HEAVENS System for Software Artifacts

Paul Matthews
Bellcore Company

The HEAVENS system is a workstation-based collection of software for analyzing, organizing and viewing software artifacts. As a prototype, the system has been used for visualizing source code structure, analyzing dependencies, and restructuring to simplify maintenance. The system has also been used in the early stages of software design to organize and relate design objects, maintain design documentation, and provide a ready-made framework for later coding.

HEAVENS System for Software Artifacts

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Hypermedia '90
Houston, Texas
December 1990

HEAVENS - IN THE BEGINNING

Circa 1987

Lots of software engineering documents.

Documents are hard to relate.

Useful information is buried and hard to find.

+

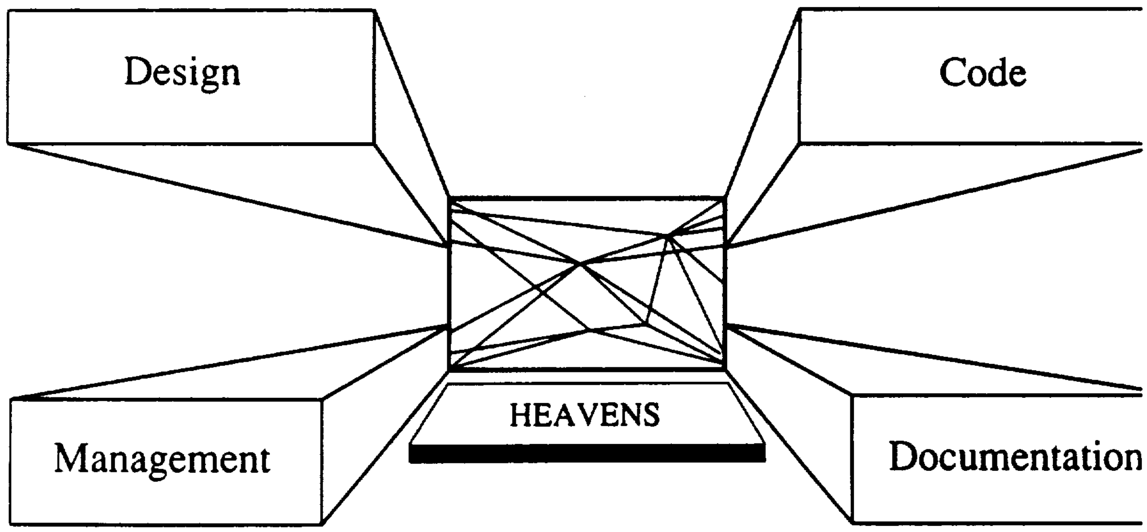
Linking document parts.

Workstation user interface.

=

Hypertext strategy.

HEAVENS - BRIDGING THE GAPS



HEAVENS - SOFTWARE ARTIFACTS

Characteristics

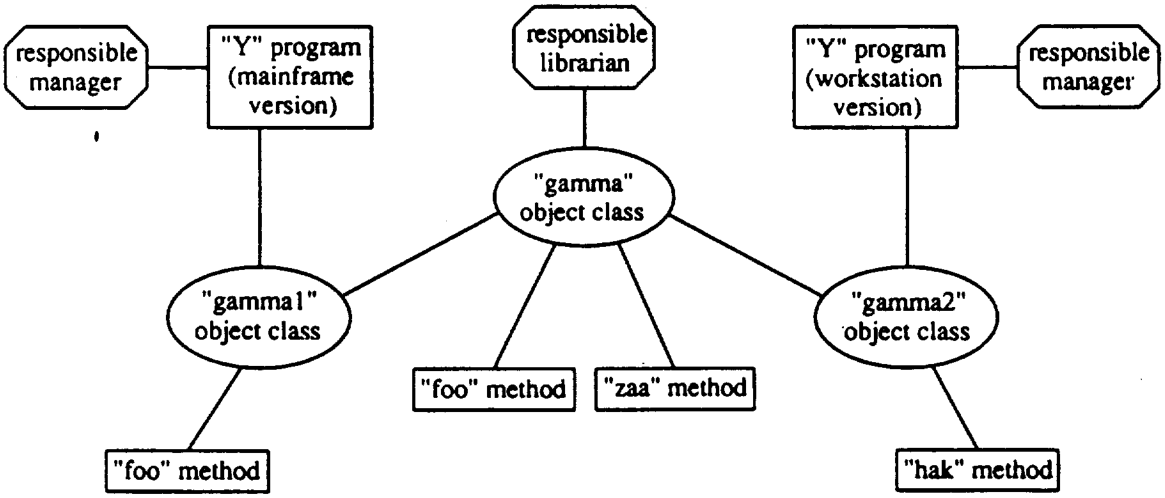
Software is relatively highly structured.

Structure itself is a managed asset.

Extension and maintenance are significant.

