

CALS/EC Korea '98

## **Project Management for Distributed Engineering Collaboration**

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### **Contents**

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- Issues of Project Coordination for Distributed Engineering Collaboration
- Vision for PM for Distributed Engineering Collaboration
- Global Open PM System
- Summary and Final Remarks

## Distributed Engineering Environment

- Projects/Subprojects/Tasks Distributed over Teams, Departments, Enterprises and the Globe
- Virtual Teaming/Enterprises
- Limitations/Barriers on Distributed Work
  - Geographical
  - Communication
  - Information/Data
  - Heterogeneous Work/System Environment
  - Heterogeneous Work Practices/Management Rules
  - Organizational/Functional Boundaries/Responsibilities
  - Resources

## Works on Collaborative Engineering

- "Distributed Virtual Engineering", <http://dream1.leeds.ac.uk>
  - University of Leeds; Integrating Information by PDM, Sharing Information by STEP
- "SHARE project"; <http://cdr.stanford.edu/SHARE/share.html>
  - Stanford; a Methodology and Environment based on Agent Technologies
- "VWS" (Virtual Workspace System), <http://www.cecer.army.mil/pl/vws/vws.htm>
  - agent technology for Communication, Constraints Propagation, Conflict Detection, Negotiation, Updates of Data Changes
- "MATES" (Multimedia Assisted Distributed Tele-Engineering Services), <http://mates.cdi.luth.se/>
  - ESPRIT 20596; communication and data exchange with others

## Issues in Engineering Collaboration

- Engineering Task Evolution, Delayed Specification/Design
- Continual Engineering/Task Changes
  - Impact, Conflicts
  - Responsibilities
- Conflicts and Constraints on Engineering Tasks
- Communication and Coordination among Engineers
  
- Geographical/Organizational Limitations
  
- Challenges
  - Communication/Coordination
  - Change Control

## Approaches for Project Coordination

- CoMo-Kit, Change Control based on Task Dependency Models and Agents
  - Maurer, U. of Kaiserslauten
- Change Control based on Knowledge Network (Network of Constraints) and Rule-based Coordinator
  - Gupta, Chionglo, and Fox, U. of Toronto
- Project Coordination in Multi-Agent Architecture
  - Brazier, Jonker, and Treur, Vrije Universiteit Amsterdam
- Procura, Agent-based Coordination/Change Control
  - Goldmann, U. of Kaiserslauten

## Critical Issues

- Can we robustly model fuzzy, complicated constraints on engineering tasks and their relationships in complicated real engineering/design projects?
- Who can define and manage the comprehensive constraints and relationships?
- Can the control/decision for engineering changes be reliably automated?
- Are agents so mighty?
- Engineering Knowledge is not so:
  - simple
  - systematic
  - explicit

## What do we really need and what can we do?

For change control and communication/coordination for real engineering collaboration

Help Engineers for Communication, Information Sharing, Coherent/Consistent Task/Work Information, and Discussion/Coordination. Some Addressed by:

