			
6. AUTHOR(S)		5d. PROJECT NUMBER			
		5e. TASK NUMBER			
		5f. WORK UNIT NUMBER			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Naval Surface Warfare Center CD Code 2230 - Design Integration Tools Building 192 Room 128-9500 MacArthur Blvd Bethesda, MD 20817-5700</b>		8. PERFORMING ORGANIZATION REPORT NUMBER			
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)			
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)			
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release, distribution unlimited</b>					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>SAR</b>	18. NUMBER OF PAGES <b>35</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

## DISCLAIMER

These reports were prepared as an account of government-sponsored work. Neither the United States, nor the United States Navy, nor any person acting on behalf of the United States Navy (A) makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness or usefulness of the information contained in this report/manual, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or (B) assumes any liabilities with respect to the use of or for damages resulting from the use of any information, apparatus, method, or process disclosed in the report. As used in the above, "Persons acting on behalf of the United States Navy" includes any employee, contractor, or subcontractor to the contractor of the United States Navy to the extent that such employee, contractor, or subcontractor to the contractor prepares, handles, or distributes, or provides access to any information pursuant to his employment or contract or subcontract to the contractor with the United States Navy. ANY POSSIBLE IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR PURPOSE ARE SPECIFICALLY DISCLAIMED.

**Proceedings**  
**IREAPS Technical Symposium**  
**September 14-16-1982**  
**San Diego, California**

**VOLUME I**



**INSTITUTE FOR RESEARCH AND ENGINEERING FOR AUTOMATION AND PRODUCTIVITY IN SHIPBUILDING**

**I R E A P S**

**COMPUTER INTEGRATED SHIPBUILDING:  
A FRAMEWORK FOR TECHNOLOGY MODERNIZATION**

**A. Wayne Snodgrass  
Senior Associate Consultant  
D. Appleton Company Incorporated**

**Mr. Snodgrass specializes in strategic and tactical management consulting services for advanced CAD/CAM technology with emphasis on program management, capital resources, information resource management and human resource planning. DACOM clients include major corporations and their subcontractors throughout the United States. He has more than 25 years of experience in the manufacturing industry. His experience covers the gamut of manufacturing functions, ranging from product design to "bottom-line" business management. Included in his background is exceptional firsthand experience in such areas as manufacturing engineering, production planning, materials planning, proposal management, and management information systems. Additionally, Mr. Snodgrass has been personally instrumental in introducing advanced state of the art practices into a number of manufacturing environments, including CAD/CAM, Group Technology, and Quality Circles.**

**Mr. Snodgrass is a Mechanical Engineer and is an Executive Program Graduate of the UCLA Graduate School of Management.**

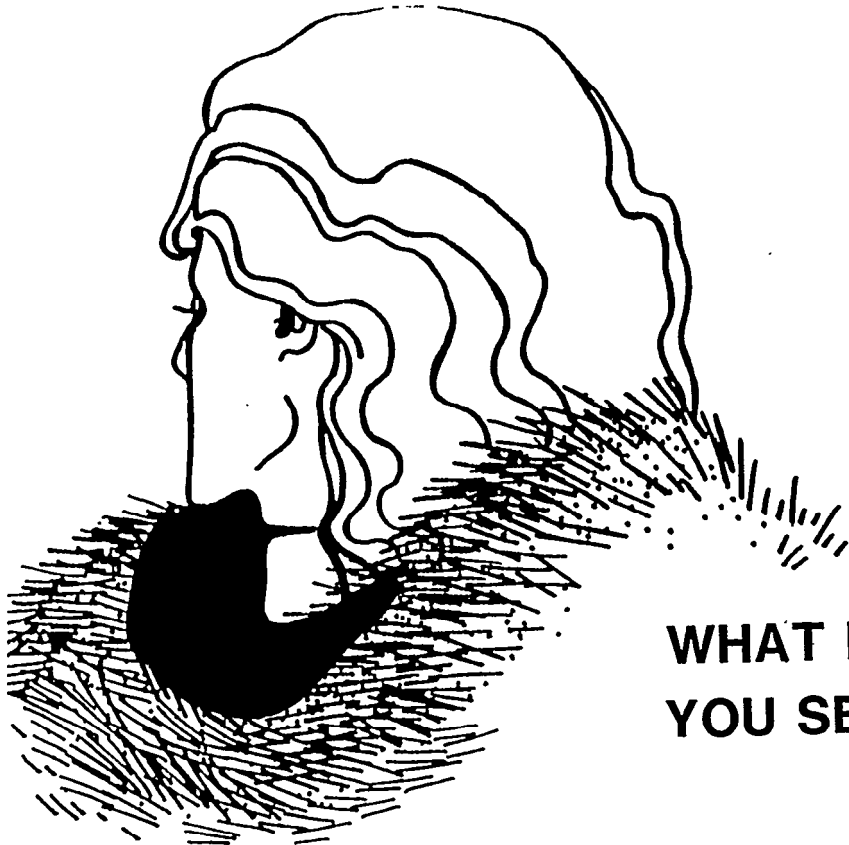
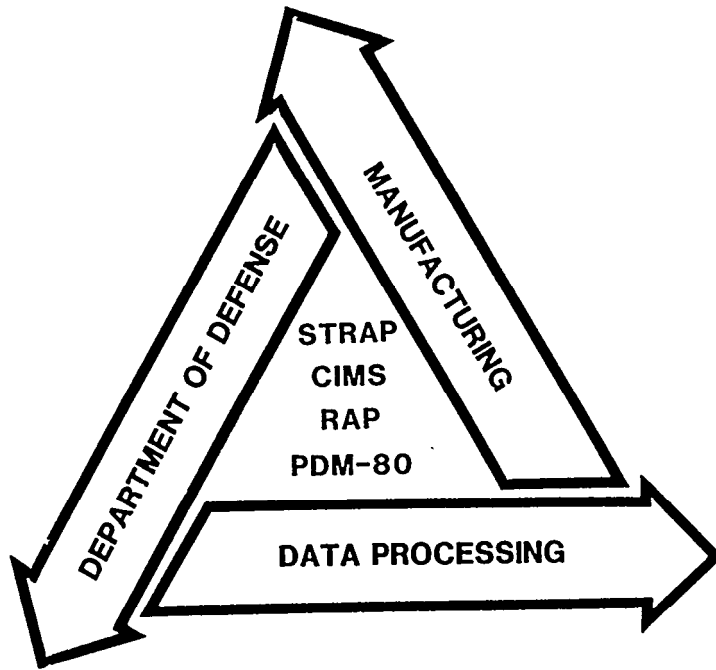
## ABSTRACT

Computer Integrated Shipbuilding (CIS) systems represent a key technology for improving the U.S. shipbuilding industry in the coming decades. CIS will be based upon a completely integrated CAD/CAM system that provides computer control or assistance to all shipbuilding functions. The shipbuilding aspects embraced by CIS include business planning and support, engineering design and ship production planning, control, and automation. All business functions of marketing, ship delivery, and logistics support can be linked into such a CIS system

The objective of this paper is to provide a framework for shipbuilding technology modernization which incorporates a road map for the integration of shipbuilding functions via systematic planning and the simultaneous systematic application of computer technology.

This CIS approach is unique in that it is data driven and is based upon a three architecture concept. This concept concentrates planning methodologies on building three formal integrated architectures: (1) the "application and database architecture", defining what applications and databases must be implemented to support the using community; (2) the "computer systems architecture" on which those applications and databases will be implemented; and (3) the "control architecture" which defines specific project and software management techniques to be used to implement and maintain the applications within the computer systems architecture. Each of the architectures is ultimately represented in the form of standards and procedures.

# DACOM



**WHAT DO  
YOU SEE?**

“CAD/CAM APPLICATIONS IN THE CONSTRUCTION  
OF NAVAL VESSELS” WORKSHOP

- 0 IDENTIFICATION OF **STP PROGRAM PROBLEMS  
& OPPORTUNITIES**
- 0 **POTENTIAL TECHNOLOGICAL & MANAGEMENT STRATEGIES**
- 0 **ROLE OF COMPUTERS IN SHIPYARD INFORMATION  
MANAGEMENT**
- 0 **APPLYING TECHNOLOGIES & ORGANIZATIONAL FORMS  
FROM OTHER INDUSTRY SECTORS**
- 0 **STRATEGIES FOR DEVELOPING THE NEXT GENERATION  
OF COMPUTER AIDED SYSTEMS**

**C**OMPUTER **I**NTEGRATED [sl] HI PBUILDING

- o **COMMON TERMINOLOGY & CONCEPTS**
- o **PRODUCTIVITY ‘MYTHS’ AND ‘DISCOVERIES’**
- o **CHANGING MANAGEMENT FOCUS**
- o **INFORMATION RESOURCE MANAGEMENT (IRM)**
- o **DATA’ DRIVEN IRM ARCHITECTURE**
- o **MANAGING CIS FOR TOMORROW**

# **COMMON TERMINOLOGY**

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

## COMPUTER INTEGRATED MANUFACTURING

---

1 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.

1 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.

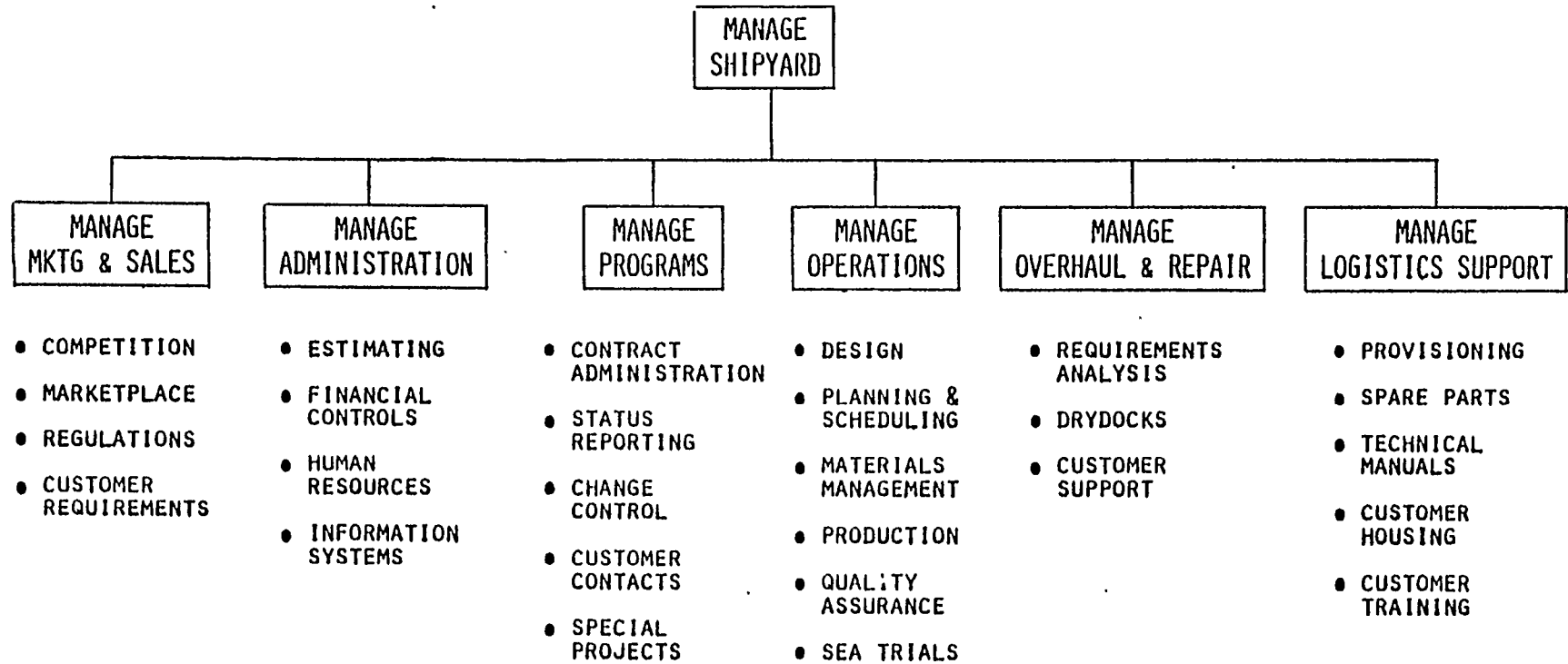
DR. JOSEPH HARRINGTON  
1990 CAD/CAM CONFERENCE

