Consistency management

- Motivation for consistency management
- Change propagation and response graphs (CPRG)
- Change descriptions
- Frameworks for change management

Gray, J. and Reuter, A. (1993) Transaction Processing: Concepts and Techniques, Morgan Kaufmann Publishers, ISBN 1558601902.
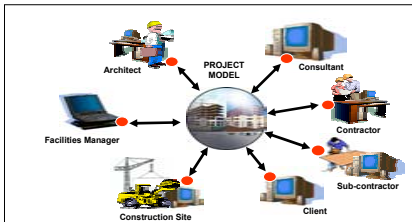
Grundy, J.C., Hosking, J.G. and Mugridge, W.B. (1996) Supporting flexible consistency management via discrete change description propagation, Software - Practice and Experience, 26 (9), September, Wiley, 1053-1083.

Motivation for consistency management

- Mappings describe how data should be transformed
- Utilising mappings we can determine what to do when data is changed in one view of a system
- Can manage dependencies between data and views of data inside a system
- Can manage dependencies between data and views of data across systems
- Can ensure correct propagation of modified data between systems and views

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Transaction Management

- Engendering Concurrent Engineering
  - Mapping data back and forth to complete processes
  - Large portions of the design are used by each professional
  - Tasks have long durations (perhaps days)
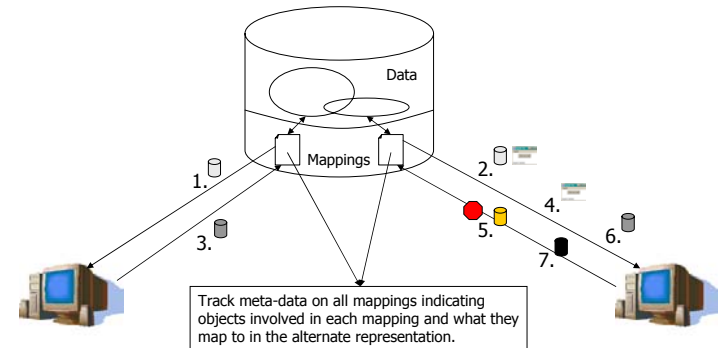 - Can't serialise all the tasks

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Transaction Management: Issues

- Standard data locking regimes are inadequate
- Professionals require asynchronous updates to the building data
- Paper-based processes manage conflict resolution
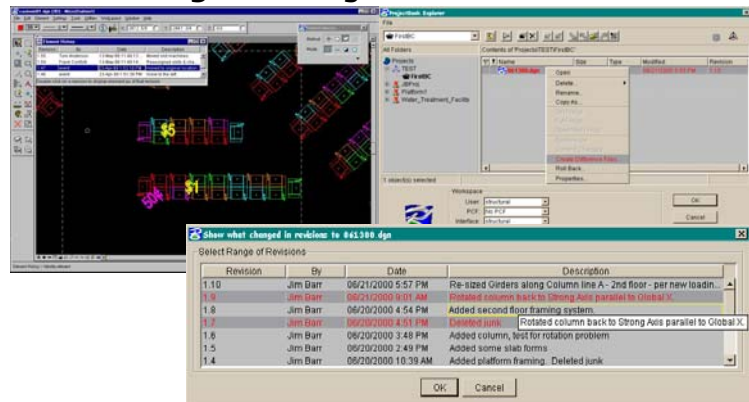 - But are a major source of building problems

Transaction Management: Solution

- Track data in use by each professional
- Notify when there is a potential update conflict
  - Don't stop the user from completing their task
- Determine actual conflicts when the professional's data is checked in
- Force acceptance (or renegotiation) of prior conflicting changes
  - Then allow data to be checked in

Transaction Management Flows

Track meta-data on all mappings indicating objects involved in each mapping and what they map to in the alternate representation.
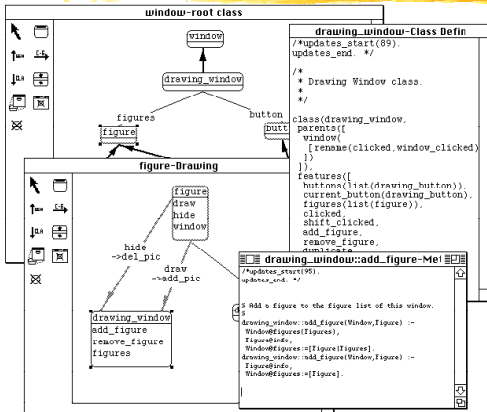