Software is manipulated by power tools.

HEAVENS - SOFTWARE ARTIFACTS



HEAVENS - SOFTWARE ARTIFACTS

Basic Hypertext Requirements

Classify nodes and links.

Visualization.

Power tool attachments.

HEAVENS - MCC CONNECTION

GERM

Provides many useful facilities:

Node-and-link graphics.

Text associated with graphical elements.

External node-and-link schemata.

Plug-in modules.

HEAVENS - SOFTWARE ARTIFACTS

Chosen for Study

Initially:

C language source code.

Program configuration.

Later:

Object-oriented design.

HEAVENS - C LANGUAGE

Features

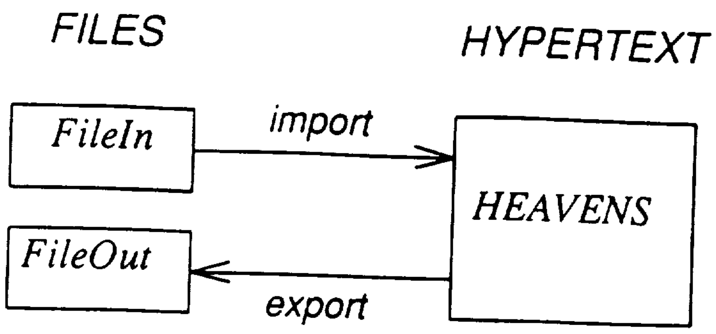
Import / export.

Dependency analysis.

Automatic "make".

HEAVENS - C LANGUAGE

Import / Export



FILES

HYPERTEXT

FileIn

import

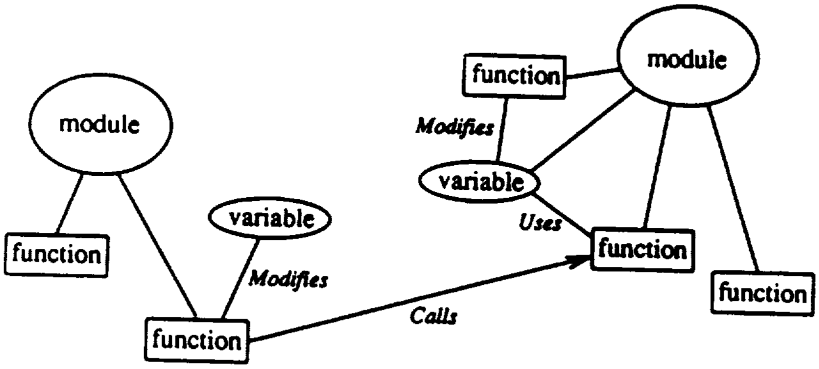
HEAVENS

FileOut

export

HEAVENS - C LANGUAGE

Dependency Analysis



module

function

variable

Modifies

function

Calls

function

module

Modifies

variable

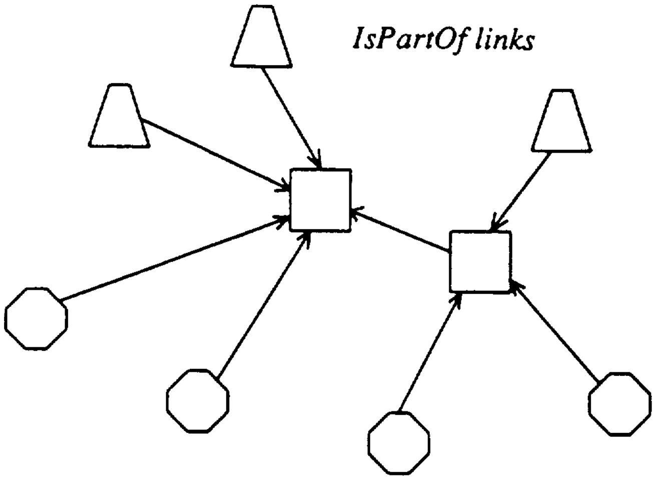
Uses

function

function

HEAVENS - C LANGUAGE

Automatic "Make"