### CIS FRAMEWORK

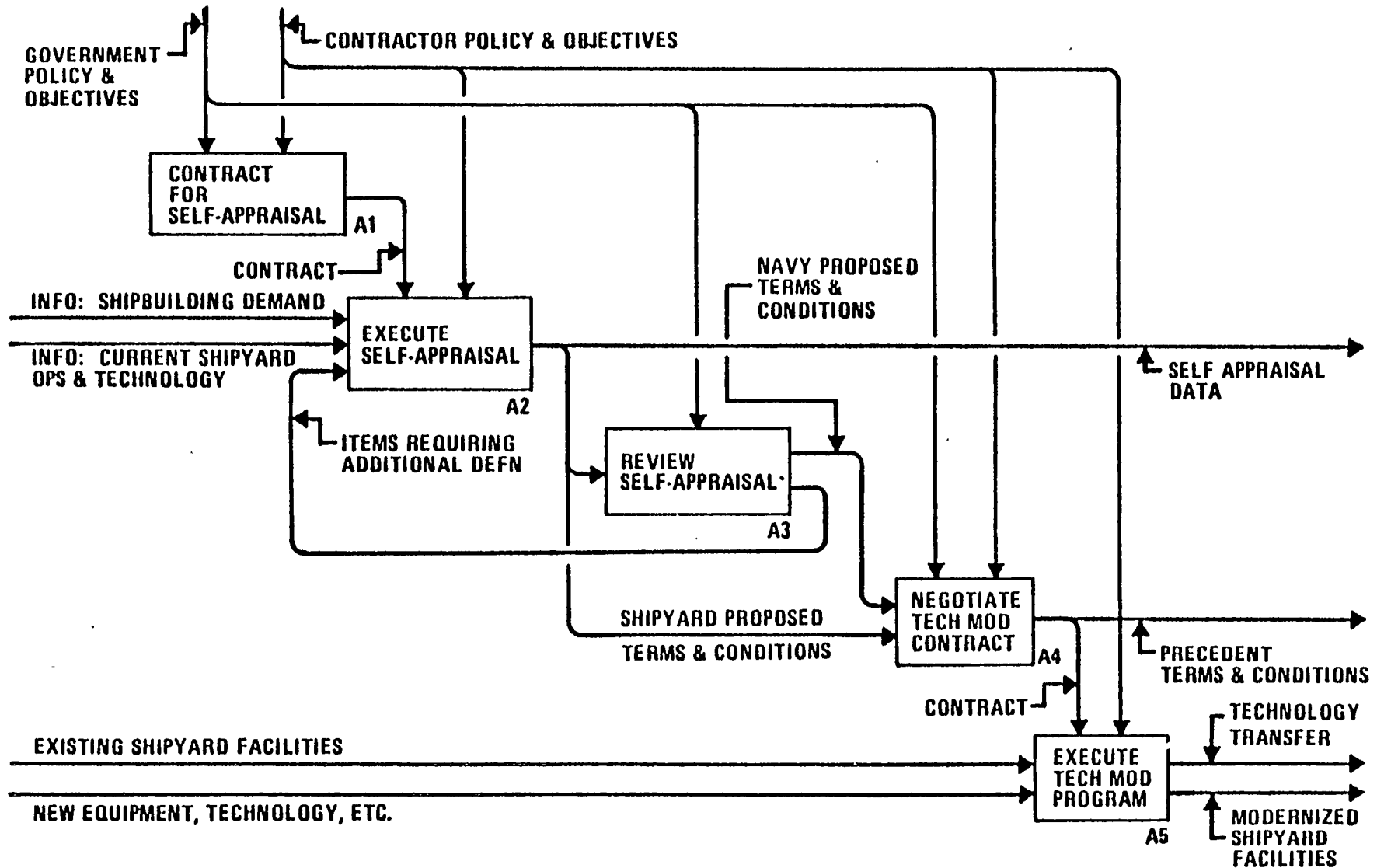
“WITHOUT SUCH AWARENESS WE WILL CONTINUE TO SUFFER FROM SUBOPTIMAL EFFORTS FROM WELL-INTENTIONED MANAGERS TRYING TO INCORPORATE NEW IDEAS PIECEMEAL FROM THE BOTTOM UP WITHOUT ANY RECOGNIZED OVERALL FRAMEWORK FOR CHANGE.”

R. VORTMAN  
NASSCO

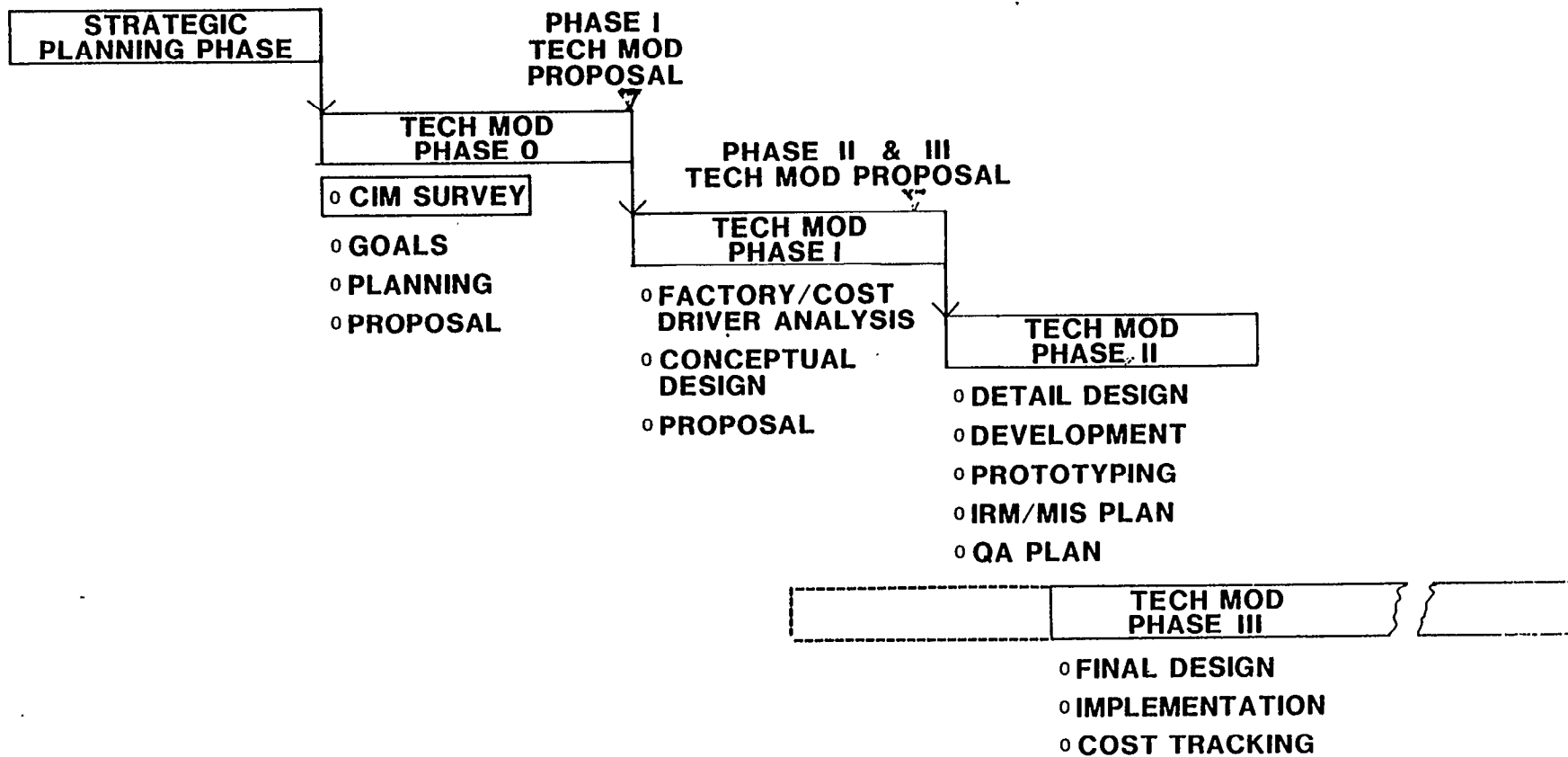
TASK WORK BREAKDOWN STRUCTURE (TWBS)