- PDM
- Workflow
- Configuration Management
- Mailing/Communication Systems

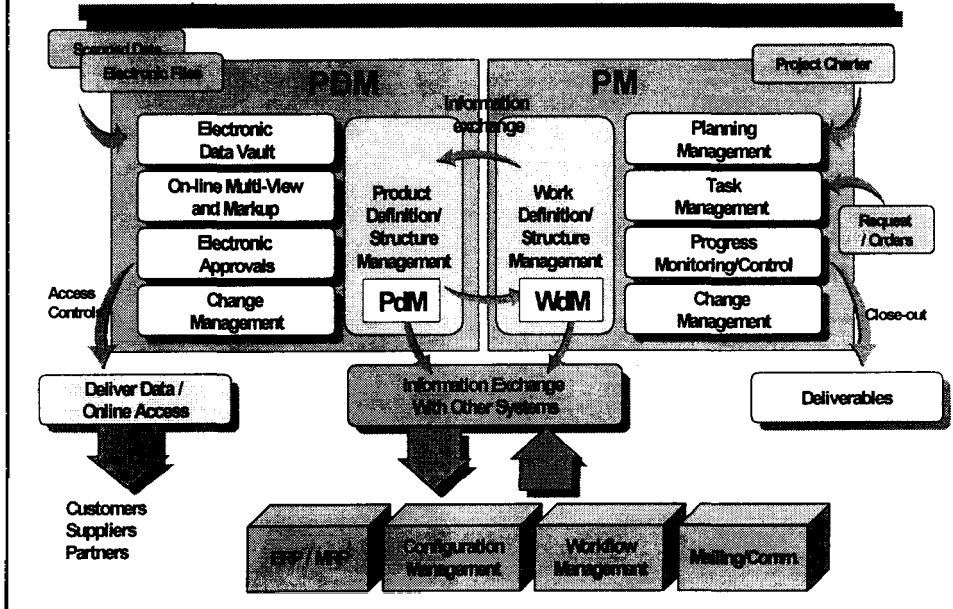
Effectively Thread Engineering Tasks into Project Management Disciplines

- Works, Schedule, Budget/Cost, Resource, Quality

## Our Strategies for Project Coordination

- Not Automated Change Control
    - Not Completely Rely on "Mighty Agents"
  - Not Completely Model Constraints and Dependency between Product Structures/Engineering Decisions/Design Tasks
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- Communication and Task Coordination based on Integrated, Transparent Work/Task Data Model/DB
  - Integrate Engineering Tasks to PMS through the DB
  - Integrate with other Engineering Applications
    - PDM/EDM, Configuration Management, Workflow, Mailing/Communication Systems

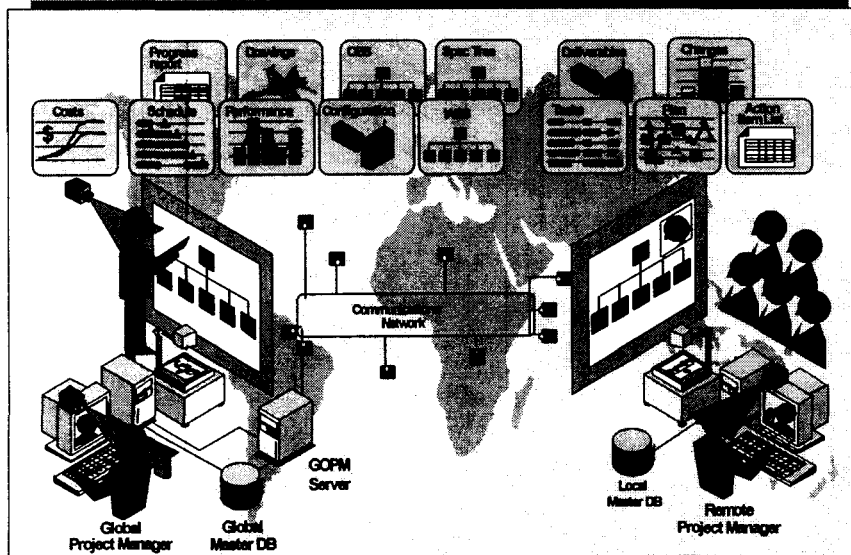
## Vision for Integrated Collaborative Engineering



