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Product Line Engineering for Global Development

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Background

- What can we do better to get products faster to the global market?
  - What software engineering technologies & processes can we apply?
    - Technical Approach – Requirements Engineering, Requirements Patterns, Domain Modeling, Business Object Modeling, Model Analysis Tools, Product Line Engineering, Software Architecture
  - What software management techniques can we apply?
    - Management Approach – Global Development, Agile Team Processes, Rapid Application Development
- How do we integrate products acquired from multiple divisions distributed around the world with local market requirements?
- How could we reduce overall development costs by exploiting local labor rates?

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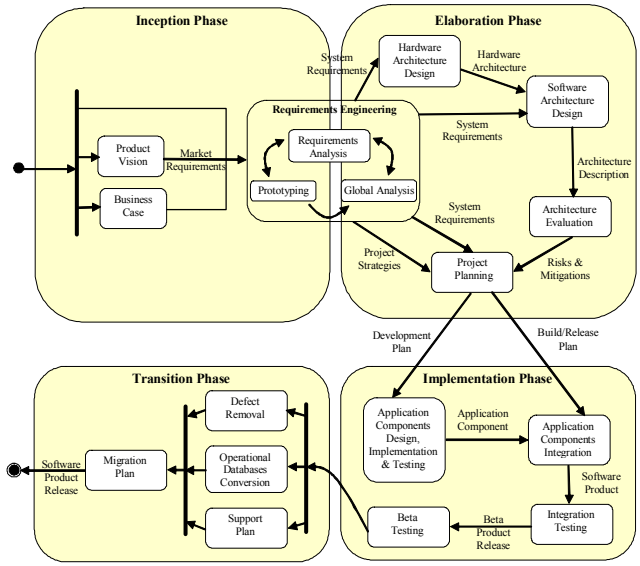
MD.RAD



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A Global Development Approach

1. Model the combined product line requirements using best practices and drive all aspects of the product line solution development from the model (requirements engineering).
2. Design standard common data models and a component-based architecture framework that will help enable integration (software architecture).
3. Optimize the organization of product solution development (global development) for best time-to-market.
   - Component-based Product Line Architecture implementation
   - Central product line management
   - Efficient synchronized, incremental distributed development using multiple product development sites

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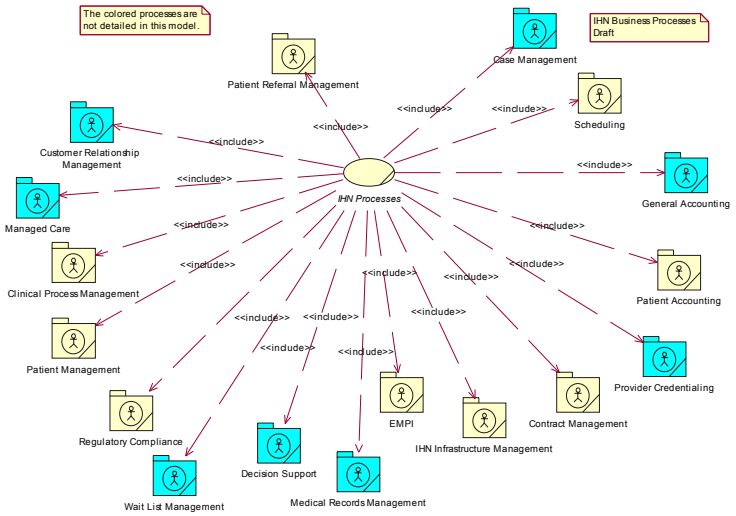
1. Develop a Business Object Model to Describe Product Line Requirements



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Benefits of Business Object Modeling (compared to Word-based Use Cases)

- Single, electronically verifiable model with multiple views
- Semiautomatic extraction of requirements, test plans, and project tasks
- Components can be identified by visual inspection.
- Cross-cutting concerns can be identified by inspection or by electronic analysis.
- Easier to partition work for parallel effort
- Accelerates design by giving the architects and designers something they can transform rather than several hundred pages of text they need to read.

"CHAOS research confirms that small projects are more likely to succeed than large projects. As project costs rise, typically through the additions of features and functions that are never or rarely used, the likelihood of success fails." *CHAOS: A Recipe for Success*, Standish Group, 1999.

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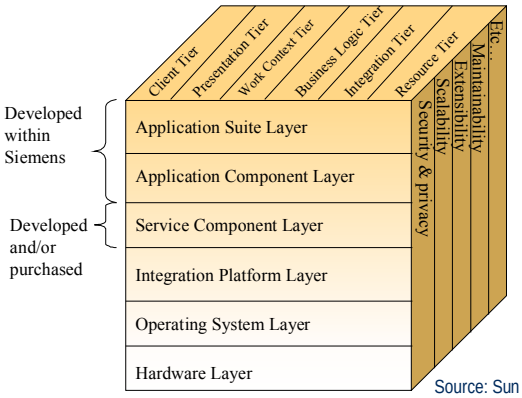
2. Component-based Architecture Framework



Source: Sun Microsystems
http://www.sun.com/executives/sunjournal/v5n1/feature2.html

- Components should be small (<100 KLOCs, <50 features).
- Buy rather than build bottom four layers.
- Software "renovation" rather than "migration" (20% of code is replaced every year).
- Implement "vertical slice" to validate architecture.

