THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

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IREAPS
COMPUTER INTEGRATED SHIPBUILDING
A FRAMEWORK FOR TECHNOLOGY MODERNIZATION

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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 roadmap 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

DEPARTMENT OF DEFENSE

MANUFACTURING

STRAP
CIMS
RAP
PDM-80

DATA PROCESSING

WHAT DO YOU SEE?
"CAD/CAM APPLICATIONS IN THE CONSTRUCTION OF NAVAL VESSELS" WORKSHOP

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

COMPUTER INTEGRATED SHIPBUILDING

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

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

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TASK WORK BREAKDOWN STRUCTURE (TWBS)

MANAGE SHIPYARD

MANAGE MKTG & SALES
- COMPETITION
- MARKETPLACE
- REGULATIONS
- CUSTOMER REQUIREMENTS

MANAGE ADMINISTRATION
- ESTIMATING
- FINANCIAL CONTROLS
- HUMAN RESOURCES
- INFORMATION SYSTEMS

MANAGE PROGRAMS
- CONTRACT ADMINISTRATION
- STATUS REPORTING
- CHANGE CONTROL
- CUSTOMER CONTACTS
- SPECIAL PROJECTS

MANAGE OPERATIONS
- DESIGN
- PLANNING & SCHEDULING
- MATERIALS MANAGEMENT
- PRODUCTION
- QUALITY ASSURANCE
- SEA TRIALS

MANAGE OVERHAUL & REPAIR
- REQUIREMENTS ANALYSIS
- DRYDOCKS
- CUSTOMER SUPPORT

MANAGE LOGISTICS SUPPORT
- PROVISIONING
- SPARE PARTS
- TECHNICAL MANUALS
- CUSTOMER HOUSING
- CUSTOMER TRAINING
FACTORY OF THE FUTURE FRAMEWORK

CORPORATION

FACTORY LEVEL MANAGEMENT

- STRATEGIC PLANNING
- ACCOUNTING
- BUDGET/SCHEDULES
- TACTICAL PLANNING
- BUSINESS SYSTEMS

- ADMINISTRATION
- FINANCIAL
- STATUS/COSTS
- ORGANIZATION
- LEGAL
- PERFORMANCE
- MANAGEMENT/CONTROL
- POLICIES/DIRECTIVES/STANDARDS
- OBJECTIVE PLANNING
- INFORMATION SERVICES
- SCHEDULES AND BUDGETS

MARKETING CENTER(S)

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

PRODUCT DEFINITION AND PLANNING CENTER(S)

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

PROVISIONING CENTER(S)

PROVIDE RESOURCES
- TOOLS
- FACILITIES
- EQUIPMENT
- PEOPLE
- INFORMATION/COMPUTER SYSTEMS
- MATERIAL
- MATERIAL HANDLING SYSTEM
- QA/QC

MANUFACTURING CENTER(S)

PRODUCE PRODUCT
- CONTROL MFG OPERATIONS
- PROCESSING
- STATUS REPORTING
- UNMANNED CELL
- MACHINE, MAN, MATERIAL STORES, ETC MONITORING
- NC
- DNC
- CNC
- AUTOMATED INSPECTION

LOGISTICS CENTER(S)

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-LEVEL 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
PLANNING
SCHEDULING
CONTROL
OF
PEOPLE
MATERIALS
FACILITIES
AUTOMATED MATERIAL HANDLING

THE LEMMING APPROACH TO AUTOMATION
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
- INFORMATION RESOURCE MANAGEMENT (IRM)
  DEPENDENT UPON COMPUTER BASED INFORMATION
  SYSTEM (CBIS) WITH NEUTRAL DATA STRUCTURE
CHANGING THE FOCUS

• EMPHASIZE INTEGRATION OF MANUFACTURING ACTIVITY VERSUS SPECIALIZATION.

• REFOCUS MANAGEMENT ATTENTION FROM MANUFACTURING TECHNIQUES TO MANUFACTURING SYSTEMS.

• FACE AND RESOLVE NEED FOR MANAGEMENT ORGANIZATION RESTRUCTURING.

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)
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"
Managing
The Transition From
Data Processing to
IRM
Transition Point

Managers Manage the Computer

Managers Manage Data Resources

Stage I
Initiation

Stage II
Contagion

Stage III
Control

Stage IV
Integration

Stage V
Data Administration

Stage VI
Maturity

Nolan Scale
Architecture = Structure Specification

Specifies:
- Components
- Logical Relationships
- Uses

Reflects:
- Philosophy
- Technique

Information Resource Component Architectures

- Control Architecture
- Information Architecture
- Computer Systems Architecture
DATA DRIVEN IRM ARCHITECTURE

- INFORMATION ARCHITECTURE (IA)
  - DATABASES
  - APPLICATIONS
  - INPUT PROCESSES
  - OUTPUT PROCESSES

- CONTROL ARCHITECTURE (CA)
  - STANDARDS & PROCEDURES
  - SYSTEMS ENGINEERING METHODOLOGY
  - INTEGRATED NEUTRAL DATA STRUCTURE
  - ORGANIZATION & TEAMS
  - PLANS & CONTRACTS

DATA DRIVEN IRM ARCHITECTURE (CONTINUED)

- COMPUTER SYSTEMS ARCHITECTURE (CSA)
  - HARDWARE
  - COMMUNICATIONS
  - SYSTEMS SOFTWARE
  - TOOL KITS
Information Architecture

External Schema (User Views)

Conceptual Schema (Logical database design)

Internal Schema (physical implementation)

(ANSI/X3/SPARC - Three Schema Architecture)
ROSETTA STONE

CONCEPTUAL SCHEMA

TRANSFORMS

EXTERNAL SCHEMA

INTERNAL SCHEMA

Information Architecture

Processes

Data
BALANCING THE ARCHITECTURES AND ACHIEVING INTEGRATION
THE WRONG WAY

INFORMATION RESOURCE MANAGEMENT (IRM)
INFORMATION RESOURCE MANAGEMENT PROGRAM

TOP-DOWN MANAGEMENT DIRECTION

EXECUTIVE MANAGEMENT

SBU PLAN
1-10 YEARS ANNUAL UPDATE

FUNCTIONAL MANAGEMENT

TOP PLAN
1-2 YEARS 6 MO. UPDATE

ACTION PLANS & STATUS

IRM PLAN
QUARTERLY UPDATE
TECHNOLOGY MODERNIZATION FRAMEWORK

STRATEGIC BUSINESS UNIT (SBU) PLAN

STRATEGIC PLANNING PHASE

PHASE I TECH MOD PROPOSAL

TECH MOD PHASE 0

- CIM SURVEY
- GOALS
- PLANNING
- PROPOSAL

TECH MOD PHASE I

- FACTORY/COST DRIVER ANALYSIS
- CONCEPTUAL DESIGN
- PROPOSAL

TECH MOD PHASE II

- DETAIL DESIGN
- DEVELOPMENT
- PROTOTYPING
- IRM/MIS PLAN
- QA PLAN

TECH MOD PHASE III

- FINAL DESIGN
- IMPLEMENTATION
- COST TRACKING

EDUCATION/TRAINING/TEAM MANAGEMENT TECHNIQUES

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

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

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