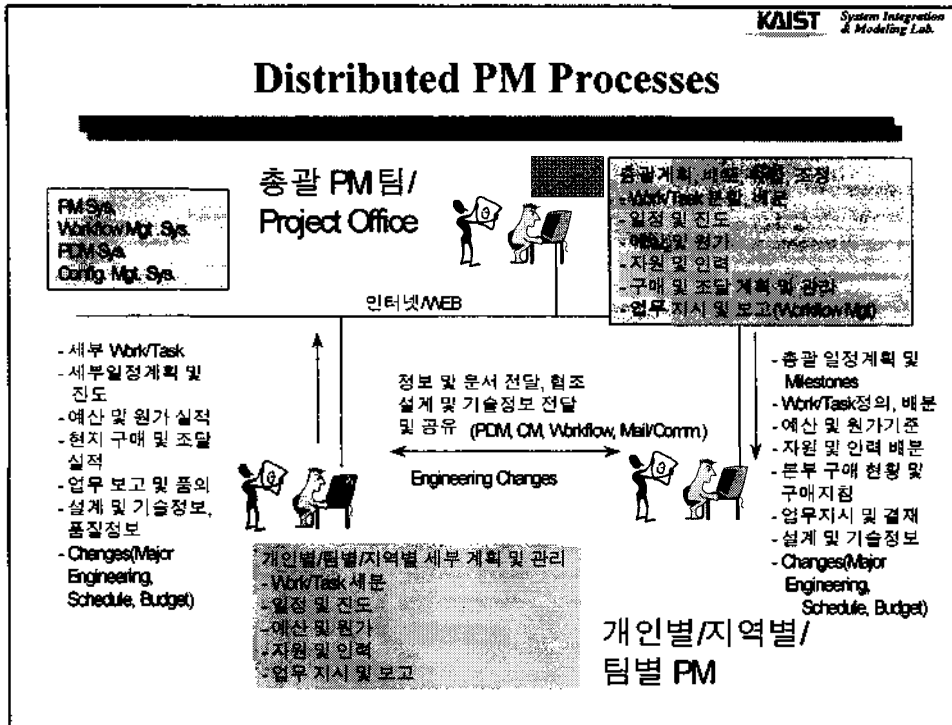
## Distributed Project Management

- To achieve Engineering Goals
  - Engineering Requirements/Specifications/Constraints
  - Schedule
  - Cost/Resource
  - Quality
  
- by Managing and Coordinating Teams/Engineers Distributed across Departments/Enterprises
  
- by Threading Engineering Tasks/Engineers into PM Disciplines
  - Works, Schedule, Budget/Cost, Resource, Quality
  - Task Management

