

# Model-Based Test and Evaluation INCOSE IW 2019

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# Why another model-based “thing”?

- Test and Evaluation (T&E) is in SE’s purview
  - Largely a “document”-based effort
- Rigorous and precise
  - Integrated with the system model
  - Consistent vocabulary
  - Semantically precise definitions
  - Maintenance and reuse of information (i.e. Don’t Repeat Yourself (DRY) principle)
- Transparent and Analyzable
  - Resource scheduling and procurement conflicts
  - Design “gotchas”
  - Impact analysis
- Resilient
  - Personnel change
- Front-end SE dividends finally pay off!

# Some factors to consider when planning and conducting a test

- **Why** is the test being conducted? **How** do we know if the test is successful?
- **What** requirements are being verified?
- **How** do we arbitrate the test, i.e. how do we render a verdict? **What** are the verification criteria?
- **What** WBS id(s) or assemblies/subassemblies/components is/are being tested?
- **What** test equipment are required? **When** is it available? **Where** is it coming from? **How** will it be acquired?
- **What** test support items (emulators) are required to aid in the “realism” of the test?
- **When** and **where** will the test be conducted?
- **Who** are the test personnel executing/assisting in the test?
- **How** will the test be conducted? **What** are the test cases? **What** are the procedures? **What** are the pre/post conditions, constraints, hazards, etc.? **What** are the valid test conditions?
- **What** data was to stimulate the test, **what** data was recorded, and **what** was the resultant?

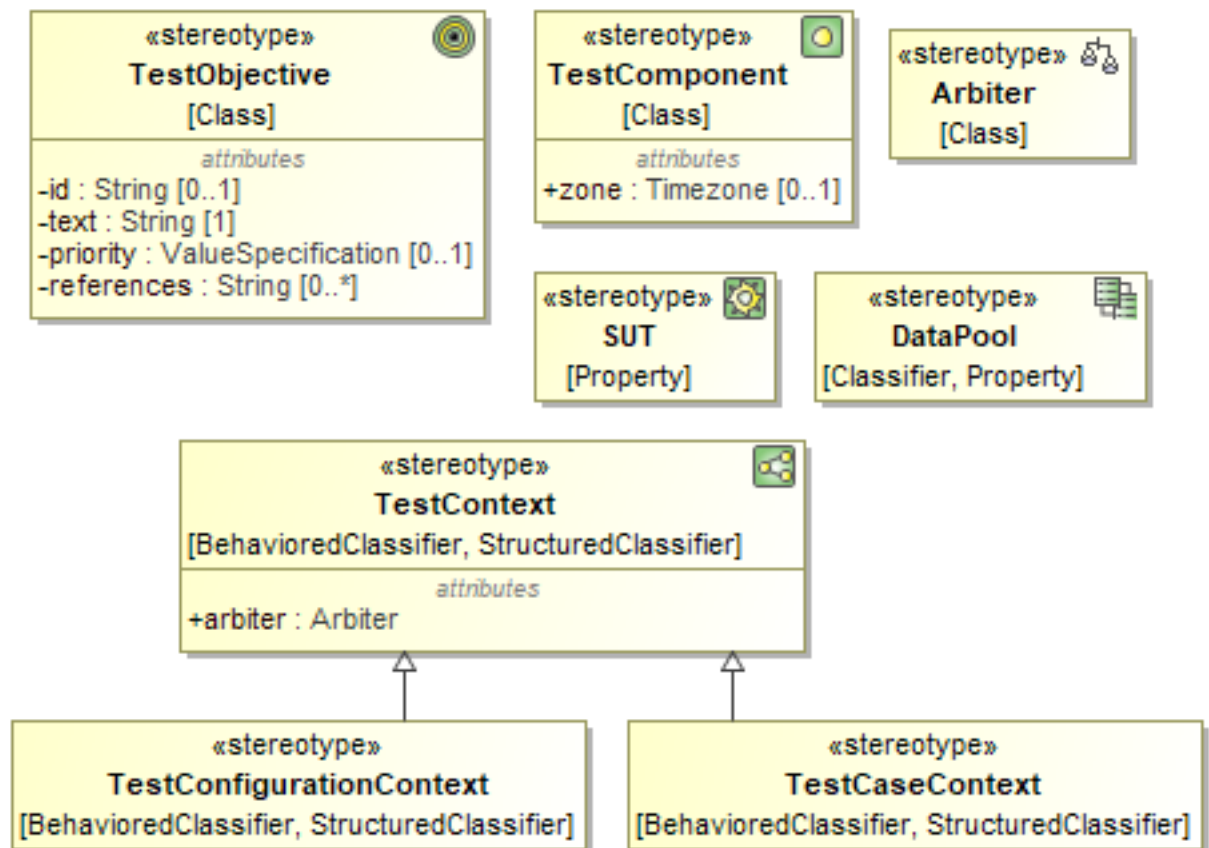
In other words, the **who, what, when, where, why,** and **how** of a test?

