



Specification-Based Web Services Verification and Validation

Wei-Tek Tsai, Yinong Chen, Ray Paul*

Department of Computer Science and Engineering
Arizona State University

Tempe, AZ 85287-8809, U.S.A.

*Department of Defense, Washington DC, U.S.A.

- Introduction
- Web Services CV&V Framework
- Specification-based Testing
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- Experiment Results
- Conclusion

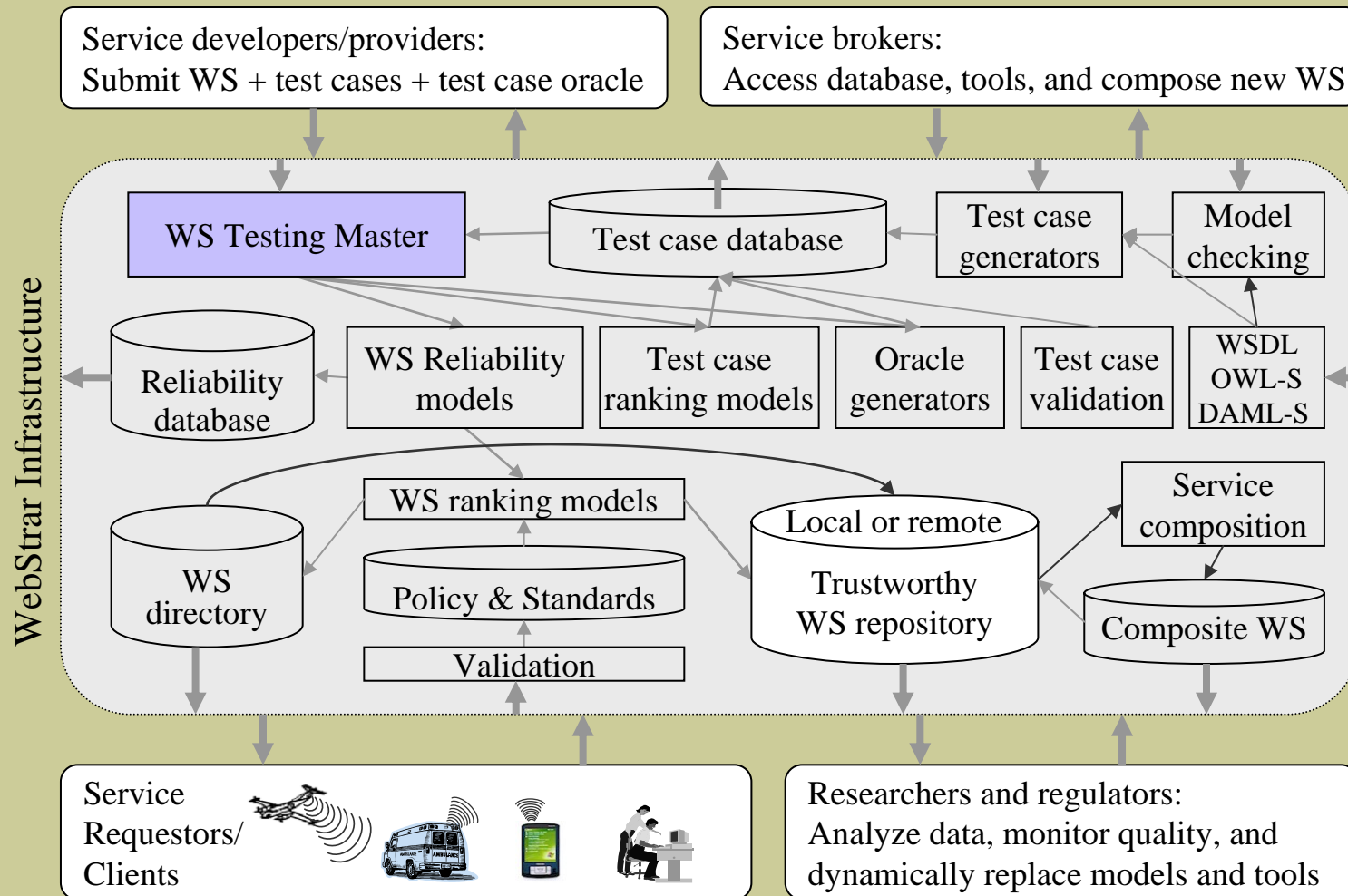
- SOA (Service-Oriented Architecture) and its Web version WS (Web Services) form a new paradigm of computing, features including:
 - Specification using standard languages such as WSDL, OWL-S, DMAL-S.
 - Runtime publishing, discovery, matching, composition, binding, execution, verification and monitoring
 - Registration and matching via intermediate agents such as UDDI servers
 - Interoperable across vendors
 - Testing without source code: specification-based only

- Can Web Services (WS) composed of components developed by different vendors be used in a mission-critical application?
 - The current answer is No, if source code not open;
 - The IV&V techniques that need source code will not be usable for WS testing.
 - Need to have specification-based V&V technique.