## Vision for Distributed, Integrated PM: Global Open PM (GOPM)



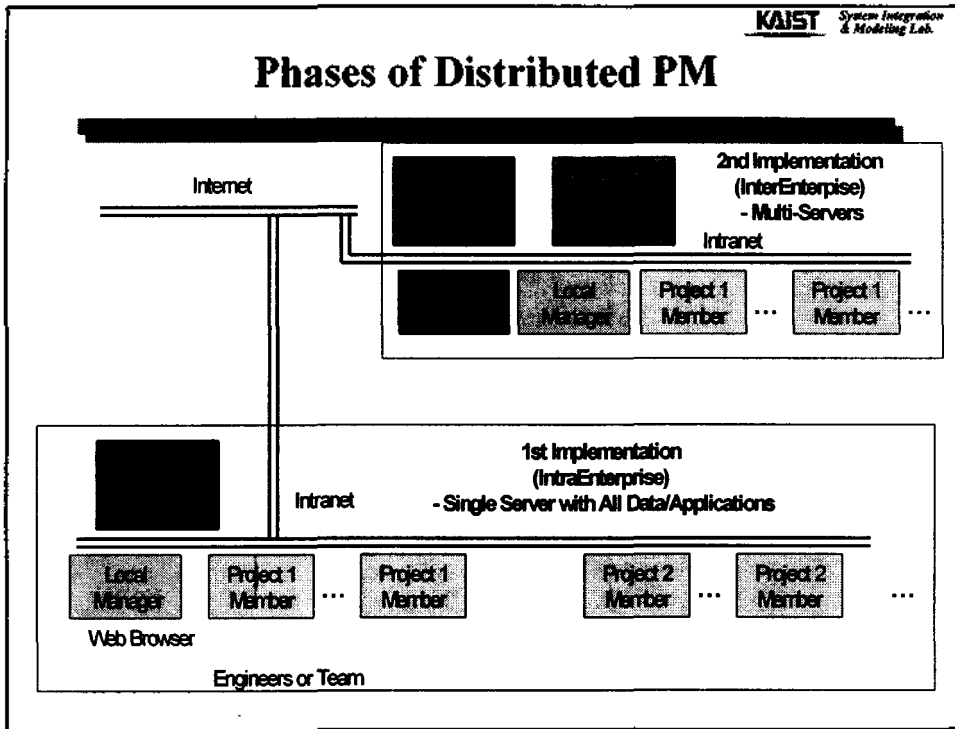
## Distributed PM Processes



## Target Functionalities for GOPM

- **Information Sharing/Communication**
  - Engineering Information/Document, Works/Tasks, Schedule, Organization/Teams, Budget/Cost
- **Coordination**
  - Works/Tasks, Schedule/Budget, Engineering Spec.
- **Change Management**
  - Engineering Information/Document, Works/Tasks, Schedule, Organization/Teams, Budget/Cost
  - Change History, Configuration Control
- **Task Management Functions - Teams/Persons**
  - Messaging/Mail, Document Control, Schedule/Cost Control
- **Data/Processes Integration with**
  - PDM Systems/Document Management Systems (for Information Sharing)
  - Workflow Control System (for Task Management)

## Phases of Distributed PM



## PMS Benchmarking/Review

- Reviewed**
  - OpenPlan, Primavera, IntraPlan, ActionPlan, AutoPlan, WebProject, MS Project98, SAP Project System
- PM Functions/Processes**
  - Focused on Planning, Tracking, Cost/Performance, Task Mgt.
  - Tends to be Distributed
- Integration with PDM**
  - Weak in WBS Mangement and Change Control
  - Not Sharing Information and Process Integration with PDM/PdM
  - Tends to be integrated with ERP (SAP Project System, AutoPlan)
- SW Implementation**
  - No Interoperability, Not CORBA-based
  - Tends to have Client/Server Architectue based on Java
  - Commercial PMS Class/Components
    - EnterpriseSoft (Java), IntraPlan (Java), AutoPlan (C++)