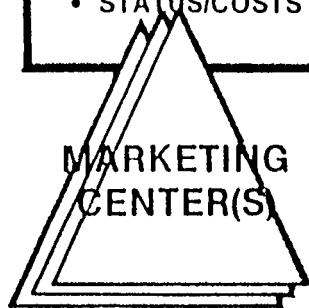
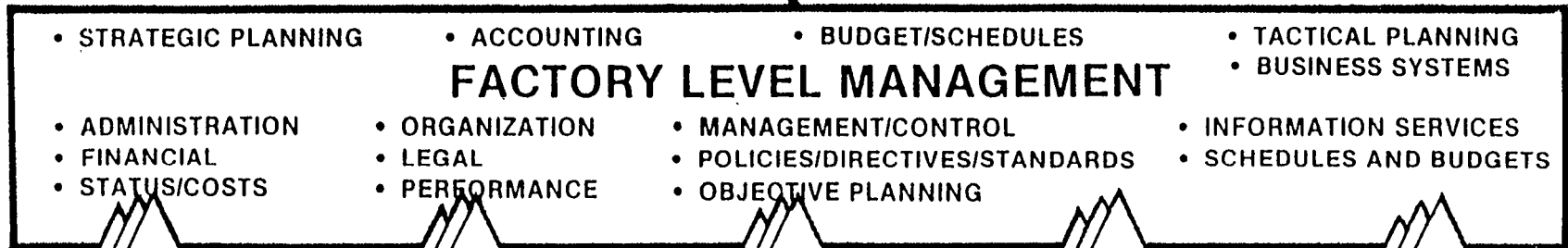
# MANAGE TECHNOLOGY MODERNIZATION



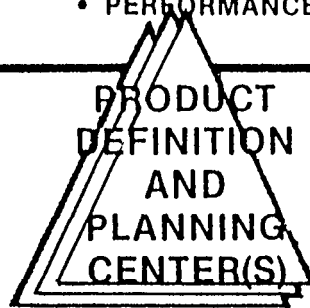
# TECHNOLOGY MODERNIZATION FRAMEWORK



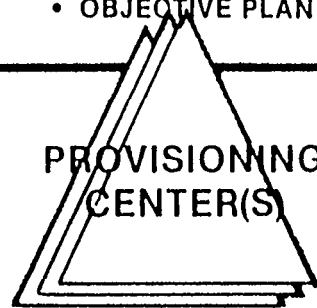
# FACTORY OF THE FUTURE FRAMEWORK



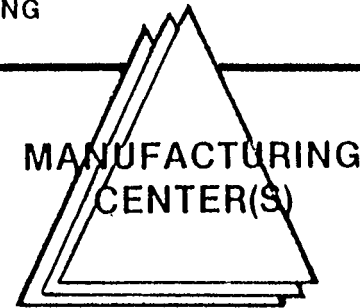
- PROVIDE CUSTOMER LIAISON AND SERVICES**
- PROPOSALS
  - NEGOTIATION
  - CONTRACT REPORTING
  - WORK AUTHORIZATION
  - CONTRACT MONITORING
  - CUSTOMER CONTACT
  - ORDER CHANGE/CANCELLATION
  - SCHEDULE/BUDGET TRACKING



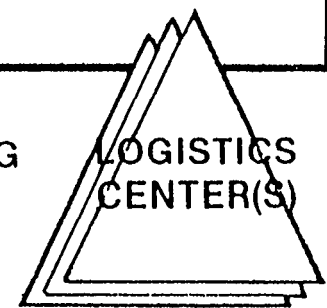
- ENGINEER AND PLAN PRODUCT**
- ENGINEERING
  - DESIGN
  - GROUP TECHNOLOGY
  - PRODUCIBILITY
  - ANALYSIS
  - MFG PLAN
  - PROCESS PLAN
  - MAKE OR BUY
  - FLOW PLAN
  - CAE
  - CAD
  - GPP



- 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

## **PRODUCTIVITY "MYTHS"**

- **TOUCH LABOR CAUSES THE PROBLEM**
- **COMPUTER'S AND PROCESS AUTOMATION WILL SOLVE THE PROBLEM**
- **SHORT TERM RESULTS COUNT MOST.**
- **"FIRST LEVEL MANAGERS" AND "MID-MANAGERS" CAN SOLVE THE PROBLEM WITHIN THEIR AREAS OF ORGANIZATIONAL RESPONSIBILITY.**

# 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

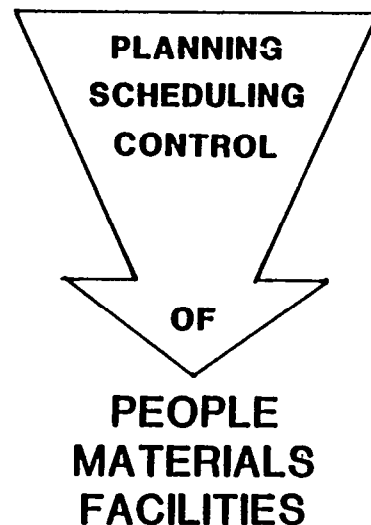
**45%**  
**OF DIRECT LABOR TIME**  
**IS NOT PRODUCTIVE**

---

## SOURCE

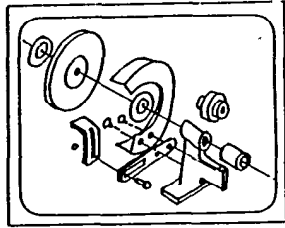
- 35% POOR SCHEDULING
- 25% POOR INSTRUCTIONS
- 15% INFLEXIBILITY
- 25% POOR MATERIAL FLOW