# Conceptualizing the problem

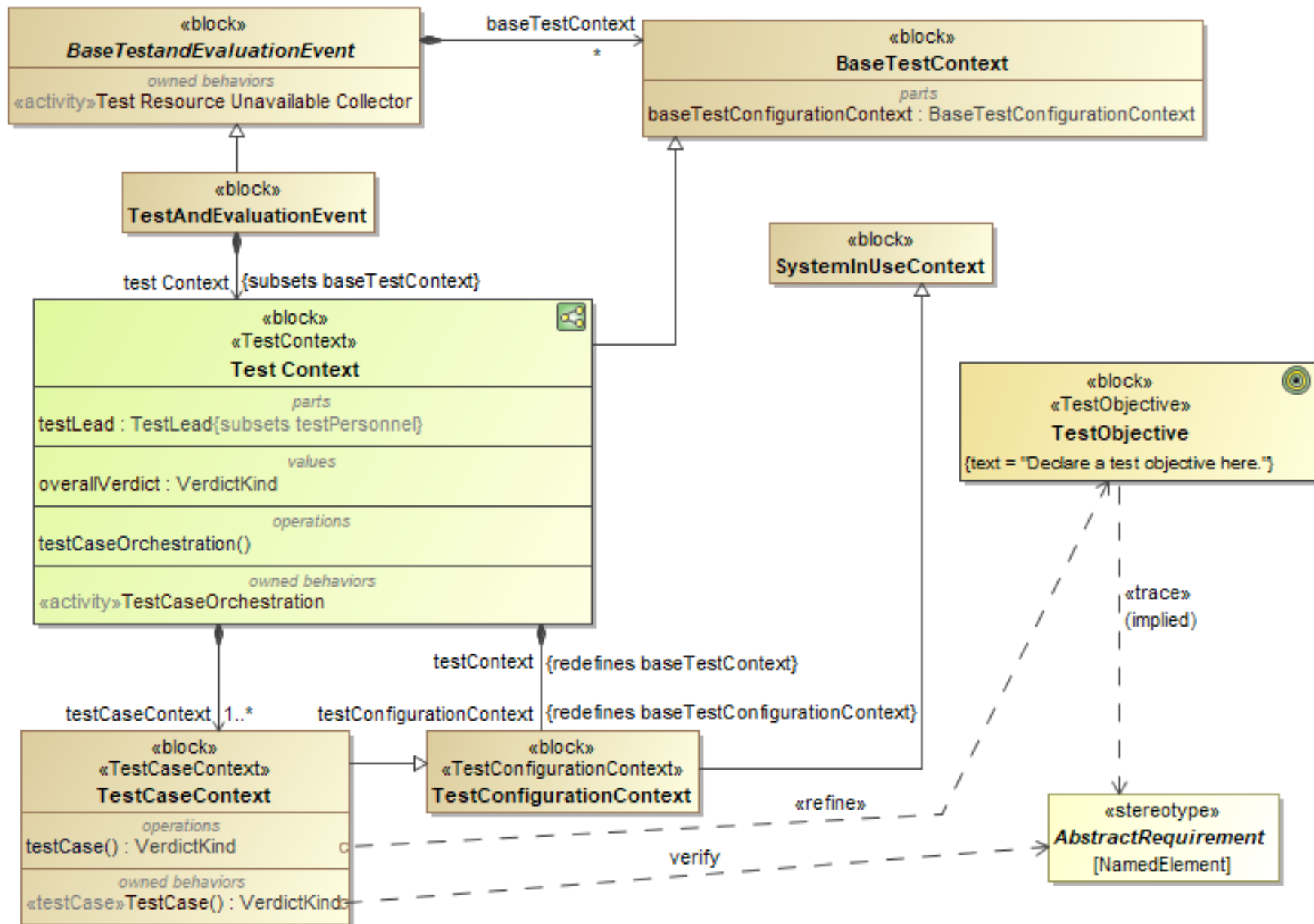
- Considerations fall into four bins/aspects:
  - Configuration – what was the setup of the test (interfaces) and what resources are required?
  - Arbitration – what can we learn from the test?
  - Data – what data was used to drive the test, what was measured and recorded, and what was the resultant?
  - Procedure – how was the test performed?
- The elements comprising the four bins form the basis of a test architecture
- Execution and evaluation of the test would be an instance of the test architecture