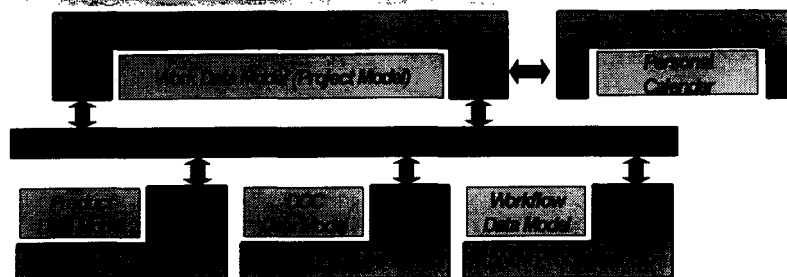


## Functional Strategies for Design of GOPMS

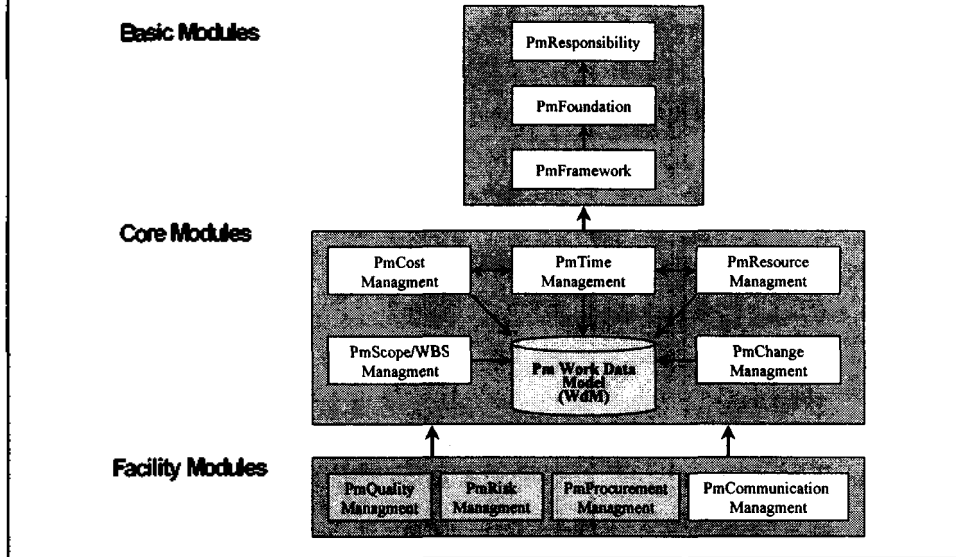
- Work Data Model-based PMS
  - PdM-based PDM, WDM - PDM
- Coherent Work/Data Structure with PdM
  - Consistent with CORBA-based PDM Enabler's Specification
    - Change Control, Various CORBA Facilities
    - Object Data Models
- Process Reference Models for Distributed PM
- Task Management
  - Communication between teams/Departments/PM/Enterprises
  - Personal Calender, Hypermail/StoryBoard (?)

## Architectural Strategies for GOPMS

- ~~Work Data Model-based PMS~~
  - ~~Integratable Data Model (Work, Schedule, Budget/Cost)~~
  - ~~Object-oriented WDM (Work Data Model)~~
  - ~~Structure Consistent with PdM (Product Data Model) of PDM Enabler Spec. 3.0~~
  - ~~CORBA-based Object Interface Model~~
  - ~~Integrate PM Processes based on WDM~~
  - ~~Prepared for Change Control and Change History Management~~
- Aimed at Smooth Integration with PdM/PDM, EDM and Workflow

