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

Reusable Objects
Software Environment
(ROSE)

(NASA-CR-197017) REUSEABLE OBJECTS
SOFTWARE ENVIRONMENT (ROSE):
INTRODUCTION TO AIR FORCE SOFTWARE
REUSE WORKSHOP (Rockwell Space
Operations Co.) 24 p

Unclas
8/2/94

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Agenda

• Who, What When Where, Why

• How

• The Goals

• Current Status

ROSE is a SOC Software Initiative
Problem: MOD Software is difficult to use and expensive to sustain

- 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
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
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)
- **ABSTRACTION**
- **SOLUTION SPACE** (Abstract Semantics)

**Minimize Abstraction**

**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 Rndzv, etc

**Analysis Category**
- Monte Carlo, Entry Bndy, etc

**Product Category**
- Iload CR's, Tgt Lines, etc

**Structured**
- Data Structure Hierarchy
- Procedure Hierarchy
- Class Hierarchy

**Reduce Complexity**

G. Booch - SW Eng with Ada

J. Rumbaugh - OO Model & Design

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The Project Process

ROSE Reengineering Evolutionary Spiral Process Model

Step 1: Define Approach
Step 2: Manage Risk
Step 3: Plan Development
Step 4: Develop Product
Step 5: Manage and Plan

How

SOC
ROSE

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

OBJECT ORIENTED ANALYSIS

- OBJECT DIAGRAMS
  - CLASSES
  - ATTRIBUTES
  - REQUIREMENTS
- STATE TRANSITION DIAGRAMS
- OBJECT DIAGRAMS
  - CLASSES
  - ATTRIBUTES
  - OPERATIONS
  - Data Flow Diagrams

FORWARD ENGINEERING

- SYSTEM DESIGN
- LANGUAGE
- DBMS
**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

Modernization

Upgrade via New Development

Reuse Technique

New Development

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

ROSE Reengineering Method Leading to Reuse Infrastructure

Current Upgrade Method

Reengineering to a Reuse Infrastructure is Cost Effective
Domain Specific Reuse

Mechanics
\[ d(mv) = \Sigma F \]
\[ d(lw) = \Sigma T \]
\[ \psi(t, t_0) = F(t)\psi(t, t_0) \]
onboard software (ON&C)
vehicle hardware, path
atmosphere, etc.

Numerical Analysis
differentiation, integration,
estimation, optimization, Monte
Carlo, etc.

Communications
data management, graphical
user interfaces, interprocess
communications, etc.

ROSE Increment 1
ROSE Increment 2
ROSE Pilot
Nav
Nav Toolkit

Mission Operations Directorate

Specific Reuse - Application Domains

IPS
ROSE
FDD, TOAST, & MOCTrajectory

CCC
TBD

Application Domains

Problem Space

Where

SOC
ROSE

Doma[...]

-17-
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Domain Engineering: Leveraged Reuse and Synthesis

Reuse Infrastructure

Appl Eng
Prj Mgmt
Rqmts
Design
Code
Test
Deliverables

Domain Eng
Domain Mgmt
Domain Analysis
Domain Definition
Domain Spec

Appi Eng
Process Support
Project Support

Domain Implementation

(SPC)
• 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

- Diagram -

  APPLICATION

  I/F SPECIFICATION

  FLAT FILE I/F  RDBMS I/F

  FLAT FILE ROUTINES  RDBMS ROUTINES  OODBMS

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

**Outputs**
- Plotted Data
- Raw Data

**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)

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## Return on Investment and Payback

### ROI of ROSE Pilot

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<tr>
<th>Measure</th>
<th>$\alpha$</th>
<th>$\beta_{(App)}$</th>
<th>$\beta_{(ASC)}$</th>
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<td>% SLOC Reduction</td>
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<td>11%</td>
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<td>% Complexity Reduction</td>
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<td>87%</td>
<td>86%</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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- Decisions: ◇
- Milestones: △
- Dependencies: ○