HEAVENS - O-O DESIGN

Purpose

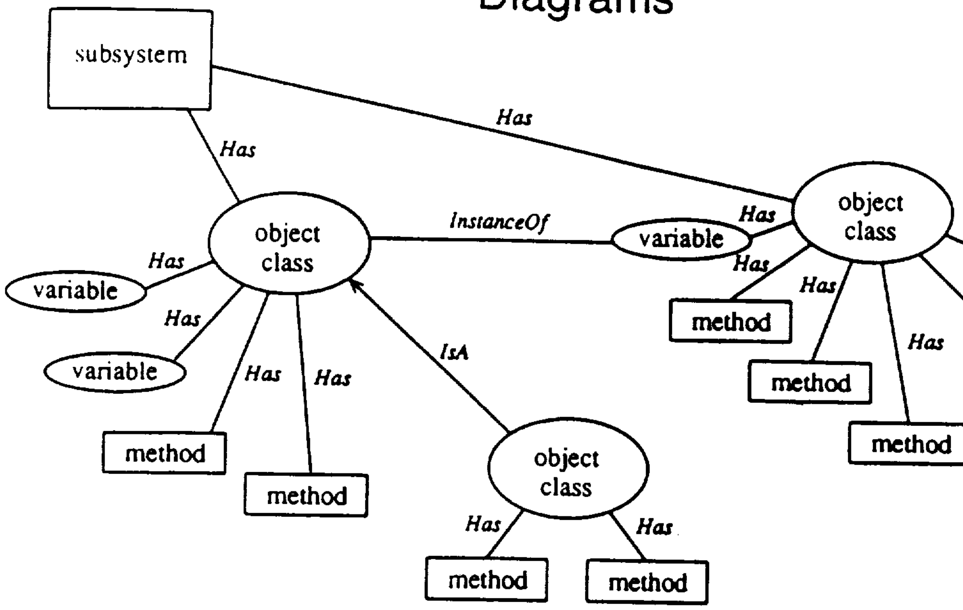
Record design decisions.

Document object classes.

Framework for coding.

HEAVENS - O-O DESIGN

Diagrams



HEAVENS - O-O DESIGN

Class Description Documents

Class name:

SuperClasses:

SubClasses:

General Description:

Member Variables:

Member Functions:

. . .

HEAVENS - HOW IT IS USED

Best Selling Features

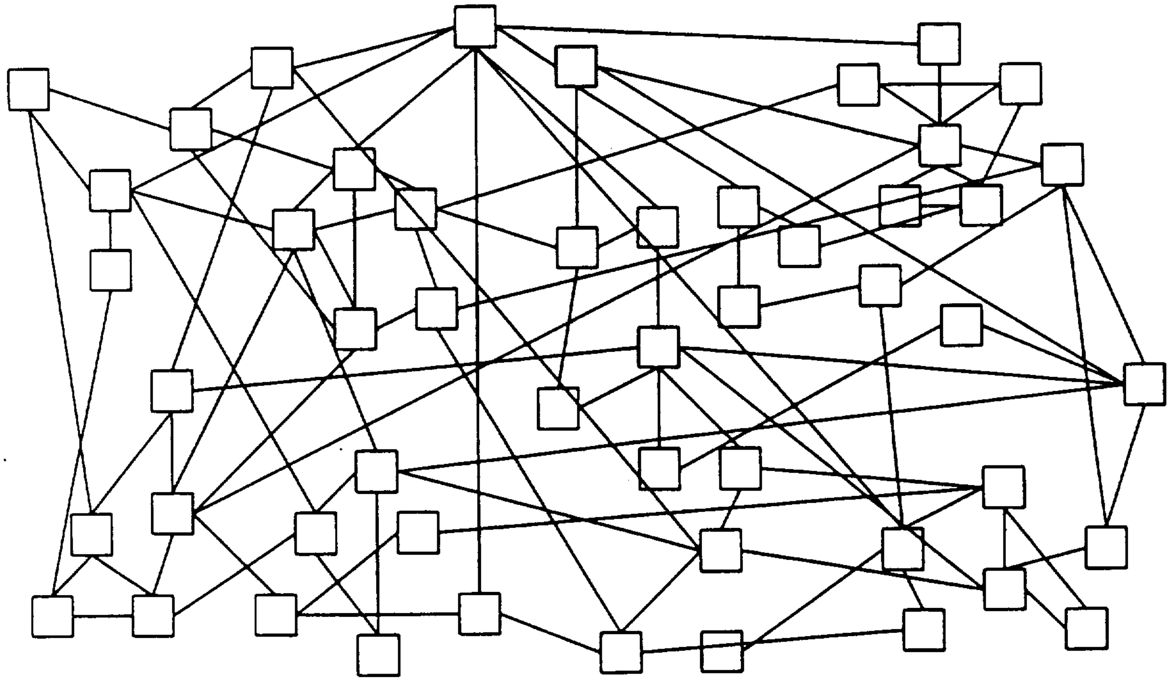
C Language:

Complexity assessment.

OO Design:

Class documentation.

HEAVENS - DISPLAY OVERLOAD



HEAVENS - INTELLIGENT DISPLAY

Logical "Reasoning"

Specifying complex operations.