## PAYOFF

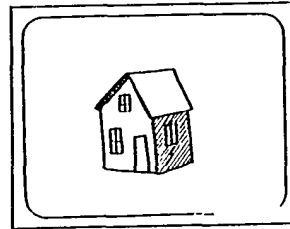


# COMPUTER AIDED DESIGN

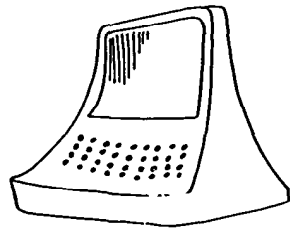
---



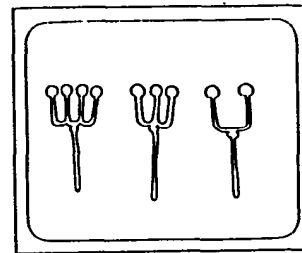
**GEOMETRIC MODEL**



**HOLOGRAPH**



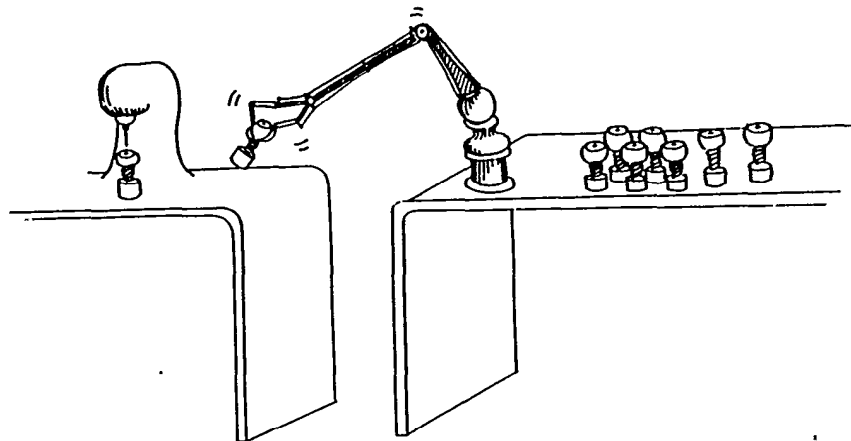
**PERSONAL TERMINAL**



**GROUP TECHNOLOGY**

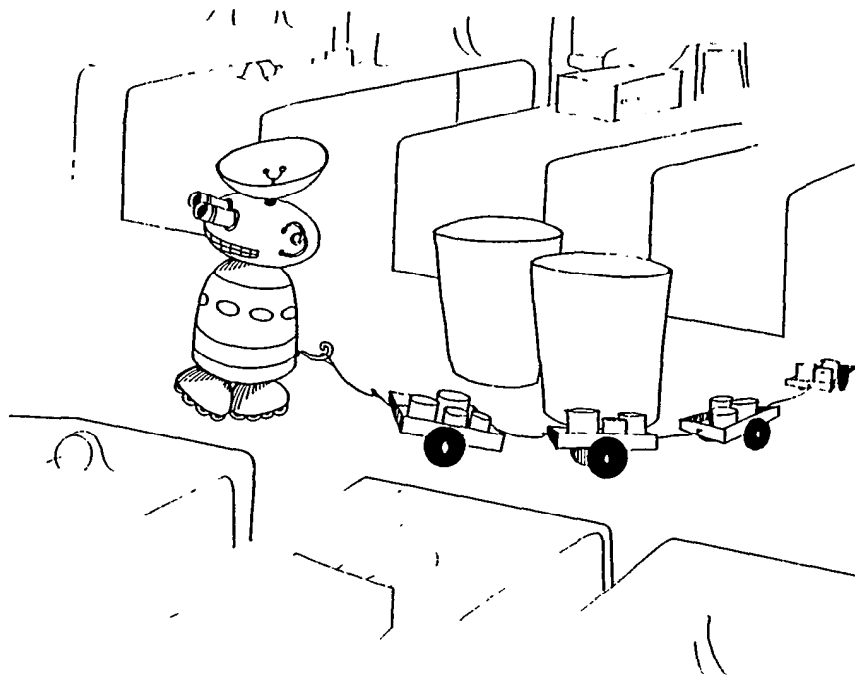
# ROBOTICS

---



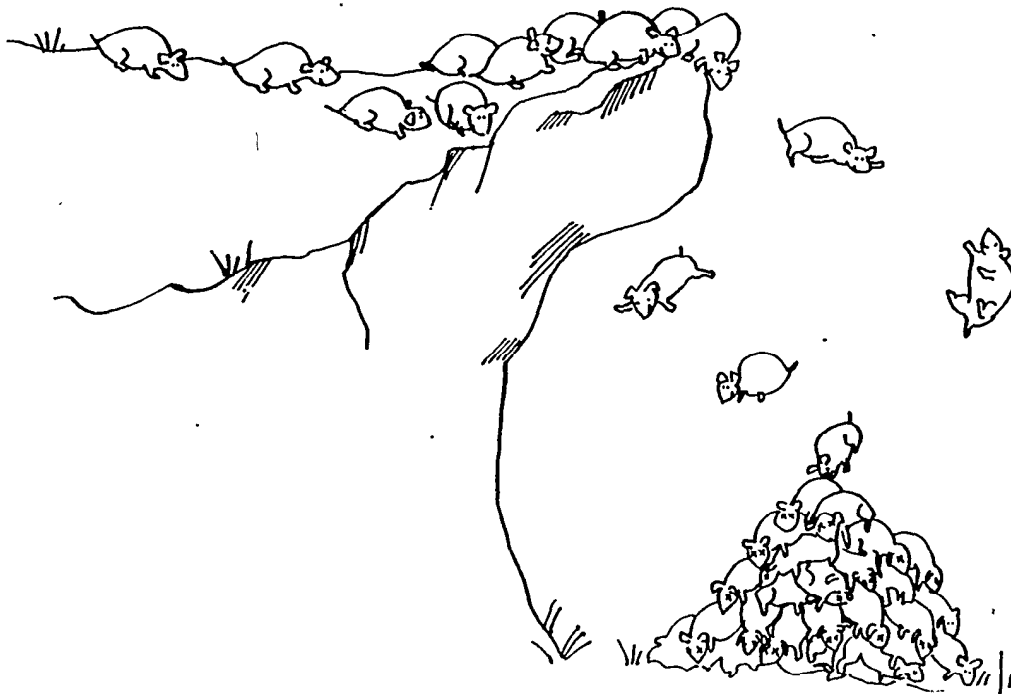
# AUTOMATED MATERIAL HANDLING

---



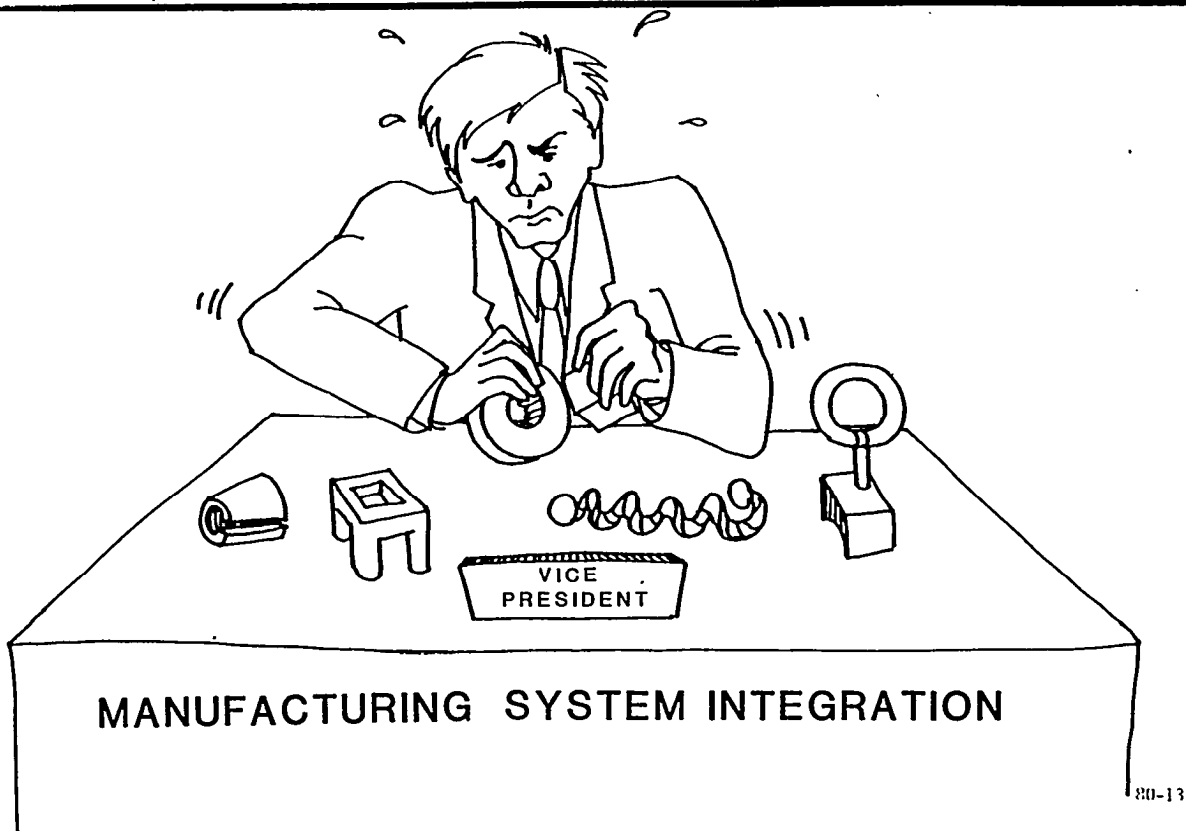
## THE LEMMING APPROACH TO AUTOMATION

---



## **C**OMPUTER **I**NTEGRATED **M**ANUFACTURING

---



### PRODUCTIVITY "DISCOVERIES"

- ADEQUATE TECHNOLOGY IS AVAILABLE
- MANAGERIAL EMPHASIS MUST SHIFT
- LONG TERM IMPLEMENTATION STRATEGY REQUIRED
- INTEGRATED IMPLEMENTATION IS THE KEY
- CONCEPTUAL INTEGRATED SYSTEMS  
ARCHITECTURE/Framework NEEDED FOR PLANNING
- **I**NFORMATION **R**ESOURCE **M**ANAGEMENT (IRM)  
DEPENDENT UPON **C**OMPUTER **B**ASED **I**NFORMATION  
**S**YSTEM (CBIS) WITH NEUTRAL DATA STRUCTURE

## **CHANGING THE FOCUS**

- **EMPHASIZE INTEGRATION OF MANUFACTURING ACTIVITY VERSUS SPECIALIZATION.**

**I REFOCUS MANAGEMENT ATTENTION FROM MANUFACTURING TECHNIQUES TO MANUFACTURING SYSTEMS.**

- **FACE AND RESOLVE NEED FOR MANAGEMENT ORGANIZATION RESTRUCTURING**

**JIM LARDNER  
DEERE&CO.**

## **INTEGRATED STRATEGIC PLANNING AND IRM**

---

- **“ONLY 19% OF THE COMPANIES SURVEYED HAVE INTEGRATED THEIR STRATEGIC PLANNING AND INFORMATION RESOURCE MANAGEMENT (IRM) SYSTEMS”**
- I **“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**
- I **NEW PROFIT MARGINS”**

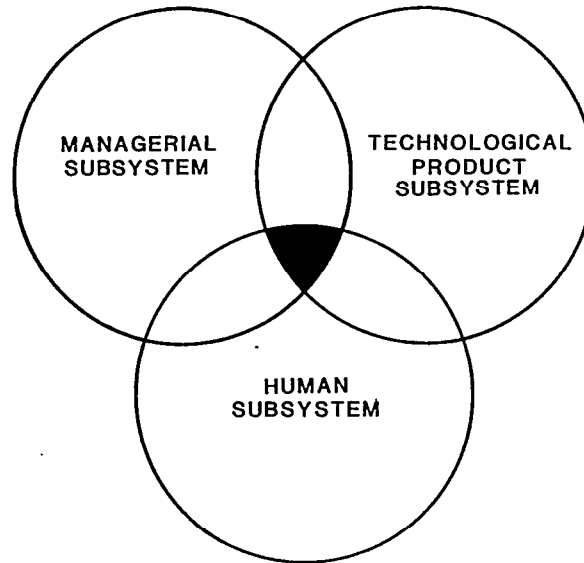
**(REF: A. T. KEARNEY, INC, MANAGEMENT CONSULTANT SURVEY OF 40 OF 500 LARGEST U.S. INDUSTRIAL AND FINANCIAL INSTITUTIONS)**