# Attacking the problem

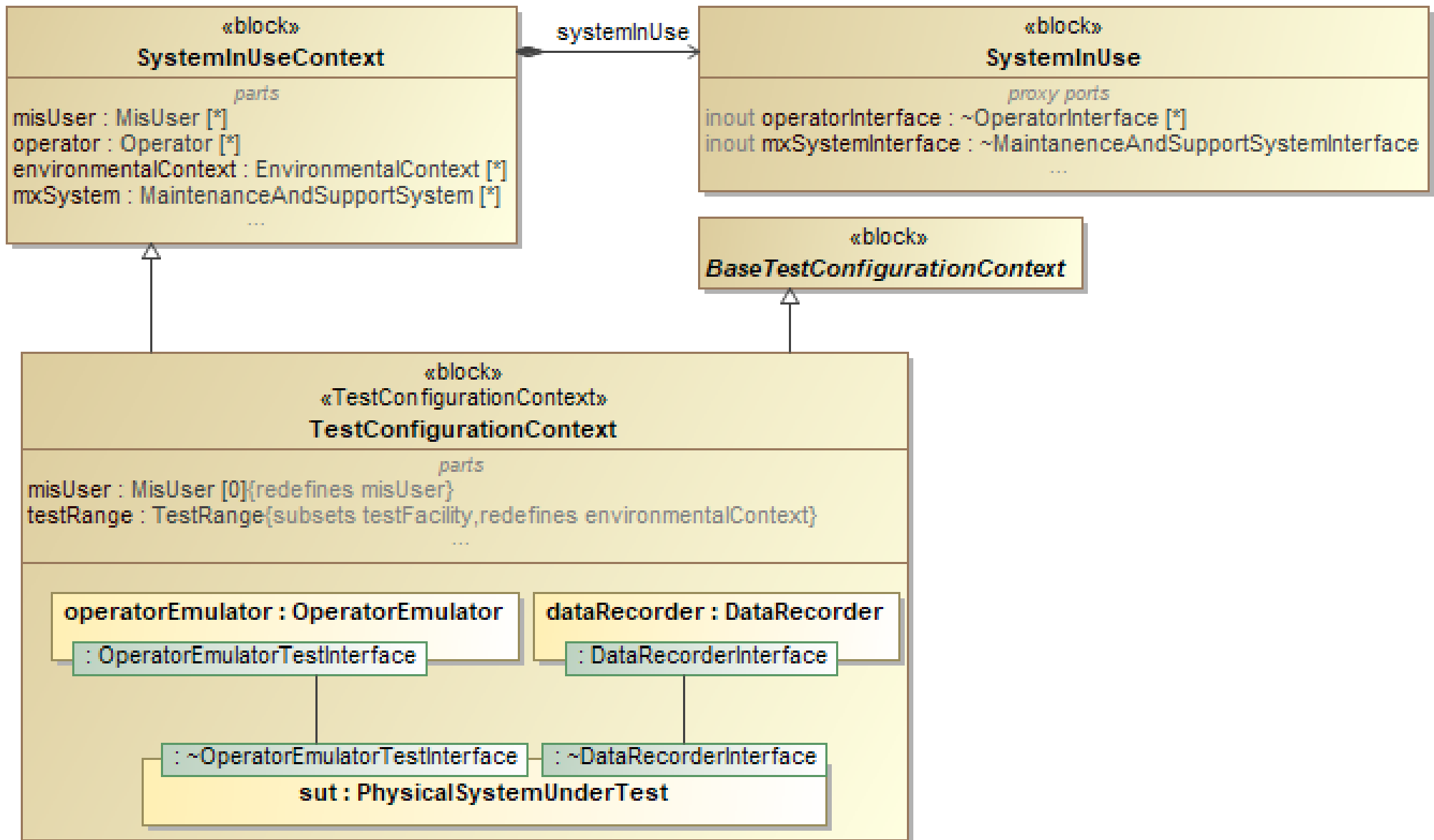
- Extends the approach described in “Model-Driven Testing: Using the UML Testing Profile” by Baker, et. al.
  - Developed for software but can be extended to systems and large scale T&E
- Formal description uses SysML as the foundation language in combination with concepts used directly and extended from the UML Testing Profile (UTP)