Bentley's ProjectBank

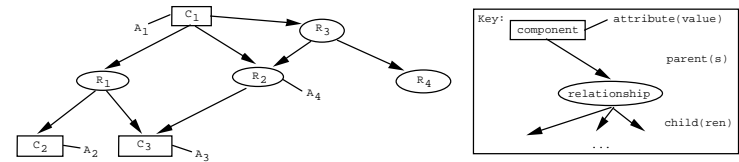
Transaction Management: Developments

- Bentley's ProjectBank model coordination
  - Conflicts are managed at the data level, not semantics
    - Low level (data based) conflicts notified
    - All changes need descriptions
    - Rotating a beam will produce a conflict
    - Rotating a chair will produce a conflict
- Progressing to:
  - Process-based conflict management
  - Object and attribute aware conflict management
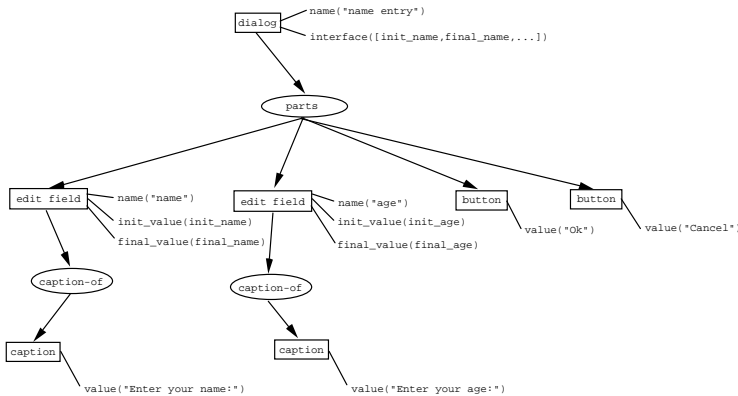
Consistency management for software tools

Change propagation and response graphs (CPRG)

- Imagine that we have the following structures
  - Components: encapsulating data and behaviour (e.g. dialog box)
  - Relationships: connecting components and used to propagate change descriptions (e.g. dialog box to a button)
  - Change descriptions: describing the change to data in a connected component

CPRG example

Consistency management requirements

- Types of changes could include
  - Moving a caption alongside its edit box
  - Resizing the dialog box
  - Adding a new edit field
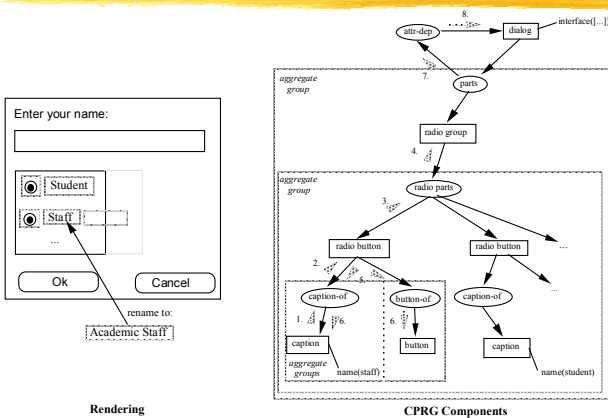 - Deleting an edit box (cascading delete, referential integrity)

Propagation of change descriptions

- Change generated by a component edit
- Change description propagated to all dependent relationships
- Relationship examines the change description to either
  - Apply further operations to itself or related components
  - Pass the change to its dependents
  - Ignore the change

Types of relationships

- Aggregation relationships
  - Parent applies the same operation to all aggregates
- Attribute dependency relationships
  - Expression across multiple attributes to be solved
- View-of relationships
  - Mappings between different representations

Aggregate and attribute recalculation

Rendering

CPRG Components

Change descriptions

- Document progress of work in an application and support further functionality
  - Support undo and redo of individual changes
  - Allow version control for a set of change descriptions
  - Inconsistency management perhaps constraining a model