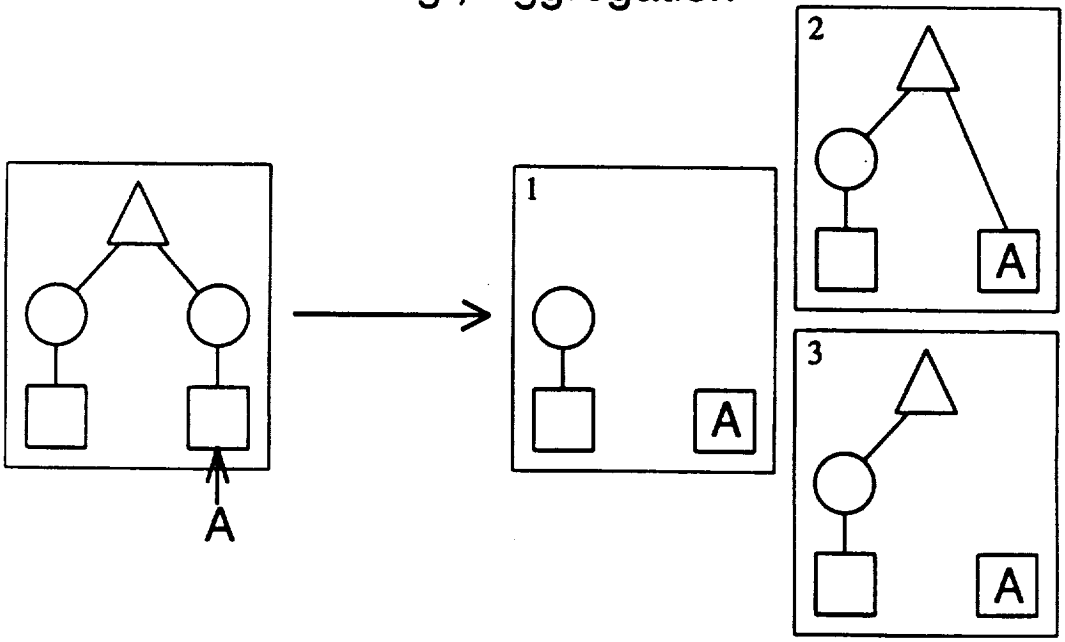
Query processing.

Deriving new nodes and links.

PGM
Bellcore
12/90

HEAVENS - INTELLIGENT DISPLAY

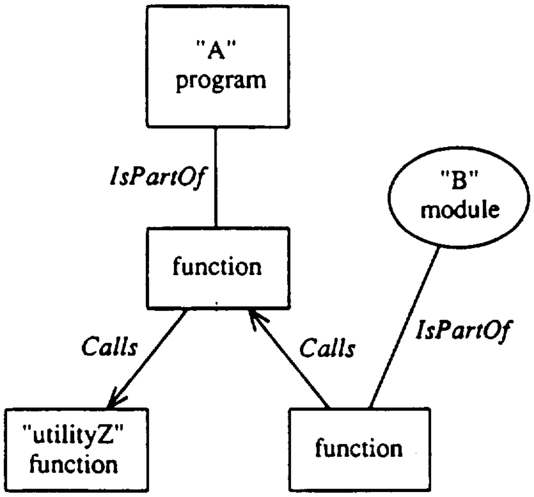
e.g., Aggregation



PGM
Bellcore
12/90

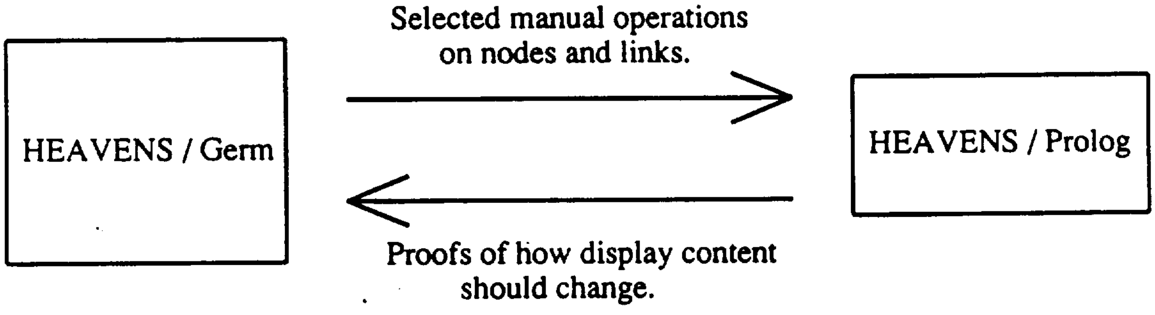
HEAVENS - INTELLIGENT DISPLAY

Pattern Query



HEAVENS - INTELLIGENT DISPLAY

Prolog Experiments



HEAVENS / Germ

Selected manual operations on nodes and links.

Proofs of how display content should change.