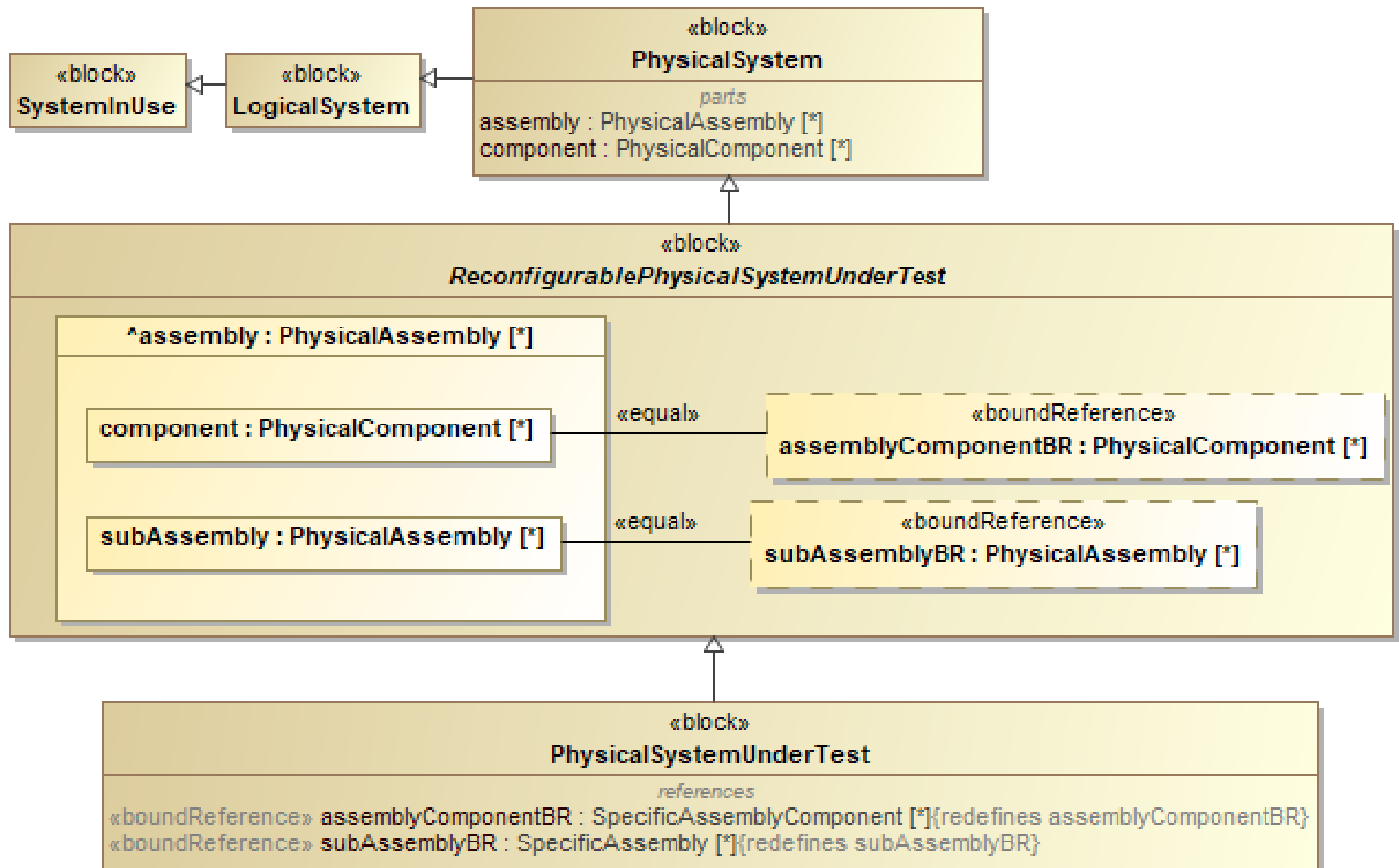
# Test Architecture



# Test