# RESOURCE MANAGEMENT

---

CAPITAL  
RESOURCES

TIME  
RESOURCES



HUMAN  
RESOURCES

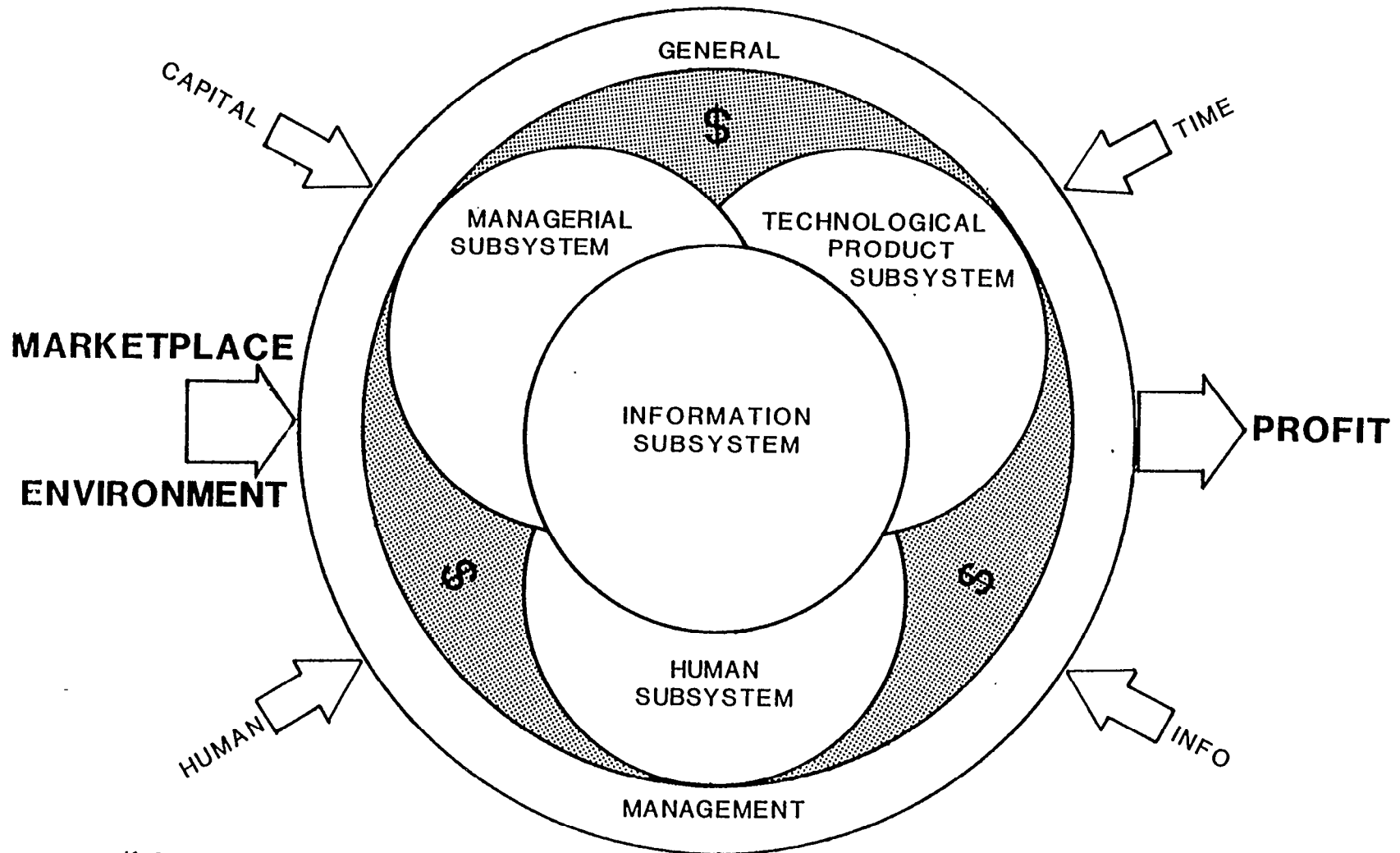
INFORMATION  
RESOURCES

## INFORMATION RESOURCE MANAGEMENT (IRM)

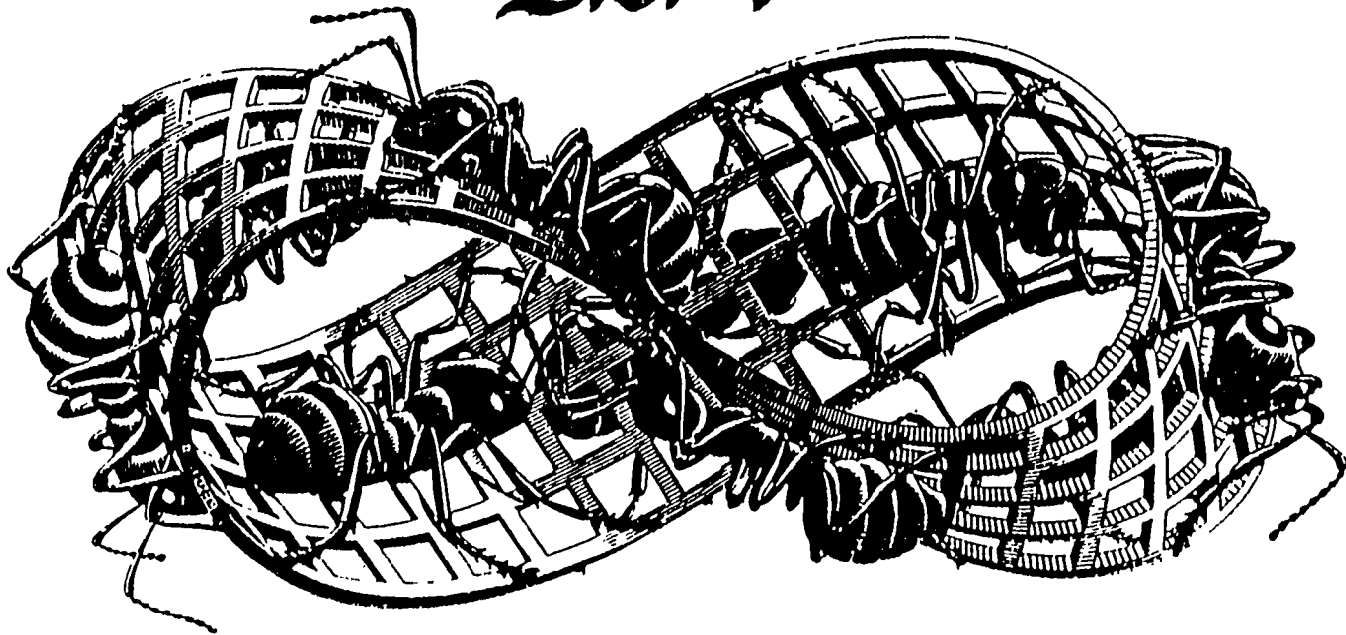
“INFORMATION IS THE MANAGER’S MAIN TOOL,,  
INDEED THE MANAGER’S ‘CAPITAL’, AND IT IS HE  
WHO MUST DECIDE WHAT INFORMATION HE NEEDS  
AND HOW TO USE IT.”

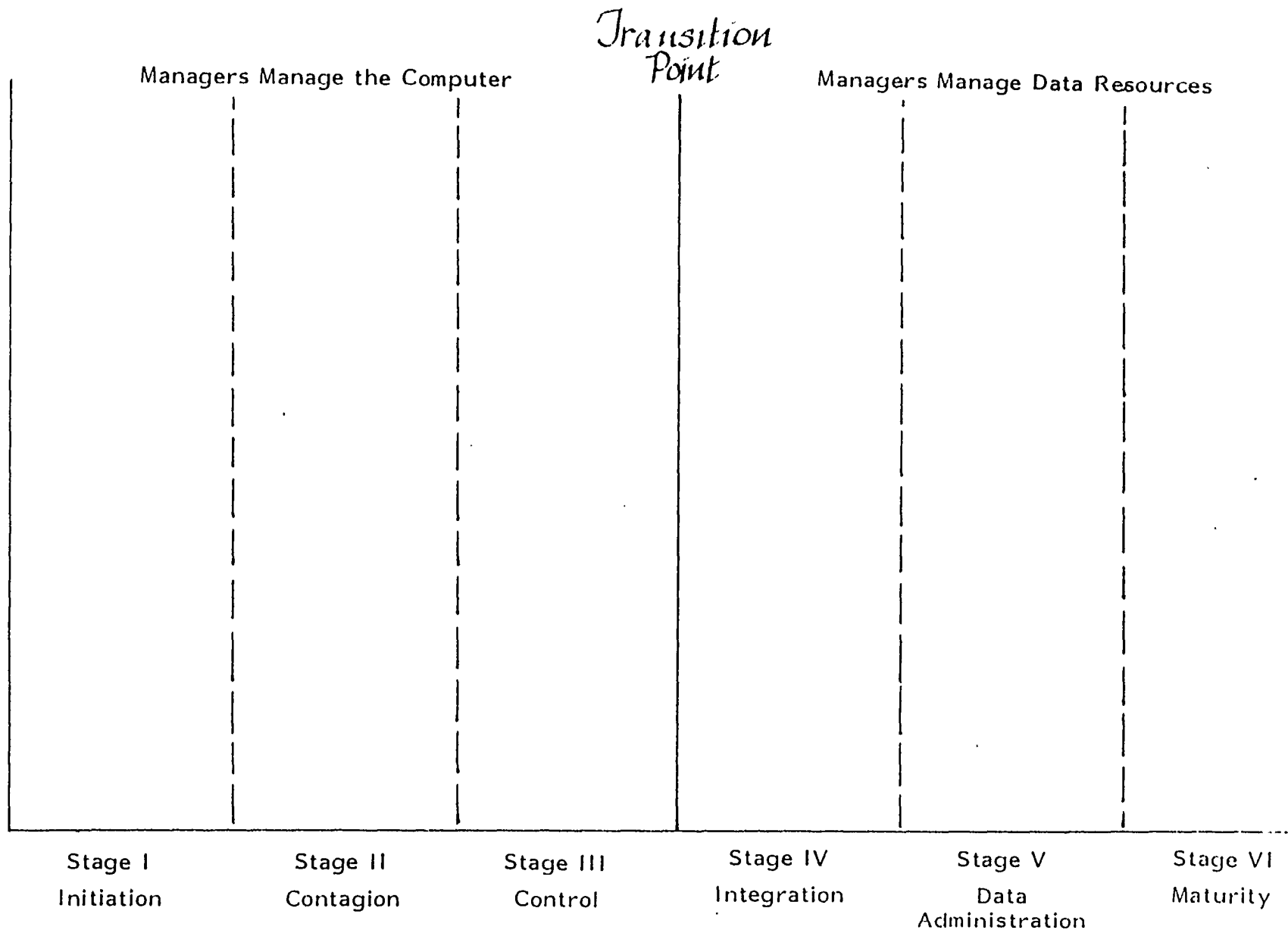
PETER DRUCKER-“MANAGING THE INFORMATION EXPLOSION”

# **I** **N**FORMATION **R**ESOURCE **M**ANAGEMENT



# Managing The Transition From Data Processing to IRM





*Nolan Scale*

Architecture = Structure Specification

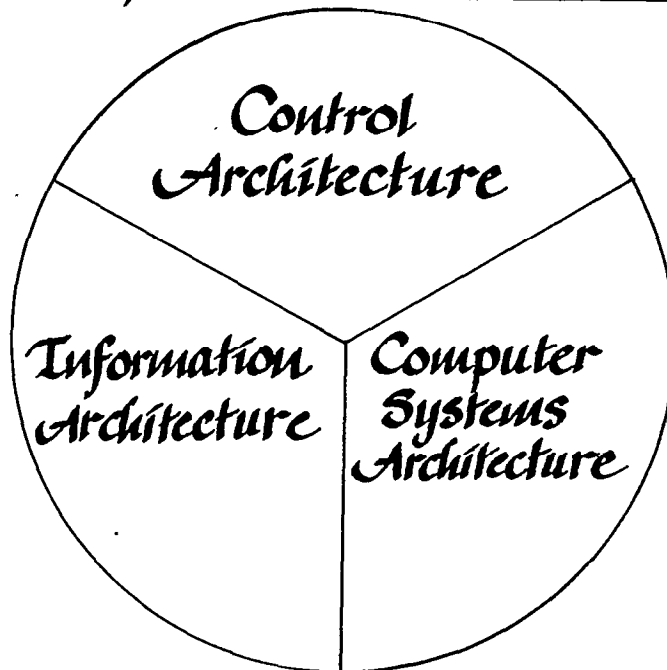
Specifies :

- Components
- Logical Relationships
- Uses

Reflects :

