ROSE
Introduction to the
U.S. Air Force Reuse Workshop
Agenda

• Who, What When Where, Why

• How

• The Goals

• Current Status

ROSE is a SOC Software Initiative
Who, What, When, Where, Why
Problem: MOD Software is Difficult to Use and Expensive to Sustain

Why

- Developed for an Environment which Placed a High Value on Machine Efficiency; Machine Dependent SW
- Software Sustaining was not Part of the Software Engineering Approach; Extremely Complex SW
- Vast Majority of the Software was Developed using an Ad hoc Software Engineering Process; Undocumented SW
- Software Reuse was not Part of The Software Engineering Approach; Redundant SW

Provide Safer Software That is More Resilient to Change
Solution: A Framework for MOD Domain Specific Reuse

ROSE Reengineering Will Address

Hardware Objects: Performance, Data Storage, Configuration, etc. as Opportunities Arise

Software Objects: Complexity, Maintainability, Reuseability, Consolidation, Portability, etc.

Process Objects: Software Life Cycle, Project Life Cycle, SW Ops etc.

Organization Objects: Efficiency, Skill Requirements, etc.

This Environment Requires an Infrastructure that Supports the Entire Software Engineering Life Cycle
ROSE Will Address Flight Design Software Systems First

The Reusable Objects Software Environment
is a Common, Consistent, Consolidated Implementation of Software Functionality Using Modern Object Oriented Software Engineering Including Designed-in Reuse and Adaptable Requirements

ROSE Emphasizes Consolidation And Reuse

Reduced Organization
Efficient Processes

Powerful Hardware
Robust CASE Tools

NAV, CSW, STAMPS Contributions

ROSE

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7/1/94
ROSE is a Community Effort

- **SOC** (Space Operations Contract)
  Project Management, System Engineering, Facilities Engineering, Domain Experts, Analysts, and Programmers

- **NASA** (Software Technology Branch and its contractors - INet & Lincom)
  CASE Support, Lab Support, Training, Technology Insertion

- **UHCL** (University of Houston Clear Lake)
  DMS Expertise, Lab Support, Training, Process Engineering

- **SPC** (Software Productivity Consortium)
  Evolutionary Spiral Process

**We are a Customer Driven and Process Oriented Team**
We Started in Dec '92

- **COST**
  - 10 EP for the Pilot
  - -140 EP for the Project
  - -$1.6 M Material Costs

- **Schedule**

- **Payback**

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Method

OOSE

PROBLEM SPACE (Real World Objects and Operations)

Minimize Abstraction

ABSTRACTION

SOLUTION SPACE (Abstract Semantics)

SOLUTION SPACE IN THE PROBLEM SPACE

Consolidate and Reuse

Atmosphere
Altitude: Real, Temp: Real, etc.
Compute Density, Pressure, Temp, Speed of Sound.

Inherits Pressure, Temp, Speed of Sound

Patrick
T0: Real,
RH01 Real
Compute Density

1962 Standard
T0: Real,
P1 Real
Compute Press

Fundamental Category
Gravity, Atmosphere, etc

Simulation Category
Asc 1st Stg, Orb Rndv, etc

Analysis Category
Monte Carlo, Entry Bndy, etc

Product Category
Iload CR's, Tgt Lines, etc

Consolidate and Reuse

Reduce Complexity

Structured

Data Structure Hierarchy

Class Hierarchy

Procedure Hierarchy

J. Rumbaugh - OO Model & Design

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How

ROSE Reengineering Evolutionary Spiral Process Model

The Project Process

Step 1: Define Approach

Step 2: Manage Risk

Step 3: Plan Development

Step 4: Develop Product

Step 5: Manage and Plan

Identify, Assess, Aversion Plans

Risk Aversion

Detailed Work Package Scheduling

Concept

Sys Req
SW Req

Arch, Design, Code

Test, Deploy

Lessons Learned

Metric Collection, Trend Analysis, & Reviews

Objectives
Constraints
Assumptions
Success Criteria

Estimate of the Situation

Assess

Step 2: Manage Risk

7/5/94
The Product Process

REVERSE ENGINEERING - SELECTED OBJECTS

ANALYZE CURRENT SYSTEMS ARCHITECTURE
- CALLING STRUCTURE

IDENTIFY PARTITIONS (OBJECT FUNCTIONALITY)
- STRUCTURE CHARTS
- DATA USAGE

REVERSE ENGINEER PARTITIONS
- Data Flow Diagrams
- Data Structure Diagrams
- REQUIREMENTS
- TEST DATA

Reengineering

OBJECT MODELING
- OBJECT DIAGRAMS
  - CLASSES
  - ATTRIBUTES
  - REQUIREMENTS

DYNAMIC MODELING

FUNCTIONAL MODELING
- STATE TRANSITION DIAGRAMS

OBJECT ORIENTED DESIGN
- OBJECT DIAGRAMS
  - CLASSES
  - ATTRIBUTES
  - OPERATIONS
- Data Flow Diagrams

OBJECT ORIENTED PROGRAMMING AND TESTING
- SYSTEM DESIGN
- LANGUAGE
- DBMS

OBJECT ORIENTED ANALYSIS

FORWARD ENGINEERING

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**The Goals**
Vision

A modernized MOD software environment that reduces the cost of maintenance and evolution for NASA’s legacy “man-rated” systems. This environment consists of reusable software objects and systems and a common maintenance process housed in a generic MOD architecture.
Evolve Our Engineering Technique To Reuse