HEAVENS / Prolog

HEAVENS - SOFTWARE ARCHITECTURE

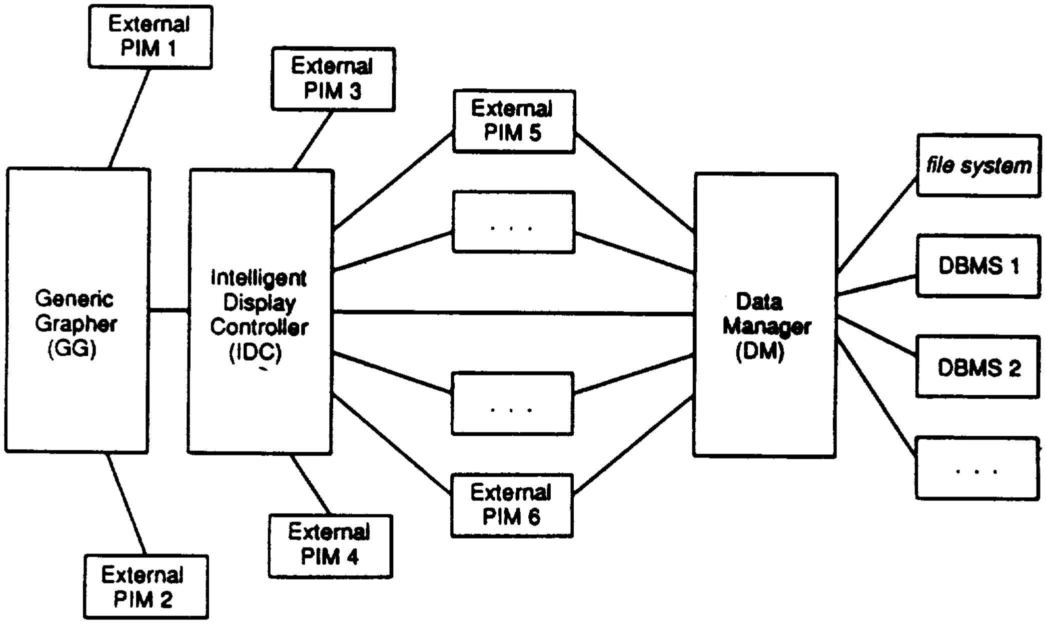
Drivers

Multiple hardware and software platforms.

Extending functionality.

Integration with other components.

HEAVENS - SOFTWARE ARCHITECTURE



HEAVENS - SUMMARY

Fine granularity.

Types.

Tool attachments.

Logical reasoning.

Architecture for extensibility.

HEAVENS - FUTURE

Busy Person Environment

Clients demand ever increasing productivity.

Software workers perform more diverse tasks.

Tasks require more complex information.

Doing it the (old) "right way" may not be humanly possible.

HEAVENS - FUTURE

Workstation for the Busy Person

Hot-spot identification.

Signal what is urgent.

Advice on resources.

Intelligent automation.

Collaboration support.

Panel: Three Issues for Real-World Hypertext Projects

David Gunning

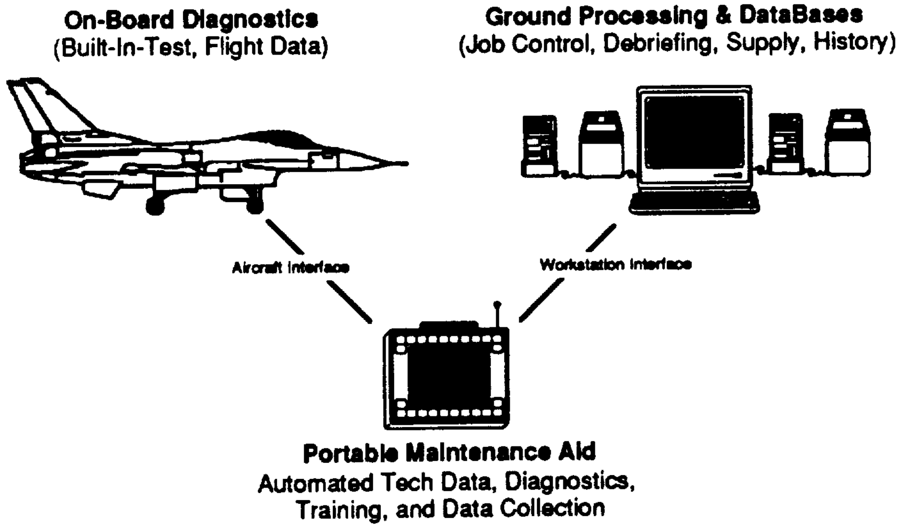
Human Resources Laboratory, Wright-Patterson AFB, OH

INTEGRATED MAINTENANCE INFORMATION SYSTEM

AIRFORCE SYSTEMS COMMAND

David Gunning
AFHRL/LRC
Wright-Patterson AFB, OH

IMIS - A CALS CONCEPT FOR MAINTENANCE



On-Board Diagnostics
(Built-In-Test, Flight Data)