Configuration

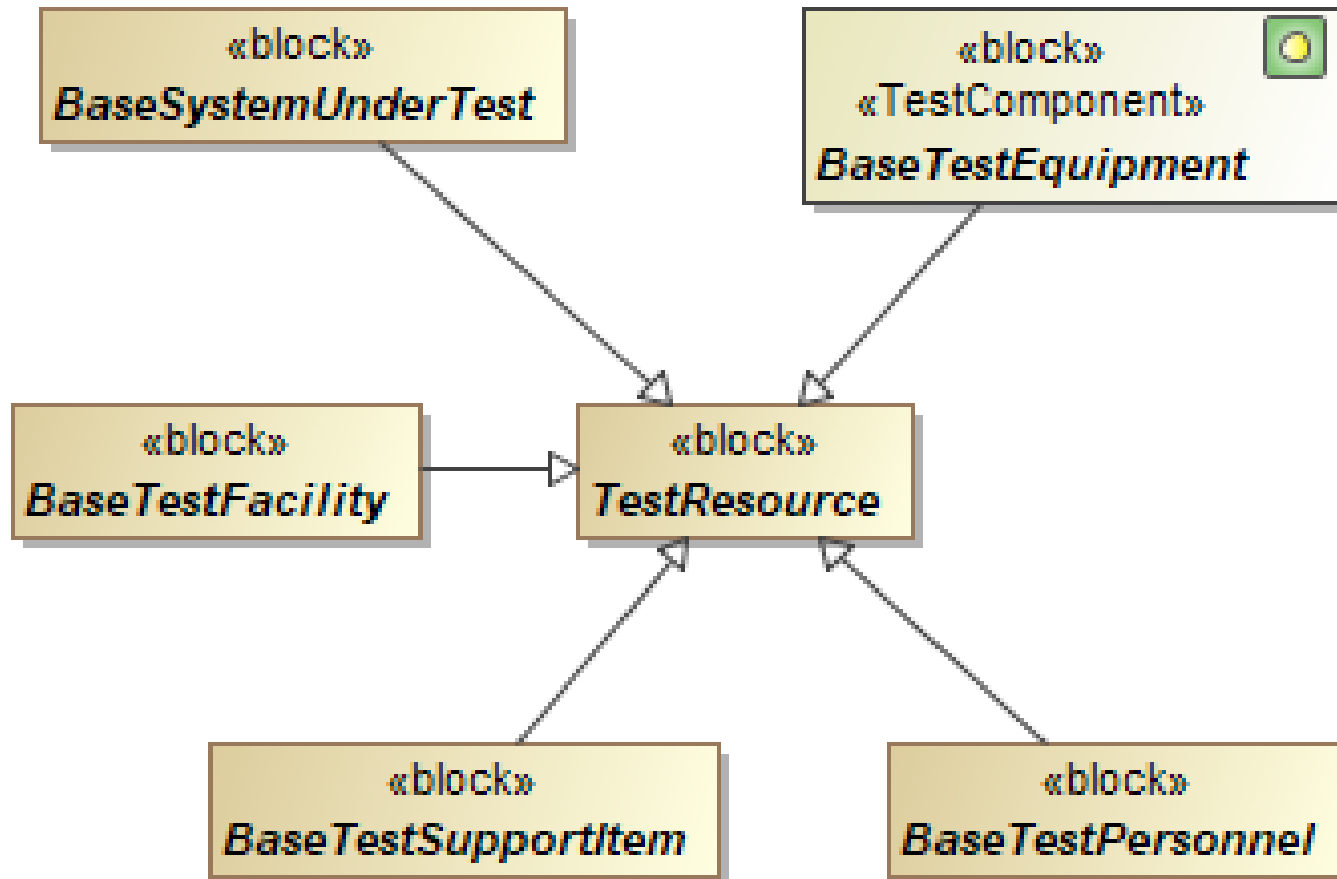


# Reconfigurable