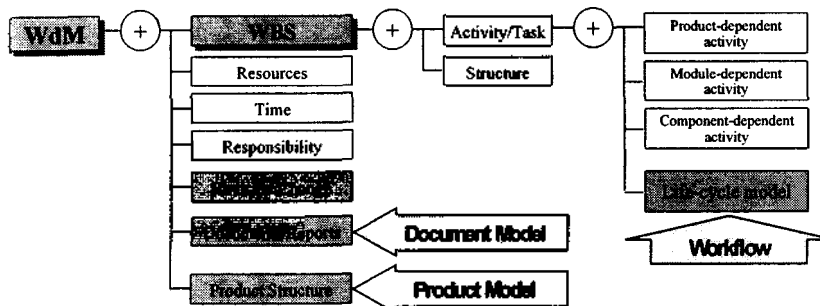


## GOPMS Application Architecture

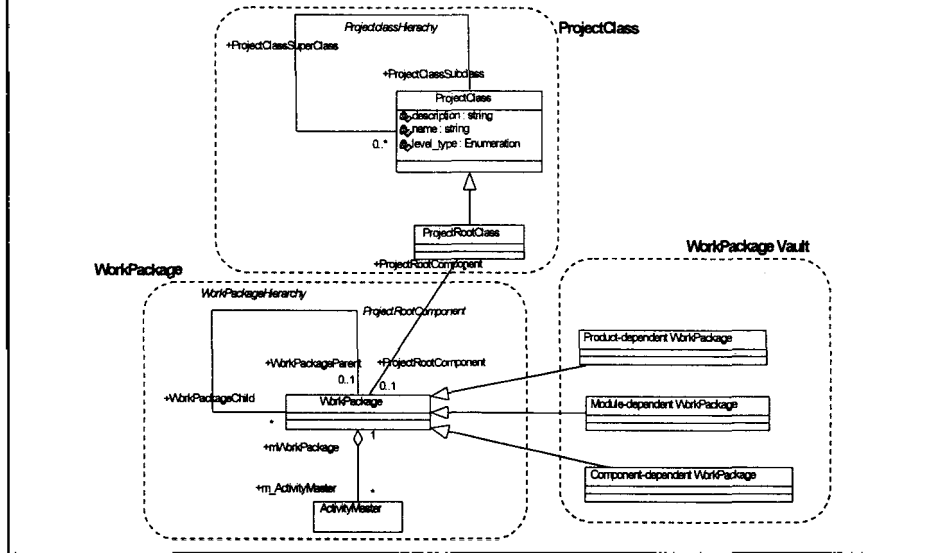


## Integrated WdM (Work Data Model)

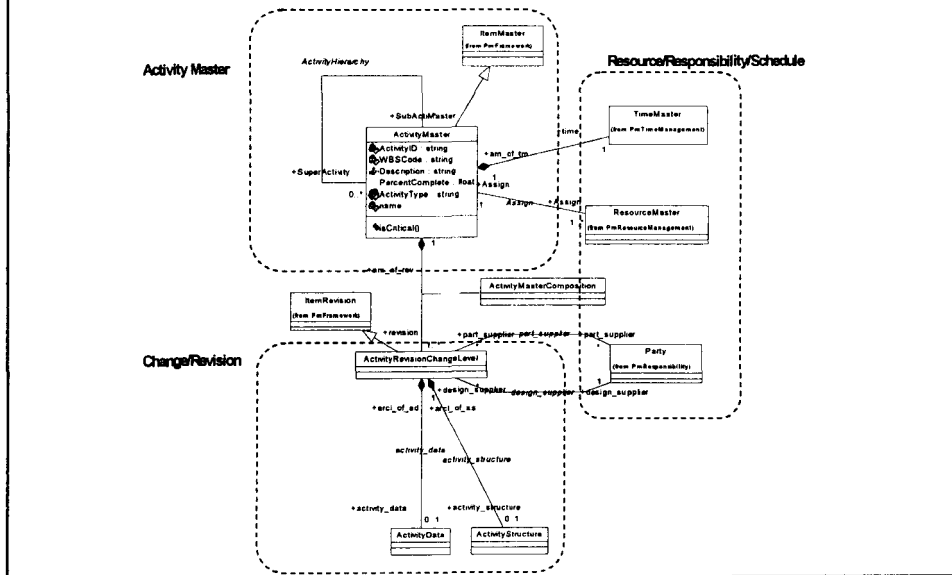
- Core data structure for PM
- Integrated data model (Extension of WBS)
- Relating to product model and document model
- Activity life-cycle model relating to workflow
- Consider change/revision of project plan



# WdM (Work Data Model) - Multi-Project Classification



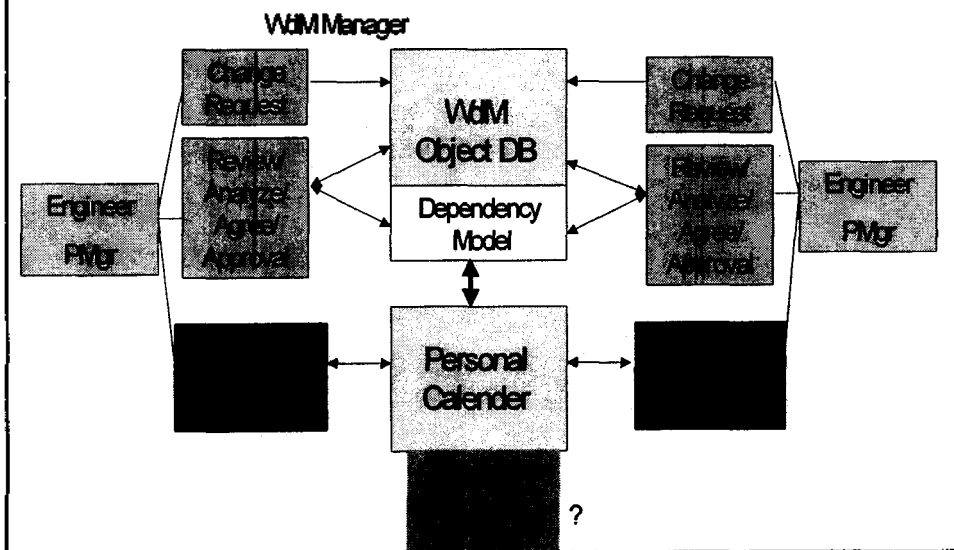
# WdM (Work Data Model) - Activity Structure