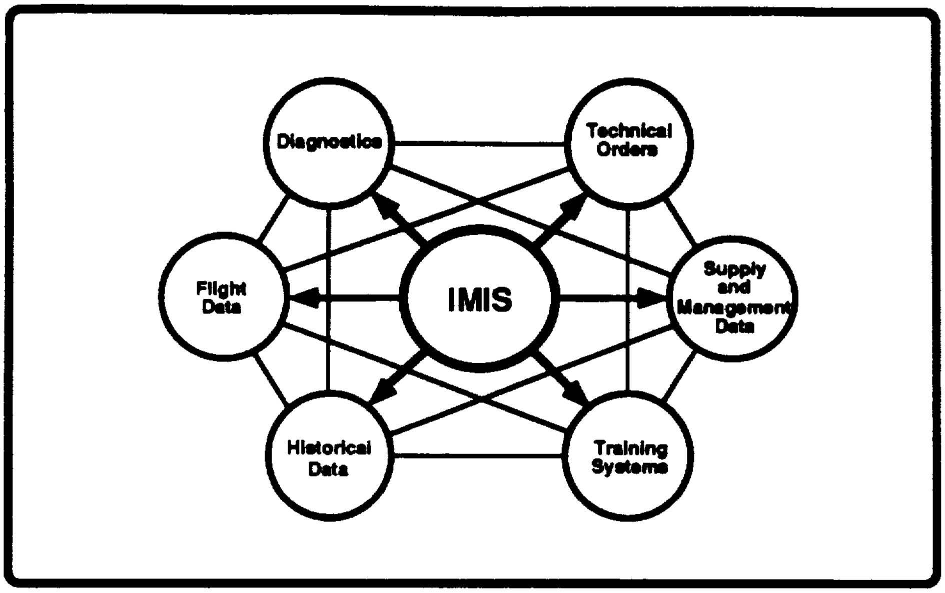
Ground Processing & DataBases
(Job Control, Debriefing, Supply, History)

Aircraft Interface

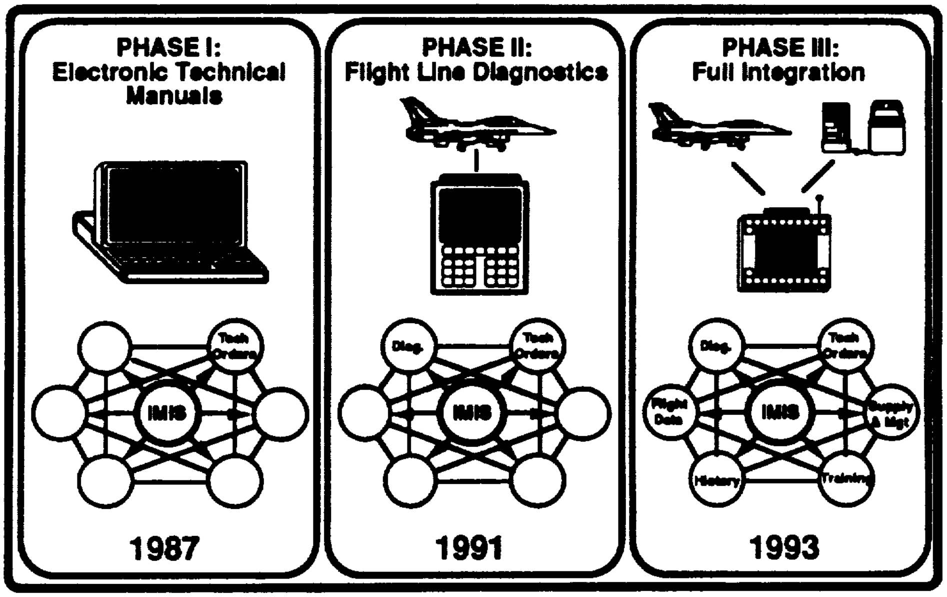
Workstation Interface

Portable Maintenance Aid
Automated Tech Data, Diagnostics,
Training, and Data Collection

INFORMATION INTEGRATION



PHASED APPROACH


PHASE I:
Electronic Technical Manuals

1987

PHASE II:
Flight Line Diagnostics

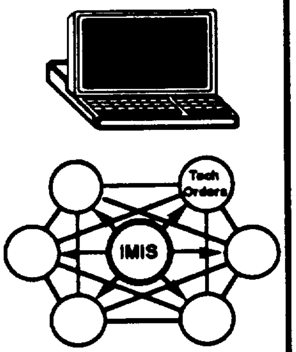
1991

PHASE III:
Full Integration

1993

IMIS PHASE I: ELECTRONIC PRESENTATION

PHASE I:
Electronic Technical Manuals

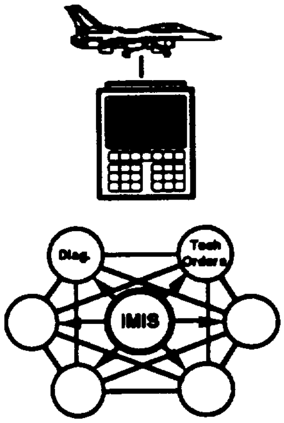


1987

- **Electronic Presentation System**
  - Off-The-Shelf Computer
  - Presentation Formats for Interactive Display
- **In-Shop Field Tests**
  - Initial Test at Offutt AFB 1984
  - Retest at Grissom AFB 1985
  - Independent Navy Test 1986
- **Performance Results**
  - 100% FI Success vs. 75% with Paper
  - Average Fault Isolation Time Halved
  - No False Removals
  - Technicians Preferred Electronic System