- Philosophy
- Technique

Information Resource  
Component Architectures



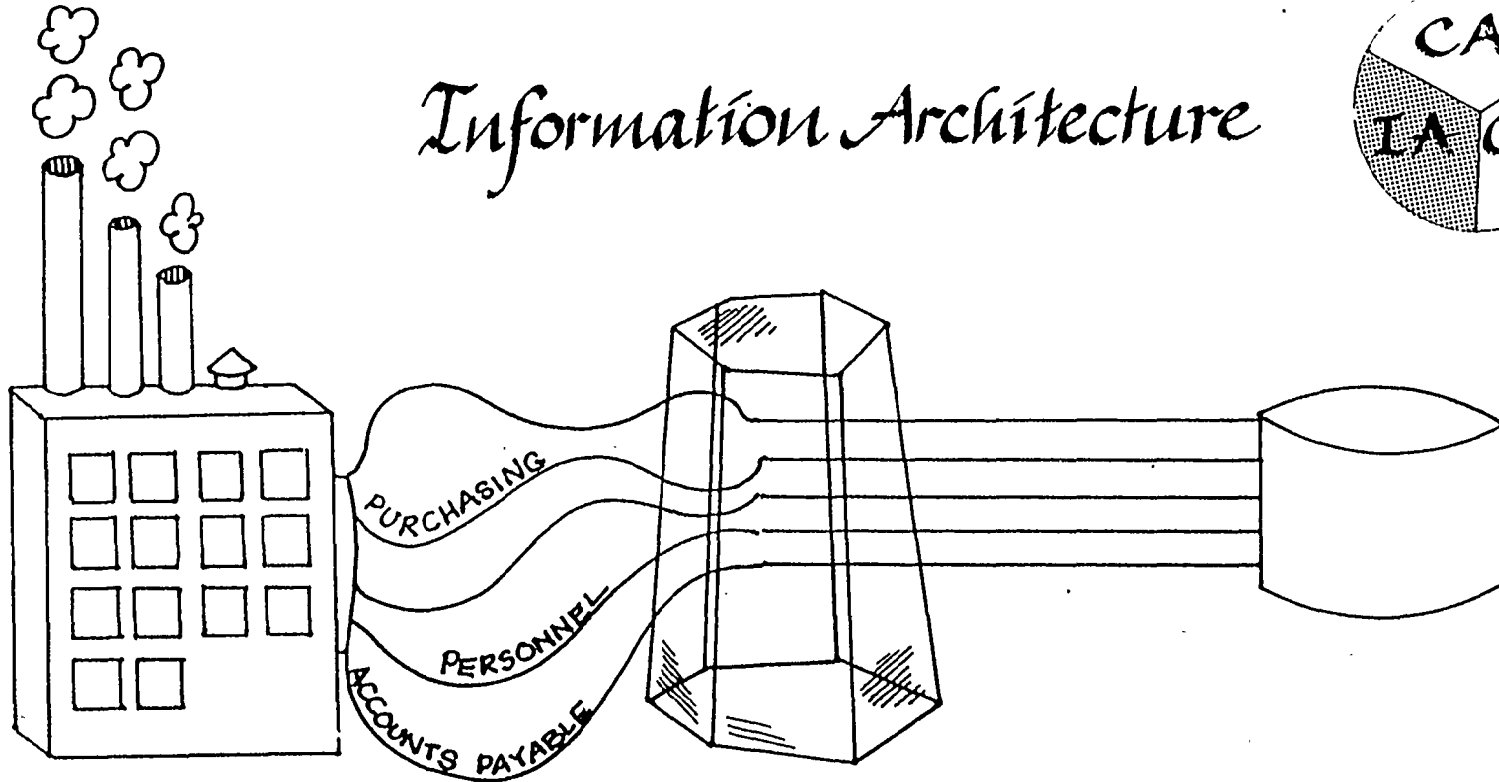
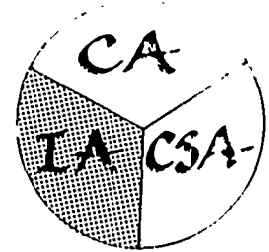
## **DATA DRIVEN IRM ARCHITECTURE**

- o **INFORMATION ARCHITECTURE (IA)**
  - o **DATABASES**
  - o **APPLICATIONS**
  - o **INPUT PROCESSES**
  - o **OUTPUT PROCESSES**
  
- o **CONTROL ARCHITECTURE (CA)**
  - o **STANDARDS & PROCEDURES**
  - o **SYSTEMS ENGINEERING METHODOLOGY**
  - o **INTEGRATED NEUTRAL DATA STRUCTURE**
  - o **ORGANIZATION & TEAMS**
  - o **PLANS & CONTRACTS**

## **DATA DRIVEN IRM ARCHITECTURE (CONTINUED)**

- o **COMPUTER SYSTEMS ARCHITECTURE (CSA)**
  - o **HARDWARE**
  - o **COMMUNICATIONS**
  - o **SYSTEMS SOFTWARE**
  - o **TOOL KITS**

# Information Architecture



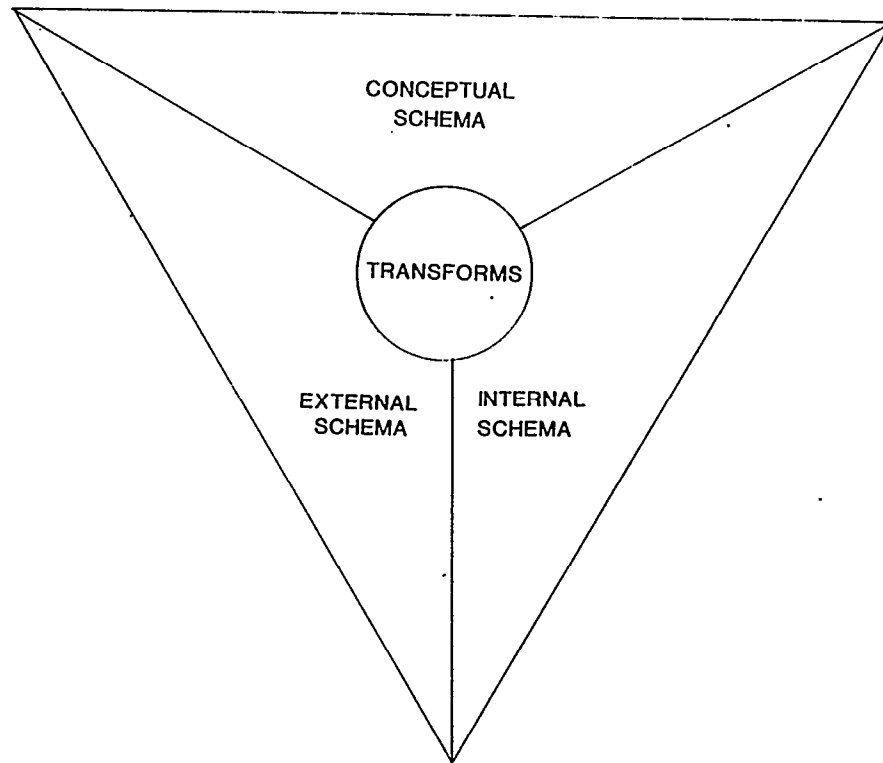
External  
Schema  
(user Views)

Conceptual  
Schema  
(Logical data  
base design)

Internal  
Schema  
(physical  
implementation)

(ANSI/X3/SPARC-Three Schema Architecture  
72-12)

