From cradle to grave: An architecture substrate for software lifecycles

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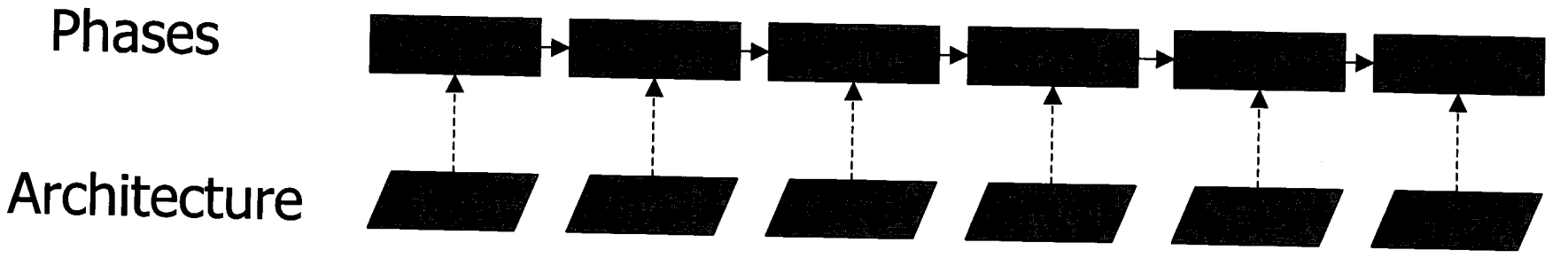
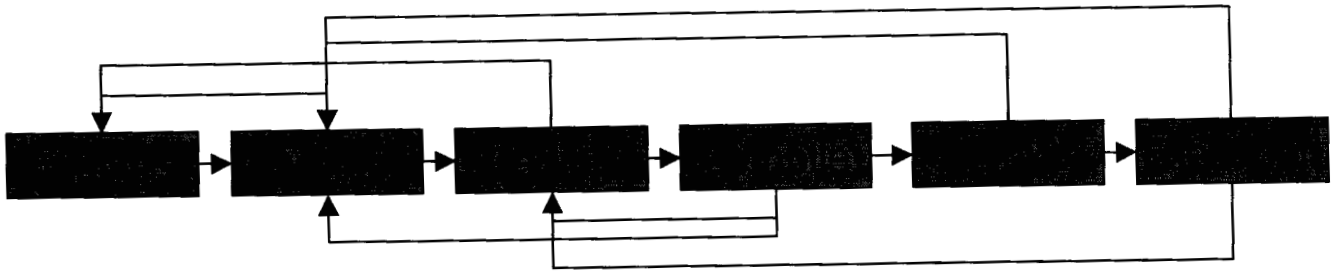
The waterflow lifecycle revisited



- Is there a consensus that architecture is a pervasive concern?
  - Issue: Architecture as a document vs. an engineering model
- Is there a continuity of architecture throughout?
  - Issue: Traceability back and forth among phases
- Do we need architecture everywhere?
  - Issue: Representation & semantics of architecture in each phase
- Is Architectural change propagation cost-effective?
  - Issue: transforming from one phase to the next (manual, assisted, ...)

The Mission Data System perspective

Phases



- The process methodology is flexible…
- … as long as State Analysis is applied throughout

- Subtle difference between:
  - Explicit architecture representation everywhere
  - Explicit architecture awareness
  - The former is "nice to have"
  - The latter is a pragmatic tradeoff for size & fit

State Analysis & SW Architecture

Similar Dimensions of Concerns	Code level	Component Architecture	System Architecture
Type information	- procedural code - functions - classes (OO)	- methods - interfaces (sets of methods) - ports (interface signature) - components (sets of ports) - connectors (sets of ports) - hierarchical composition	- types (from state analysis) State variables Achievers, etc... - domain-specific types Units, etc...
Instance information	- variables - events - objects	- component instances - connector instances - links (pairs of port bindings) - hierarchical composition	- instances (from state analysis)
Composition Mechanisms (how is it built?)	- function calls - symbolic references/linkages - shared variables - ad-hoc runtime mechanisms	- prescription languages (requires type database) - Base schema: XADL instances - Extensible via XML schemas - Compressible via transformations	- subject to lower-level mechanisms
Description Mechanisms (what's inside?)	- ad-hoc runtime mechanisms	- description languages (requires instance database) - Base schema: XADL instances - Extensible via XML schemas - Compressible via transformations	- subject to lower-level mechanisms