IMIS PHASE II: FLIGHT LINE DIAGNOSTICS

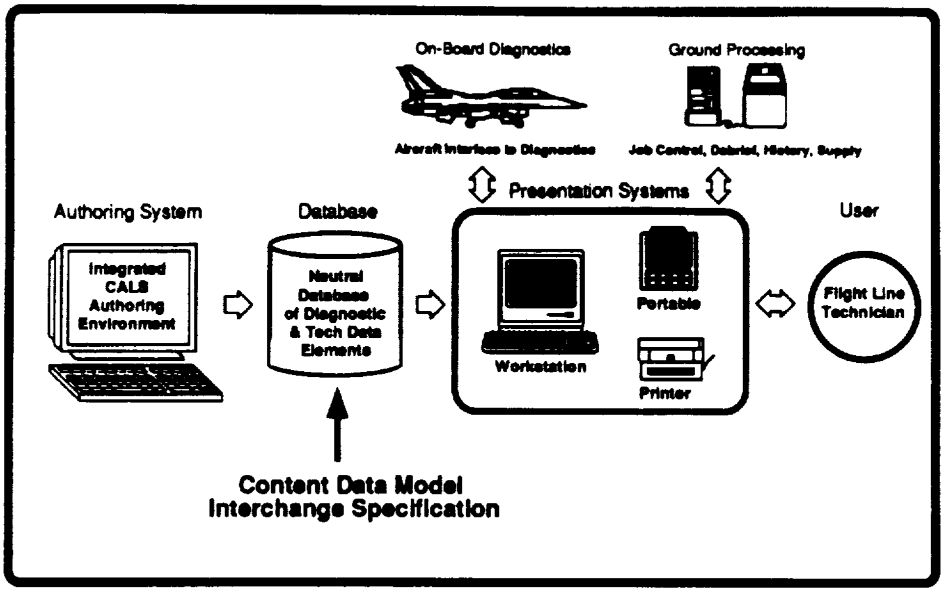
PHASE II:
Flight Line Diagnostics



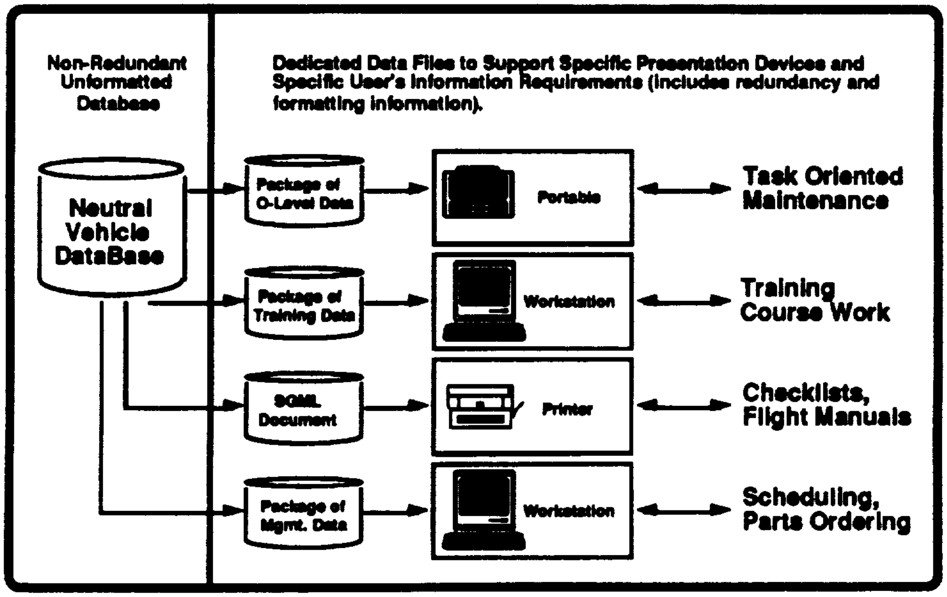
1991

- **Flight Line Diagnostic System**
  - Portable Maintenance Aid (PMA)
  - 1553 Aircraft Interface
  - Integrated Diagnostics / Tech Data Software
- **Authoring System for "Type C" Data**
- **Flight Line Field Tests**
  - Initial PMA Demo at MacDill AFB 1988
  - F-16 Test at Homestead AFB 1989
  - F/A-18 Test at Patuxent River 1991
  - F/A-18 Test at Cecil Field 1991
- **Content Data Model (CDM)**
- **Tri-Service Specification**