- Traditional Technique
  - New Development
    - New Development CASE
  - Mods
    - Maintenance
      - Fix DR's
      - Upgrades
      - Maintenance CASE

- Modernization
  - Upgrade via New Development
    - Lift or Modify only

- Reuse Technique
  - New Development
    - Continues for R&D only

- Sustain
  - Corrective: Fix DR's
  - Adaptive: Change to meet user Needs
  - Perfective: Improve to new technology
    - Reuse Infrastructure
    - Continuous Process Improvement
    - CASE Reengineering
    - CASE Robust Off-line Sustaining Platform / Tools
    - Synthesis (Adaptive RQMTs)

- Other MOD Domains

- Leveraged Reuse

Reengineering to a Reuse Infrastructure is Cost Effective
Domain Specific Reuse
Domain Engineering: Leveraged Reuse and Synthesis

Reuse Infrastructure

- Appl Eng
- Prj Mgmt
- Rqmts
- Design
- Code
- Test
- Deliverables

Domain Analysis
- Domain Def
- Domain Spec

Appl Eng Process Support

Project Support

Domain Implementation

(SPC)
Trade Study

- Quantified Proof that I/F Spec between Application and Database engine is not only Feasible but Doable
  -- Allows delay of specific database engine selection and growth to higher technology

```
  APPLICATION
   /\ I/F SPECIFICATION
   |  /\ FLAT FILE I/F
   |   /\ OODBMS
   |  /\ RDBMS I/F
   |   /\ OODBMS
   |     FLAT FILE ROUTINES
   |     RDBMS ROUTINES
```

- Still Too Early to Identify Database Technology as an Opportunity for Improvement
- Continuing with review of other OODBMS's and Repeat of performance on target platform
**Planning Model Extended**

**Inputs**
- COCOMO Multipliers
- COCOMO Life Cycle Factors
- Planned Code Makeup
- Existing Code Makeup
- Uncertainties
- Distributions

**Processes**
- Project Costing
- Micro Schedule
- Macro Schedule

**Data Store**
- Data Base
- Raw Data

**Outputs**
- Plotted Data
- Raw Data

- Reengineering cost
- Transition cost
- Completion date
- DA2 Payback
- DM Payback
- Life Cycle Cost
- Maintenance Index

**Model Explicitly Deals with Uncertainty**
- Provides quantified uncertainty of SLOC, cost, schedule, and payback
- Identifies areas which are major contributors to uncertainty
  - focus metrics on sensitive areas
  - focus action on sensitive areas

*The Planning Model will be used Throughout the Project*
Planning Model Output

Preliminary M&M Reduction from ROSE vs. Budget Commitment

Delta Reengineering Cost-Maximum (percent)
(change based on maximum positive delta for input)

7/1/94
Return on Investment and Payback

ROI of ROSE Pilot

<table>
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<tr>
<th>Measure</th>
<th>( \alpha )</th>
<th>( \beta \text{ (App)} )</th>
<th>( \beta \text{ (ASC)} )</th>
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<td>88%</td>
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- Alpha Based on 36% of Rose SLOC mapped to Current FDD SLOC
- Beta Applications(App) are DOPS(realtime) and LandOPS(flight design)
- Detailed analysis available for review

Booked Payback

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# Current Plans

## DECISIONS

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## PILOT

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## DI - 3 / DI - 4

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- Project Approval: 10/1
- Adjustments: 7/1
- Project Continue: 10/1
- Start: 10/1
- Complete: 3/25
- Procurement: 2/15
- Concept & Sys Reqts: 3/11
- Domain Analysis: 7/29
- Domain Analysis & Application Concept Development: |
- Remaining Reusable Components: |
-Remaining Applications (including 6DOF): |

**Milestones:**
- FY94: ONDJFMAMJJAS
- FY95: ONDJFMAMJJAS
- FY96: OJAJ
- FY97: OJAJ
- FY98: OJAJ

**Dependencies:**
- Project Approval
- Adjustments
- Domain Analysis
- Application Concept Development
- Remaining Reusable Components
- Remaining Applications (including 6DOF)

**Scheduling:**
- 01/01/94: Project Approval
- 02/28/94: Alpha Complete
- 03/11/94: Train Complete
- 07/29/94: Domain Analysis
- 09/01/94: Remaining Reusable Components
- 10/01/94: Remaining Applications (including 6DOF)

**Notes:**
- Some Flight Mechanics and Some Numerical Analysis & Comm Reusable Components; Some 3DOF Orbit, Analysis & UIF Sim Applications
- Most Flight Mechanics, More Numerical Analysis & Comm Reusable Components; More Analysis Sim & UIF Apps

**Dates:**
- 7/5/94