Component Oriented Software Development
A new Approach and a Case Study

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Contents
• Component Orientation
• COSEML and UML
• A Case Study
• Evaluation and Metrics
• Conclusions

Introduction
• Unified Modeling Language: UML (OO)
• Component-Oriented Software Engineering Modeling Language: COSEML (CO)
• A case study including 20 student projects
• 3 group of metrics to evaluate process and product

UML
• Abbreviation for Unified Modeling Language
• Object Oriented Modeling, heavily based on classes, inheritance, and messages
• Defines 9 types of diagrams to represent various modeling viewpoints:
  – Use Case Diagrams
  – Class Diagrams
  – Sequence Diagrams
  – Collaboration Diagrams
  – Object Diagrams
  – Activity Diagrams
  – Statechart Diagrams
  – Component Diagrams
  – Deployment Diagrams

COSEML
• Supports Component Oriented Development
• Primary view is the structural decomposition
• Representation of abstractions as well as implementation-level components
• Static (composition) and dynamic modeling (message) links
• Decomposition view supported with UML syntax
• Yet experimental

Component-Based versus Component-Oriented
• The system that are not fully object-oriented but that consist of objects are called object-based.
• Similarly, systems that are not fully component-oriented but consist of components are called component-based.
A New Paradigm

- Build by Integration vs. code writing
- Issues
  - Locating the components
  - Integration
  - Hard Engineering disciplines discovered earlier

Graphical Symbols in COSEML
Abstract Modeling of a Small Business in COSE

Corresponding Abstractions to Components in COSE

Detailed Modeling Through Components in COSE

A Case Study
- 20 projects
- UML and COSEML designs for each project
- Groups of 1-2 senior undergraduate students
- Students having a little O-O background and no UML or COSEML experience
- Two metrics forms

Project Titles
- Factory Automation System
- Inventory System for Small Business
- Component-Based Case Tool
- THBT Member Tracing
- Hospital Management Automation
- Data Warehouse Office Automation
- Travel Agency Automation
- Hospital Automation System
- Automile Stability Control System
- E-Commerce for Selling Mobile Phones
**Project Titles (Contd.)**

- Human Resources System
- Component-Based Case Tool
- Modeling of Dormitory Management System
- General E-Commerce
- Robot Pet Karabash
- Pharmacy Automation System
- Seat Reservation System for Laboratory Environments
- A Web-Based Application for a Multi-national Company
- Web-Based Teaching
- Computer Center Library Automation

**Process Metrics**

- Total development, modification, and correction efforts:
  - Effort: Person-hours spent for the development of a design model
  - Modification: Effort when any part of a design is revisited
  - Correction: Effort for revisions after the completion of the design

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**Process Metrics Results: Effort**

<table>
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<tr>
<th></th>
<th>Total</th>
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Success Comparison based on Statistics

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**Process Metrics Results: Modification**

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Success Comparison based on Statistics

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**Process Metrics Results: Correction**

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Success Comparison based on Statistics

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**Subjective Evaluation**

Two subjective evaluations:

1. **EASE**: It was easy to model your problem using UML/COSEML.
2. **Understandability**: Your model is an understandable representation of the problem.
Process Metrics Results: Ease

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<tr>
<td>Percentage (%)</td>
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Success Comparison based on Statistics

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Process Metrics Results: Understandability

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<td>Percentage (%)</td>
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Success Comparison based on Statistics

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<tbody>
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<tr>
<td>COSEML</td>
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Product Metrics

- Also called Model-Complexity Metrics
- Different for UML and COSEML
- Cannot be directly compared. Needs different strategies. Results left out of thesis.

Conclusions

- For the small projects involved, COSEML did not display a remarkable drawback,
- Further case studies are required, especially to be carried out by more experienced developers.

Similar Case Studies in the Field

- No similar case studies for component-software
  Compared:
  - Jackson program design
  - Object-oriented design
  - Functional decomposition.
  Used metrics to evaluate solution completeness, time to design and code, and model complexity.

Product Metrics for Object-Oriented Models

- Number of Classes
- Number of Objects
- Number of Subsystems
- Number of Methods per Class
- Maximum Depth
- Maximum Width
- Number of Compositions
- Number of Inheritances
Product Metrics for Component-Oriented Models

- Number of Boxes
- Number of Event Links
- Number of Method Links
- Number of Methods per Component
- Number of Interfaces per Component
- Number of Methods per Interface
- Number of Subsystems
- Maximum Depth
- Maximum Width

Effort Values for each Project

Ease Grades for each Project

Understandability Grades for each Project

EASE Grade Counts for UML and COSEML

Understandability Grade Counts for UML and COSEML