- Paradox
 - The WS and SOA were proposed to address interoperability issues so that any software can interoperate with another service.
 - But the issue of trust has prevented this from happening.
- Fortunately, we used software without source code frequently, and the reasons for trust:
 - Reputation of name brand (Microsoft, IBM, SAP, Linux)
 - Third party evaluation and validation (Consumer report, FDA, FAA and similar organization)

- The WS Testing is different:
 - The trust must be on *individual* component services, not just composed services.
 - Need to worry about WS unit and integration V&V
 - The trust must be created *in real time* during discovery and matching
 - Need to verify a large number of WS efficiently
 - The trust must be created in an objective manner
 - Not by brand name only
 - But by a neutral party evaluation using specification-based testing only, i.e., without source code
 - Specification-based dependable techniques: model checking, test case generation, group testing, reliability analysis, using information in the WS specification only.

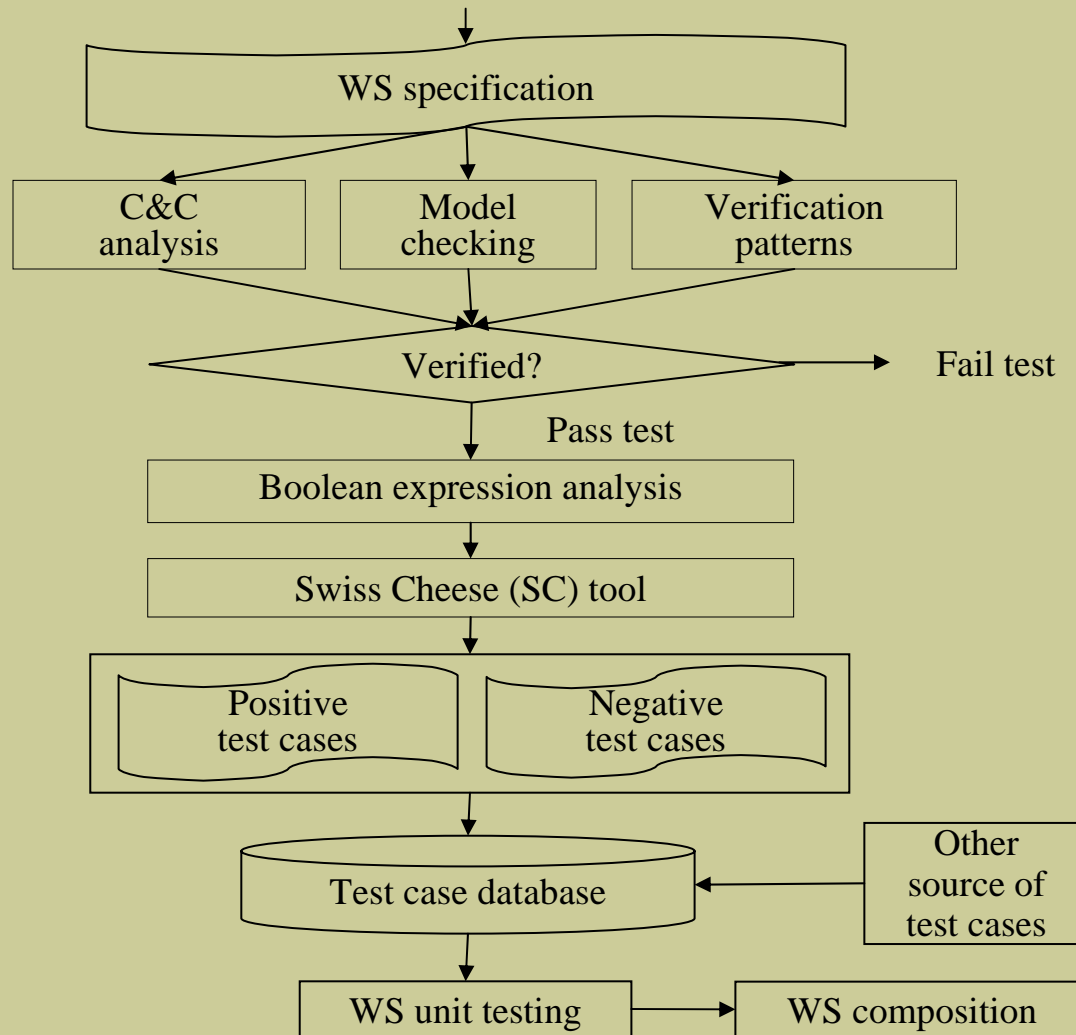
A Framework for WS Testing, Reliability Assessment, and Ranking