Architecture Composition in MDS

- xADL extension for component/connector implementation inheritance
- Separation of structure (defined in xADL) & implementation

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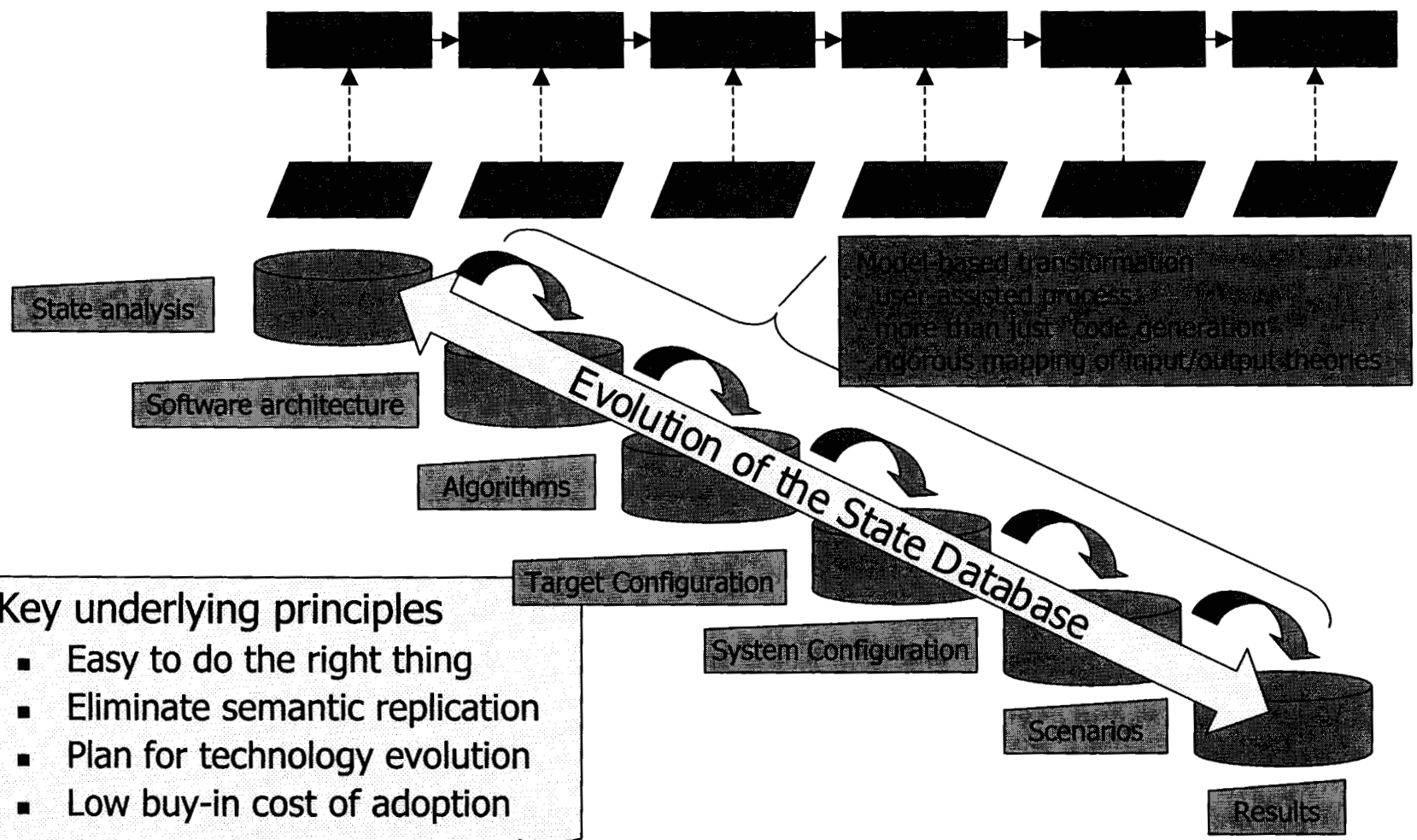
- Architecture profiling for optimizing transformations of xADL to code

- Packaging of architecture elements into shared objects
- Dynamic registration of architecture elements at shared object init/fini

- Extensible prescription protocols support connector optimizations
- Architecture evolution includes types & instances
  - Type reconfiguration via dynamic object loading/unloading
  - Instance reconfiguration via prescription changes

The architecture waterflow



- Key underlying principles
  - Easy to do the right thing
  - Eliminate semantic replication
  - Plan for technology evolution
  - Low buy-in cost of adoption