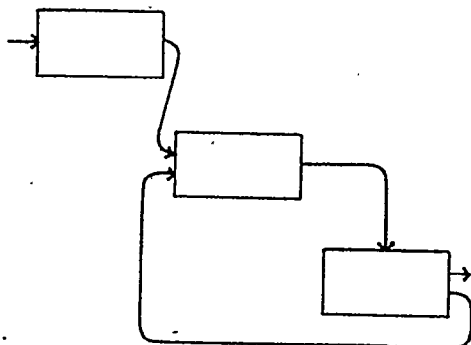
# ROSETTA STONE



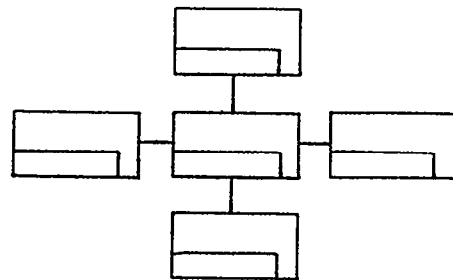
## *Information Architecture*



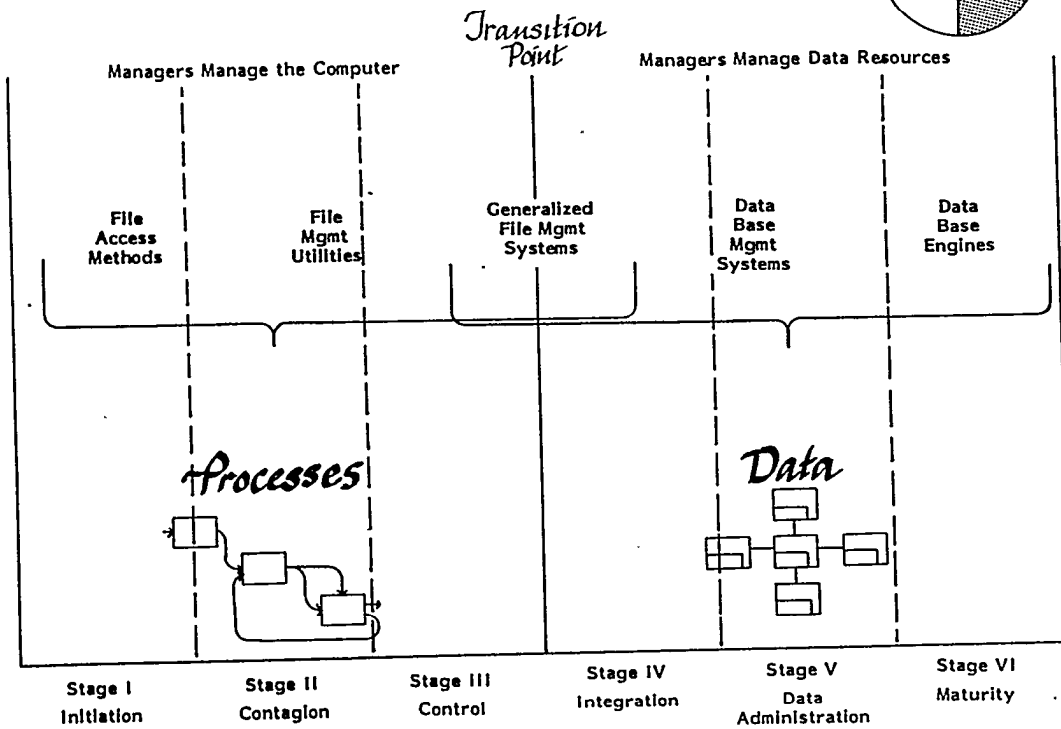
### *Processes*



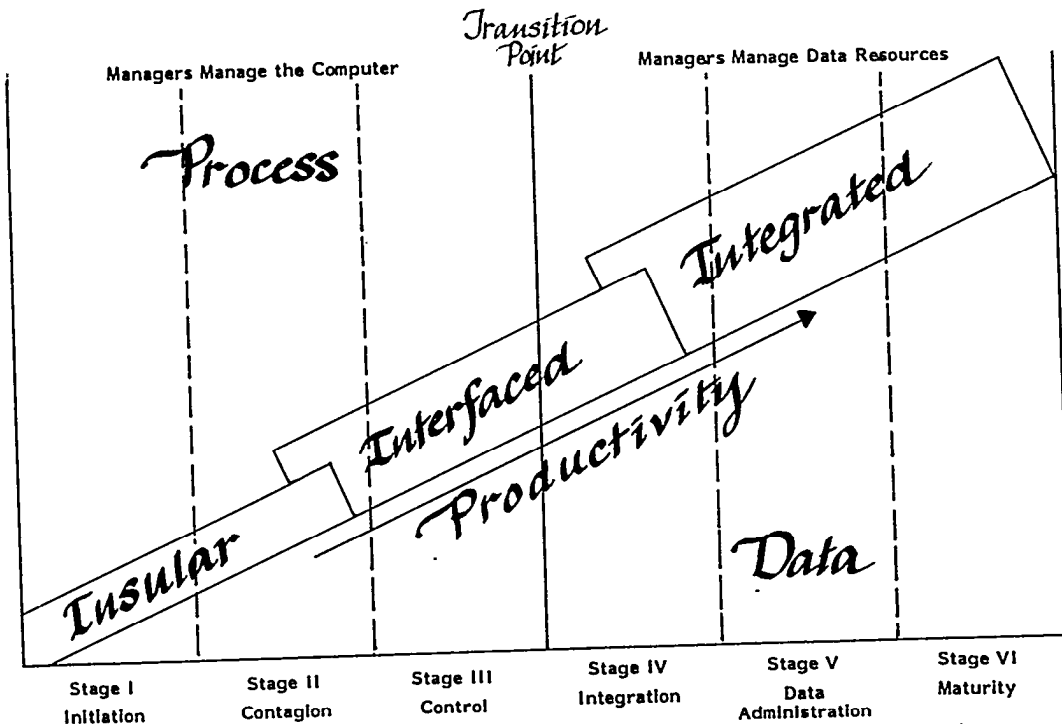
### *Data*



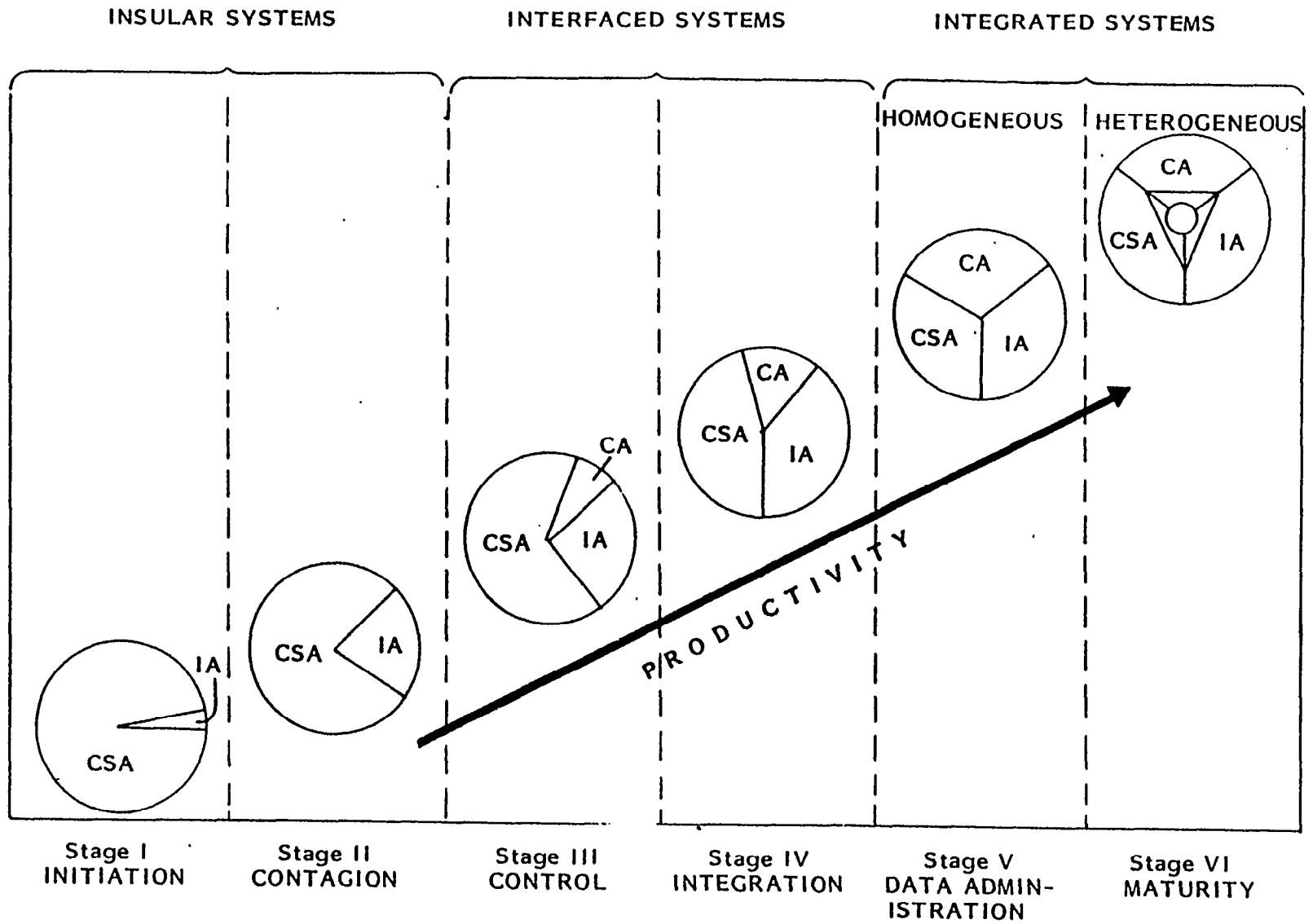
# Computer Systems Architecture



## Nolan Scale



## Nolan Scale



NOLAN SCALE:

Stage I INITIATION

Stage II CONTAGION

Stage III CONTROL

Stage IV INTEGRATION

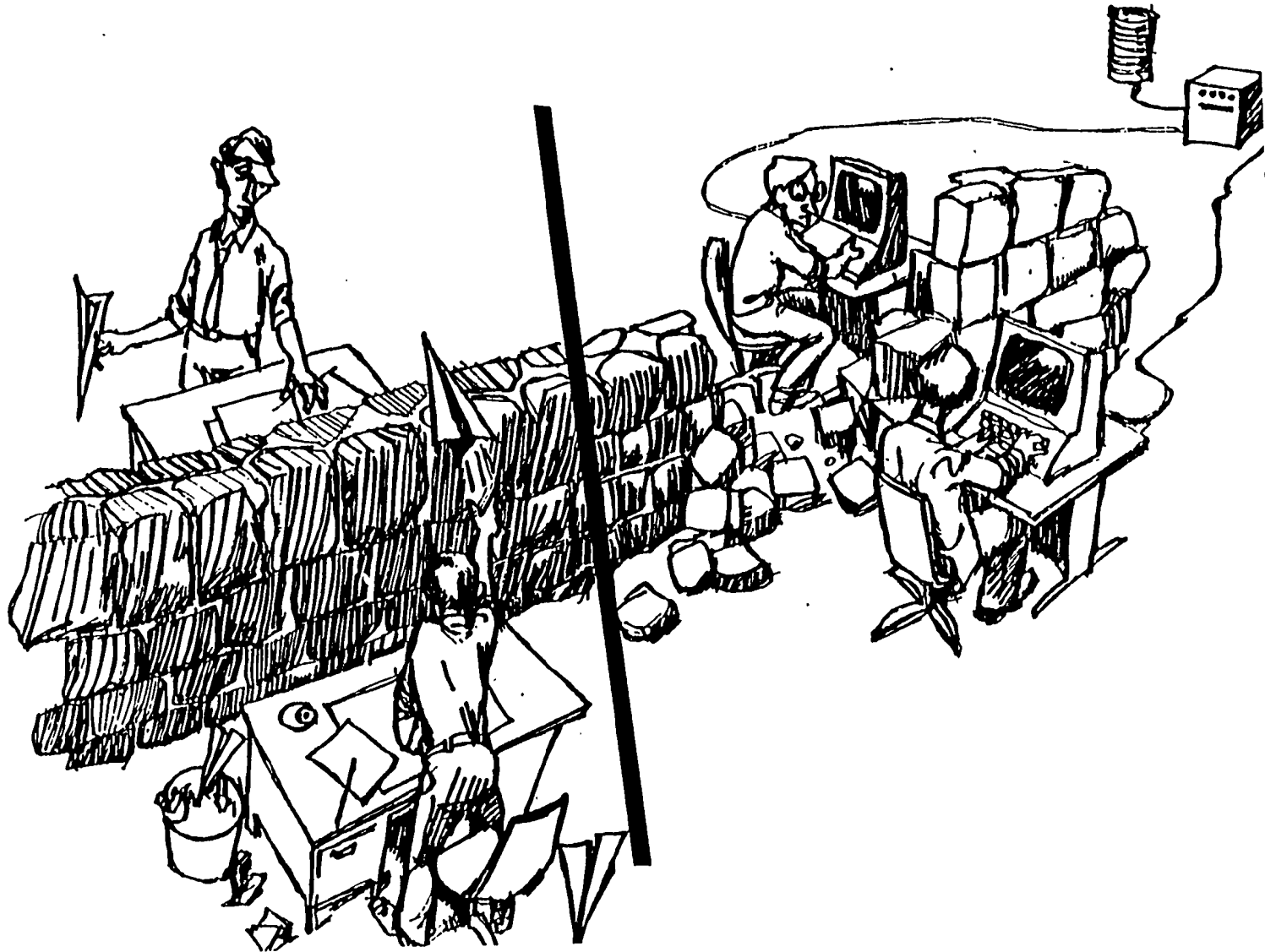
Stage V DATA ADMINISTRATION

Stage VI MATURITY

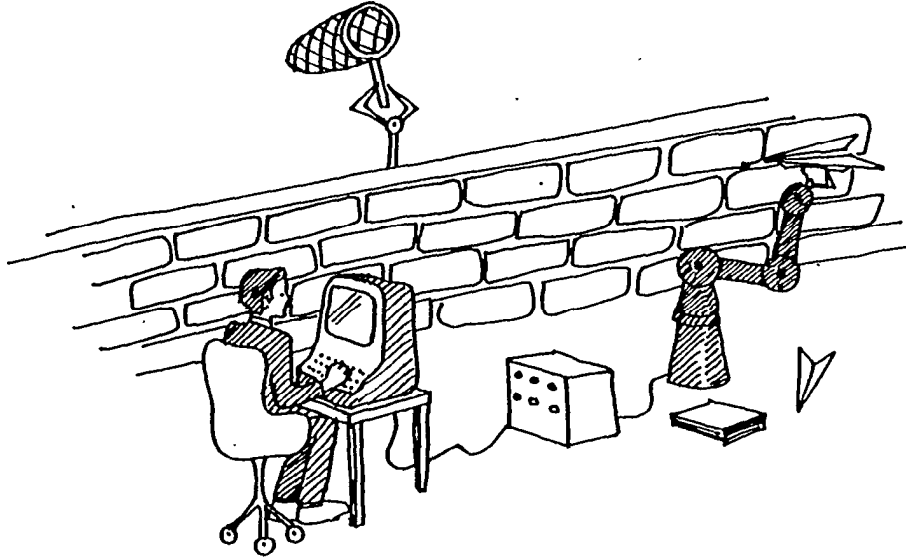
BALANCING THE ARCHITECTURES AND ACHIEVING INTEGRATION

# THE OLD WAY

# THE NEW WAY

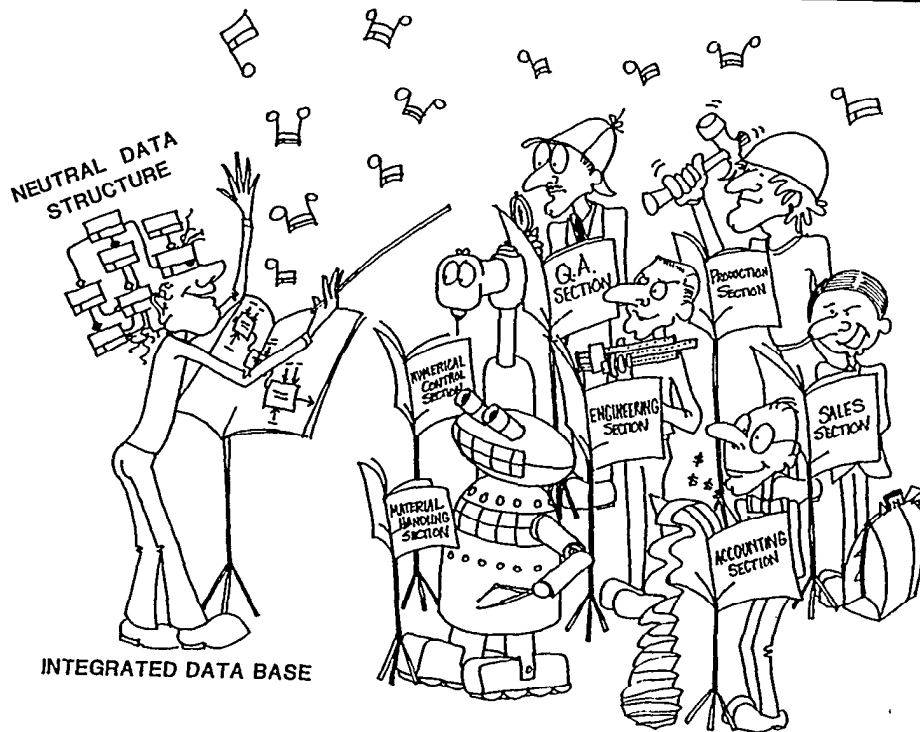


# THE WRONG WAY



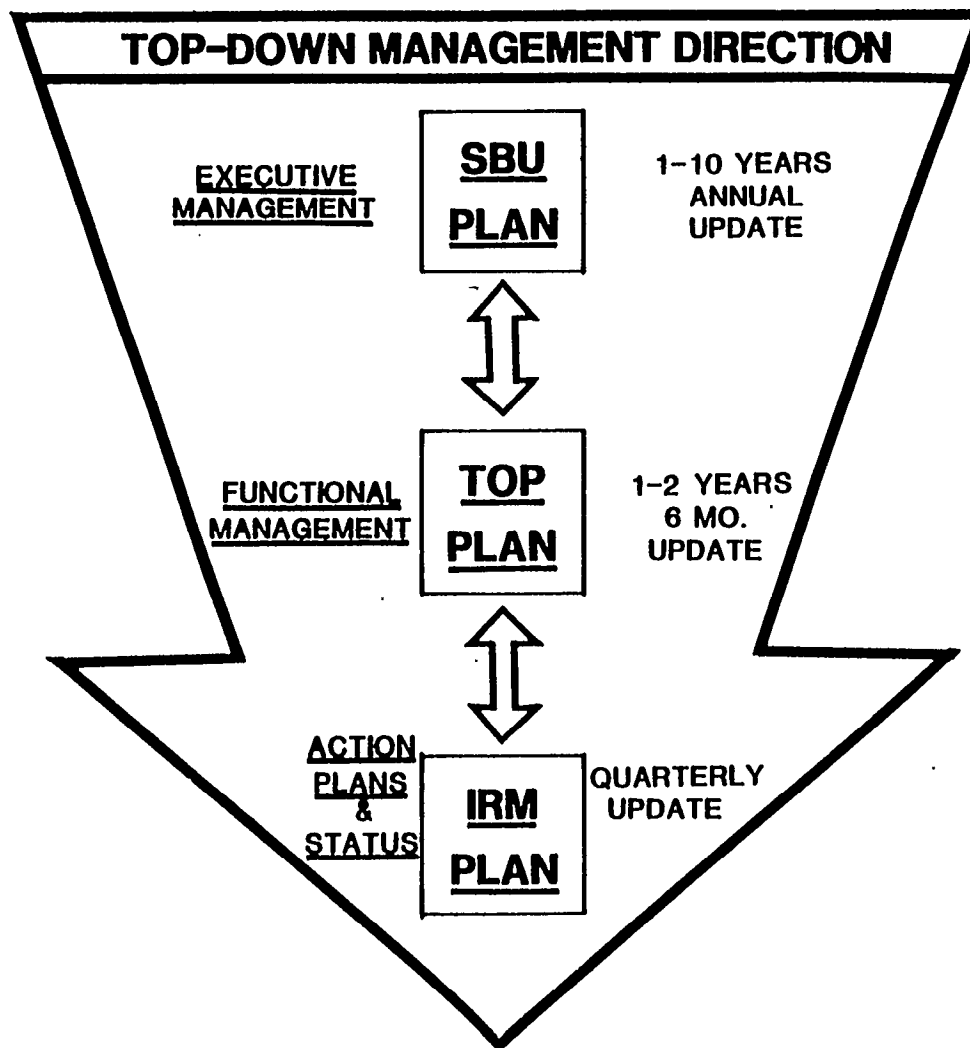
## INFORMATION RESOURCE MANAGEMENT (IRM)

---

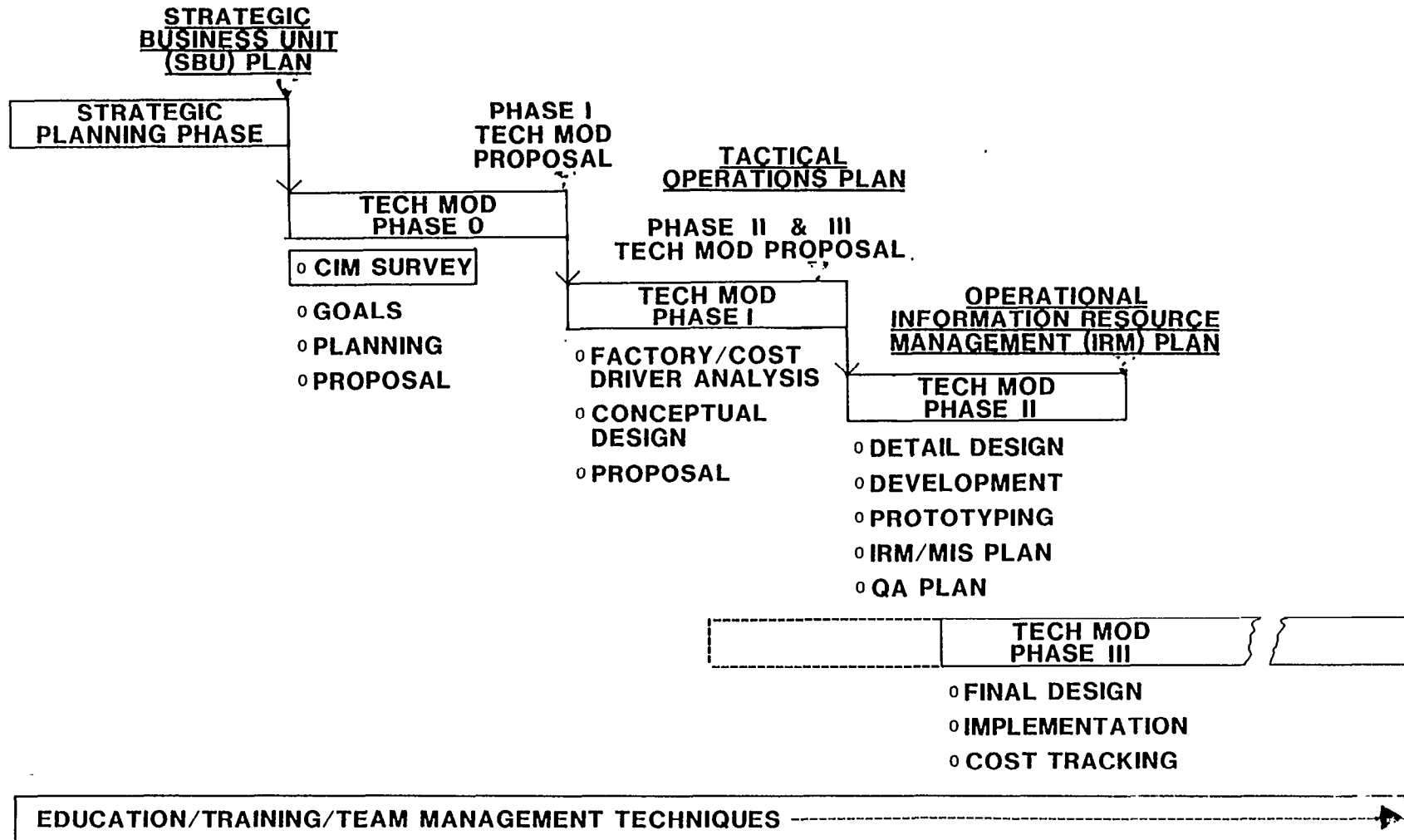


# INFORMATION RESOURCE MANAGEMENT PROGRAM

---



# TECHNOLOGY MODERNIZATION FRAMEWORK



298

## **MANAGING CIM FOR TOMORROW**

**“IN TURBULENT TIMES, MANAGERS CANNOT ASSUME TOMORROW WILL BE AN EXTENSION OF TODAY. ON THE CONTRARY, THEY MUST MANAGE FOR CHANGE; CHANGE ALIKE AS AN OPPORTUNITY AND A THREAT.”**

**PETER DRUCKER- “MANAGING IN TURBULENT TIMES”**

### **C O M P U T E R I N T E G R A T E D S H I P B U I L D I N G**

- o COMMON TERMINOLOGY & CONCEPTS**
- o PRODUCTIVITY “MYTHS” AND “DISCOVERIES”**
- o CHANGING MANAGEMENT FOCUS**
- o INFORMATION RESOURCE MANAGEMENT (IRM)**
- o DATA DRIVEN IRM ARCHITECTURE**
- o MANAGING CIS FOR TOMORROW**

Additional copies of this report can be obtained from the  
National Shipbuilding Research and Documentation Center:

**<http://www.nsnet.com/docctr/>**

Documentation Center  
The University of Michigan  
Transportation Research Institute  
Marine Systems Division  
2901 Baxter Road  
Ann Arbor, MI 48109-2150

Phone: 734-763-2465  
Fax: 734-763-4862  
E-mail: [Doc.Center@umich.edu](mailto:Doc.Center@umich.edu)