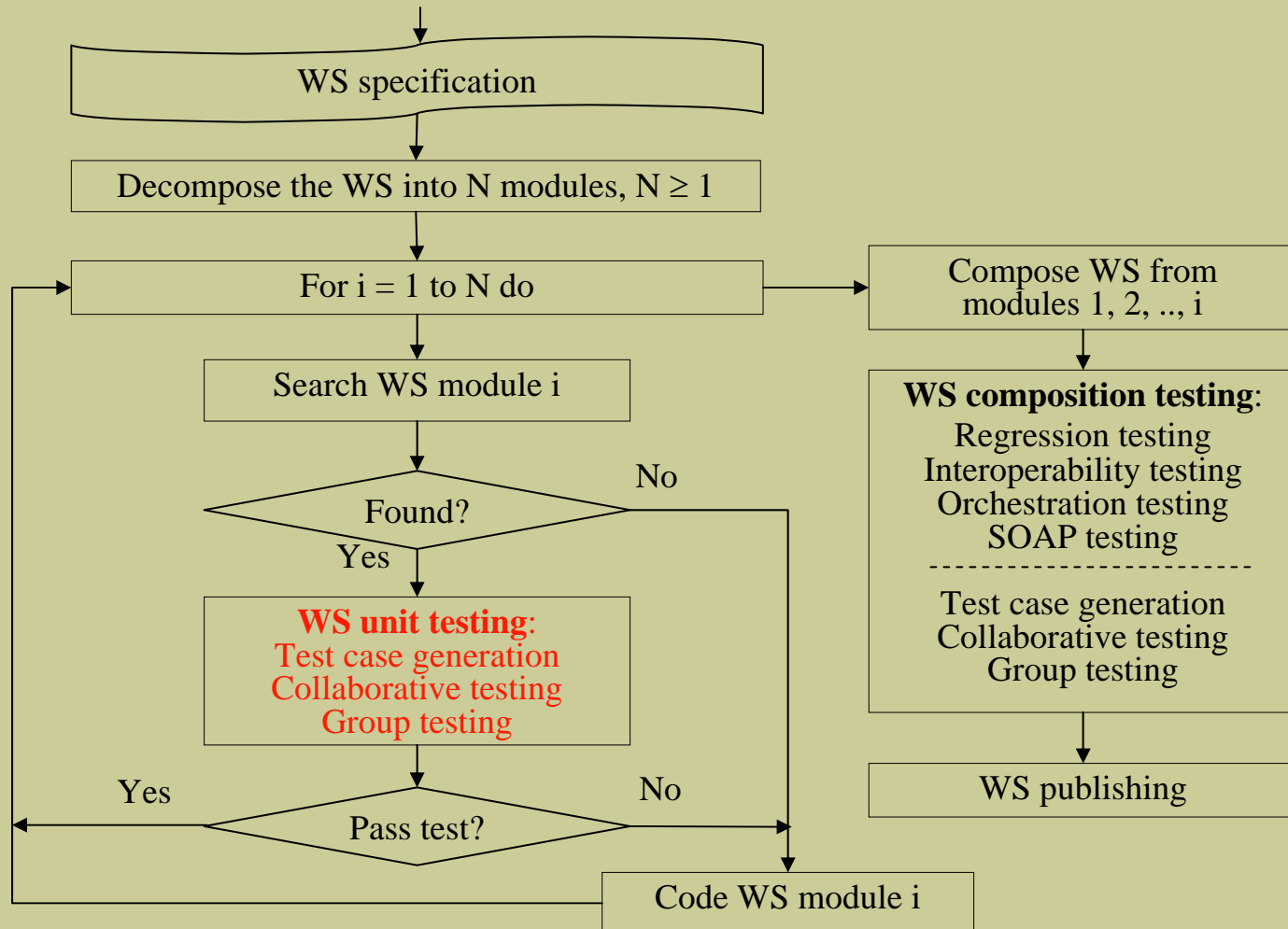




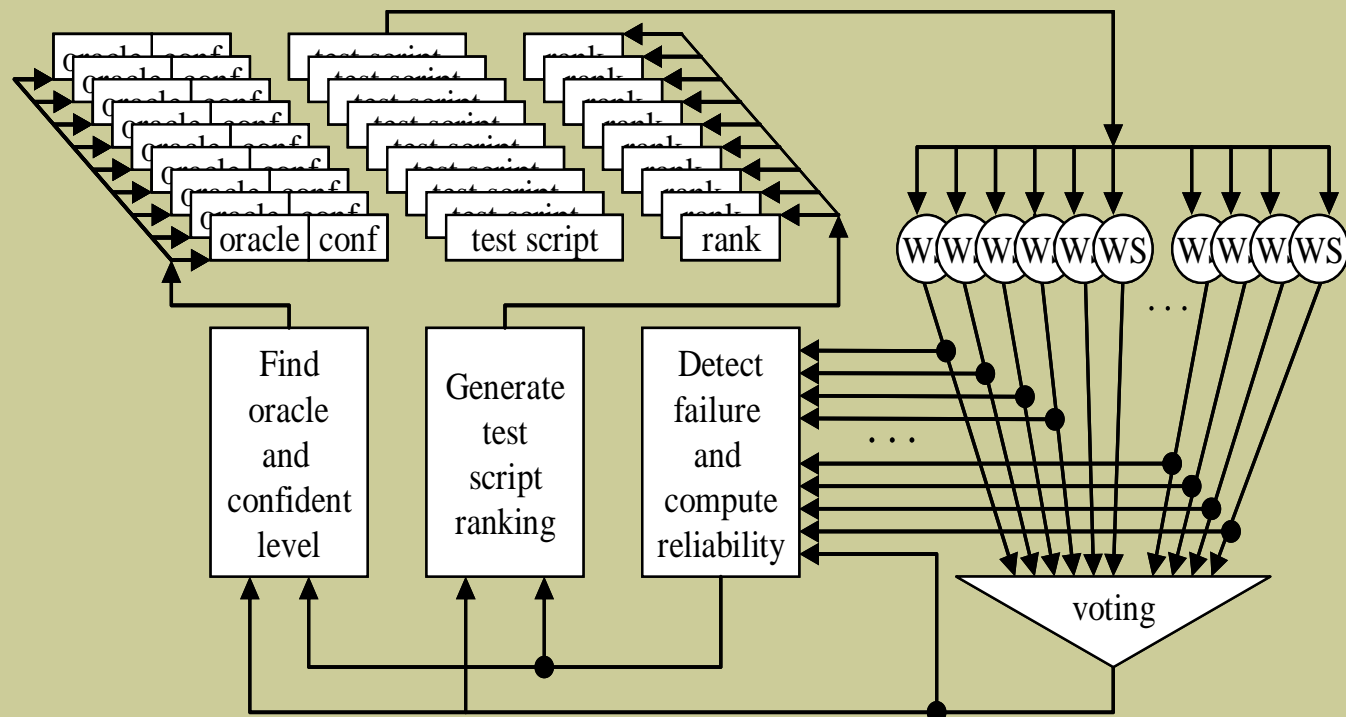
IV&V versus CV&V

	Traditional IV&V	Service-Oriented CV&C
Definition	By independent team	Collaboration among multi-parties
Approach	Off-line field testing	On-line just-in-time testing
Regression	Off-line regression	On-line regression
Integration	Static configuration & linking	Dynamic reconfiguration & binding
Testing coverage	Structural & functional	Specification-based
Profiling	Static and centralized	Dynamic and distributed
Model checking	Based source code & states	Just-in-time dynamic model checking
Reliability model	Input domain & Reliability growth models	Dynamic profiling and group testing
Certification	Static certification center	Dynamic certification based on history