CONTENT DATA MODEL


On-Board Diagnostics
Ground Processing
Aircraft Interface to Diagnostics
Job Control, Debrief, History, Supply
Presentation Systems
Authoring System
Database
User
Integrated CALS Authoring Environment
Neutral Database of Diagnostic & Tech Data Elements
Portable
Workstation
Printer
Flight Line Technician
Content Data Model Interchange Specification

USING NEUTRAL, INTEGRATED DATA


Non-Redundant Unformatted Database
Dedicated Data Files to Support Specific Presentation Devices and Specific User's Information Requirements (includes redundancy and formatting information).
Neutral Vehicle DataBase
Package of O-Level Data
Portable
Task Oriented Maintenance
Package of Training Data
Workstation
Training Course Work
SGML Document
Printer
Checklists, Flight Manuals
Package of Mgmt. Data
Workstation
Scheduling, Parts Ordering

Interactive Electronic Technical Manuals (IETM) Specifications

- **General Content, Style, Format, and User Interaction**

  General specification of the technical content, writing style, display formatting, and user interaction requirements for an IETM system.

- **Revisable Data Base (Content Data Model)**

  Detailed specification of the data model (i.e., data entities, attributes, and relationships) required for a neutral database of IETM information.

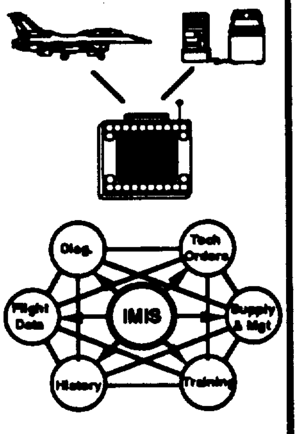
- **Quality Assurance**

  General specification of the quality assurance steps necessary for developing, validating, and verifying IETM data.

- **View Package Handbook**

IMIS PHASE III: FULL INTEGRATION

PHASE III:
Full Integration

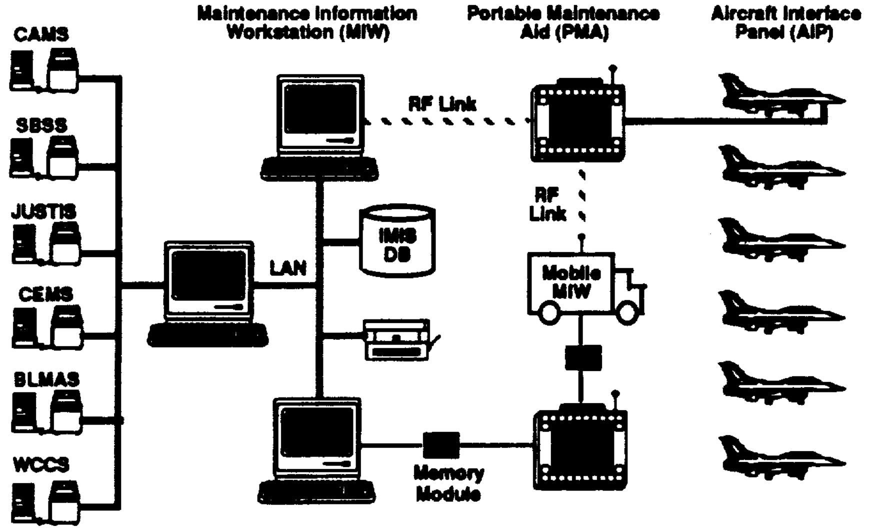


1993

- **Fully Integrated Information System**
  - PMAs + Maintenance Workstations
  - Interfaces with A/C, CAMS, SBSS, etc.
  - Information Integration Software
- **Detailed Requirements Analysis**
  - Activity Model of Maintenance Functions
  - Data Model of Information Elements
  - Computer Systems Architecture
- **Base-Level Field Test of IMIS Prototype**
- **Concept Applications Specifications**

Activity Model of O-Level Maintenance

IMIS ARCHITECTURE


CAMS
SBSS
JUSTIS
CEMS
BLMAS
WCCS
Maintenance Information Workstation (MIW)
Portable Maintenance Aid (PMA)
Aircraft Interface Panel (AIP)
RF Link
RF Link
IMIS DB
LAN
Mobile MIW
Memory Module

IMIS APPLICATIONS

- **Phase I: Electronic Technical Manuals**
  - B-2 Improved Technical Data System (ITDS)
- **Phase II: Interactive Diagnostics**
  - JSTARS Computerized Technical Order System (CTOS)
  - F-16 "Type C" Retrofit
  - Army Contact Test Set for the M-1 Tank
- **Phase III: Fully Integrated System**
  - ATF Integrated Maintenance System (AIMS)
  - A-12 Interactive Electronic Technical Manual System