## Change Control - Communication/Coordination

- Engineering Changes from PDM
  - Notification to Engineers
    - Personal Calendar/Task Management
  - Manual Changes in WdM
  
- WdM Design for Changes/Revisions/History
  
- Support Engineers to Review/Analyze Changes and their Impacts
  - WdM Work Manager, Advanced Query
  - WdM Work Dependency Models
    - Object Links/Associations

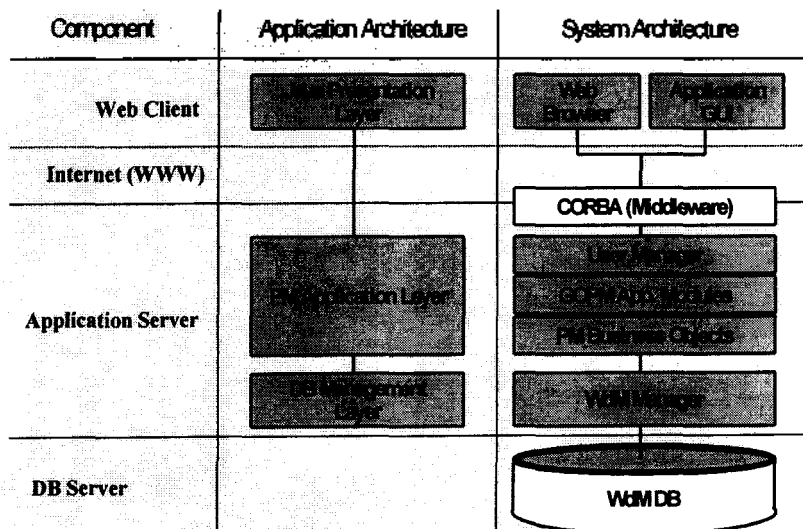
## Project Communication & Coordination



## Technical Specification of GOPMS

- Integrated W3M (RDB-Oracle → ODB - ObjectStore)
- CORBA-based Object Interface (VisiBroker)
- Full Java Implementation, Java applet / application (JBuilder, Enterprise Server)
- Universal User Interface (WEB Browser)
- Use Basic Java Components for PM

## System Architecture



## Application Layer

- customized middle-ware engine, available to all users through http web server
- User Manager
  - user authority check, coordination/consolidation
  - connection / transaction management
- GOPM Application Modules
  - WdM Manager, Project Scheduler, Cost/Budget Analyzer, Report/Writer, Resource Scheduler, Calendar, Change Manager, Communication/Notification System
  - Quality Manager, Procurement Manager, Risk Manager
- GOPM Business Objects
  - Responsibility, Person, Resource, Activity, Artifact,
  - Time, ItemMaster, ItemRevision ...
- CORBA IDL
  - implementation skeleton/client stub

## Current Implementation

- Prototype
- Single Server Architecture → Multi-Server
- WdM Model
  - Object Model
  - RDB-based Implementation → ODB-based
    - Extensive Association between Objects, WdM Manager
- Basic FM Processes
  - Work, Schedule/Progress, Organization, Task Management by Personal Calendar
  - Need Change Control, Budget/Cost, Scheduling Algorithms

## Future Directions

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- Process Models for DPM - Change Control and Communication
- Change Management
  - Adapt Configuration Control for PDM to WDM
  - Work Dependency Models -- Object Models
  - Decision Support, WDM Manager
- Task Management by Mail/Communication/Conference
  - Personal Calender + HyperMail/Storyboard/Mrphone (?)
- Integration/Relationships with PDM, EDM and Workflow
  - Requirements, Models

## Conclusion

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**An Integrated  
Work Data Model  
is the Key.**