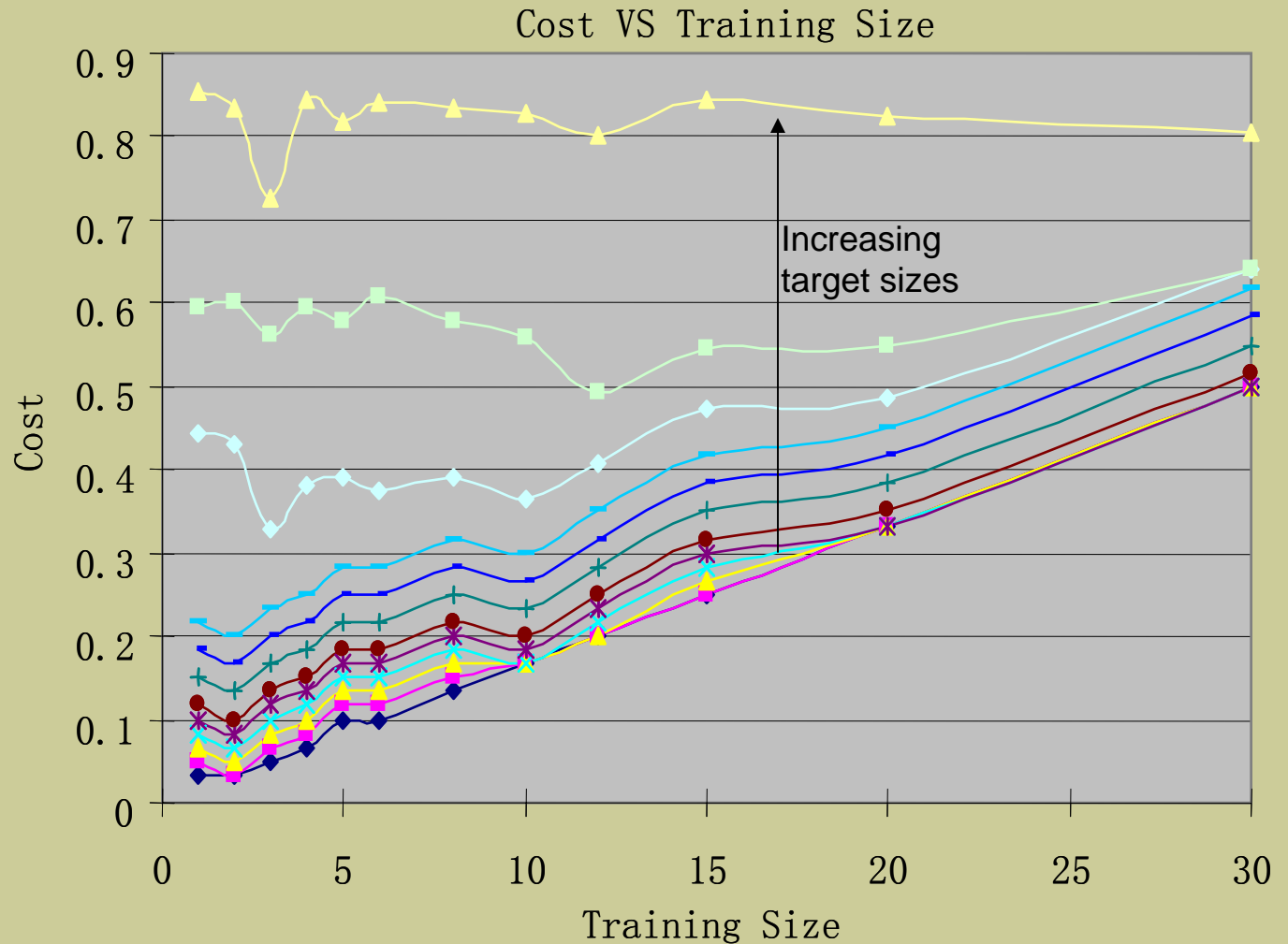
- Originally developed for testing a large number of blood samples and later for software regression testing
- The main idea is to test the large number of WS in two phases.



- By the end of training phase, we have tested the selected sample WS and we have the:
 - Test scripts ranked by their capability so far in detecting failures.
 - Oracle for most test scripts established as well as their confidence levels;
 - Best WS in the samples ranked;

- By the end of Phase 2 group testing:
 - All the WS available are tested and a short list are ranked;
 - Test scripts are updated and ranked;
 - Oracles and their confidence levels are updated.

- Larger training size incurs higher cost
- Larger target size incurs higher cost



- A CV&V framework is being develop
- Major components of the framework are developed
 - Specification-based test case generation
 - Dynamic model checking and unit testing
 - Dynamic composition and integration testing
 - Group testing
 - Dynamic reliability model
- Simulation and extensive experiments have been conducted
 - Verify the effectiveness of the group testing techniques.
 - The data show that this approach save significant time and effort (80% to 90% depending on the size of training WS and the target WS)