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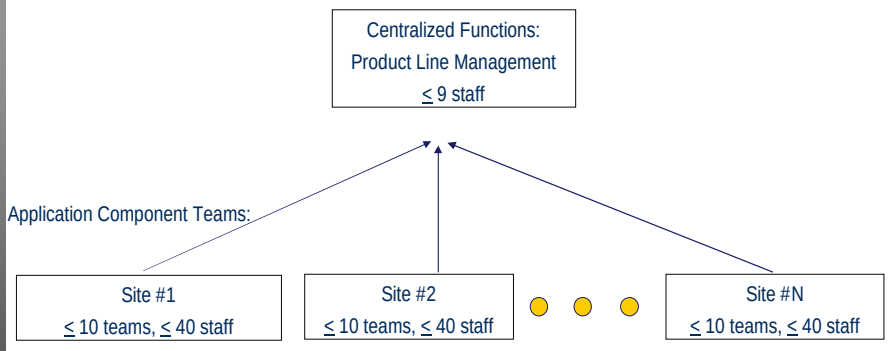
3. Example Global Development Organization – *synchronous*, incremental distributed development



≤ 30 synchronous component development teams located around the world coordinated by the centralized team.
≤ 40 staff at any single development site.
Individual small teams (≤ 10 staff) communicate with centralized functions,
but not with other component teams at other sites.

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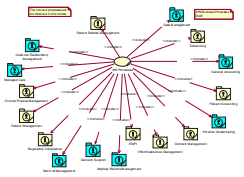
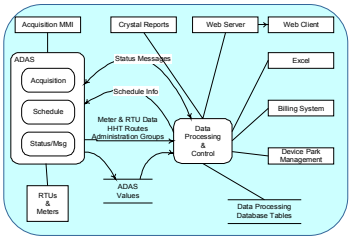
Centralized Functions
Product Line Management

Component Development

Requirements Engineering



User Interface Design



Architecture Design

System Integration & Validation

Quality Assurance

Project Planning

Schedule Maker	ER1	ER2	ER3	R1	R2+
Search Consumer Tree for Scheduled Events	√			√	
Create a Schedule	√			√	
Handle Report Events				√	
Handle Acquisition Events		√		√	
Optimize Acquisitions					√
Handle set Parameter Scheduled Events		√		√	
Display and manual Update of Schedules			√	√	

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Remote Development Functions

Application Component Development teams are given:

- Part of business model to implement
- Architecture description
- Acceptance tests
- Incremental development plan and integration dates
- Component interface specifications
- Vertical slice implementation
- UI Style Guide

Development Team Roles:

- Project Leader
- Subject Matter Expert

} Experts at each development site

- Architect
- Developer
- QA/Component Testing

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Success Factors – Global Development

- Machine-analyzable, visual requirements model; centrally managed
- Centrally designed and enforced architecture framework
- Requirements are decomposed and mapped to small software components within the architecture before commissioning the small distributed teams.
- Agile processes are used within small component development teams.
- Centralized incremental integration planning
- Vertical slice model implementation
- Daily synchronized communications.

Experimental Global Studio Project

- **Experimentally apply the Siemens global software development process (MD.RAD) using students in Europe, India, and the U.S. to develop some components of a Siemens product line.**
- **Harvard Business School helps us define the experiments, observes the distributed development, and documents as a case study.**

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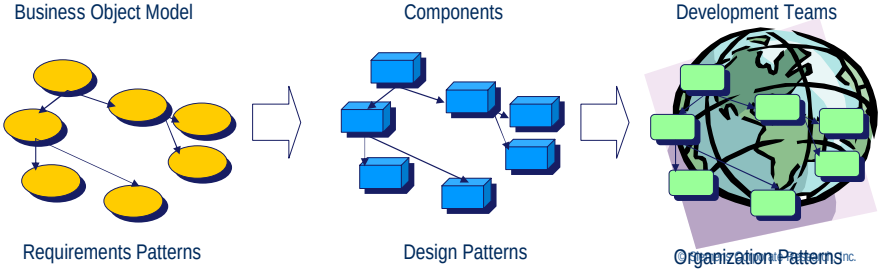
IIIT BANGALORE

Business Object Model | Components | Development Teams



Requirements Patterns | Design Patterns | Organization Patterns

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Research Questions

1. Given that the technical artifacts that are delivered to the remote component development teams are not adequate in specifying the precise work to be done, in what ways are they deficient?

2. What strategies do the remote teams employ (and to what effect) to compensate for the deficiencies found in the received technical artifacts?

3. What are the early warning signs that an issue is imminent? Can communication patterns, for example, between the central and remote teams be used to predict future component integration problems?

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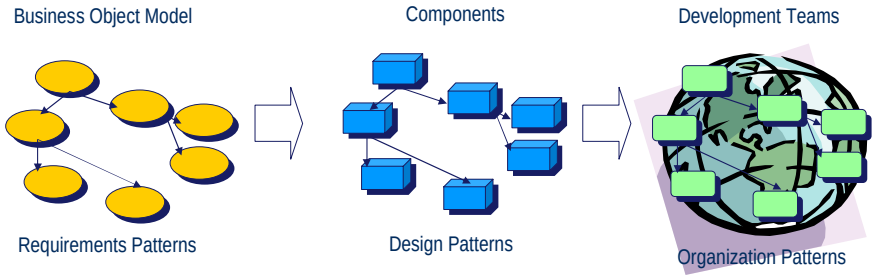
Model-Driven Team Organization



- Hierarchy of business object model = framework of components = distribution of teams.
- Each development team does the following:
  - Develops one component (10-100 KLOC)
  - Supports its own QA
  - Specifies requirements and writes tests for their components (test-first development)
  - Performs acceptance testing on subcomponents
- Small central organization supports use case capture, component libraries, integration and validation testing.
- No single development organization should consist of more than 10 teams or 100 people.

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