System Under Test

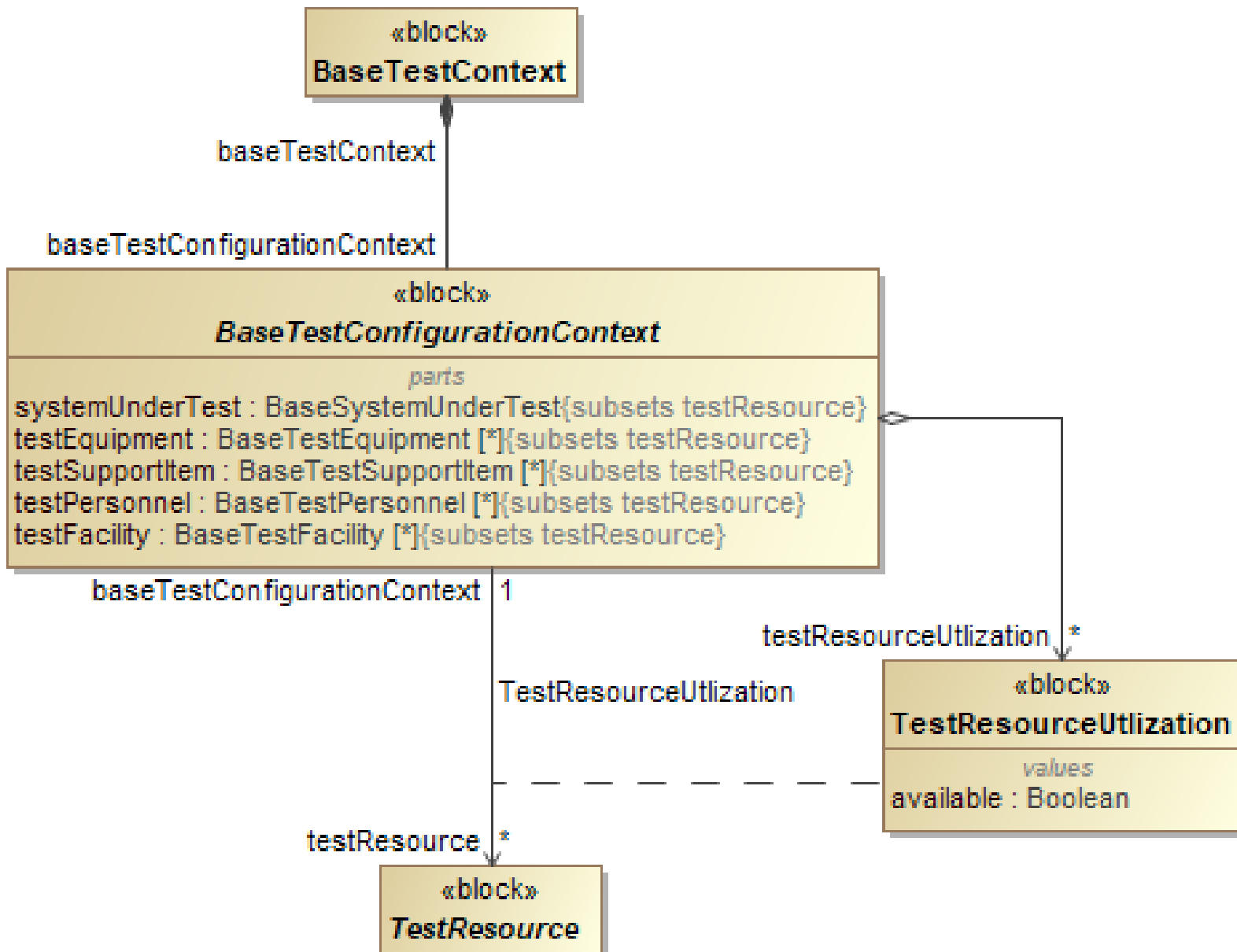




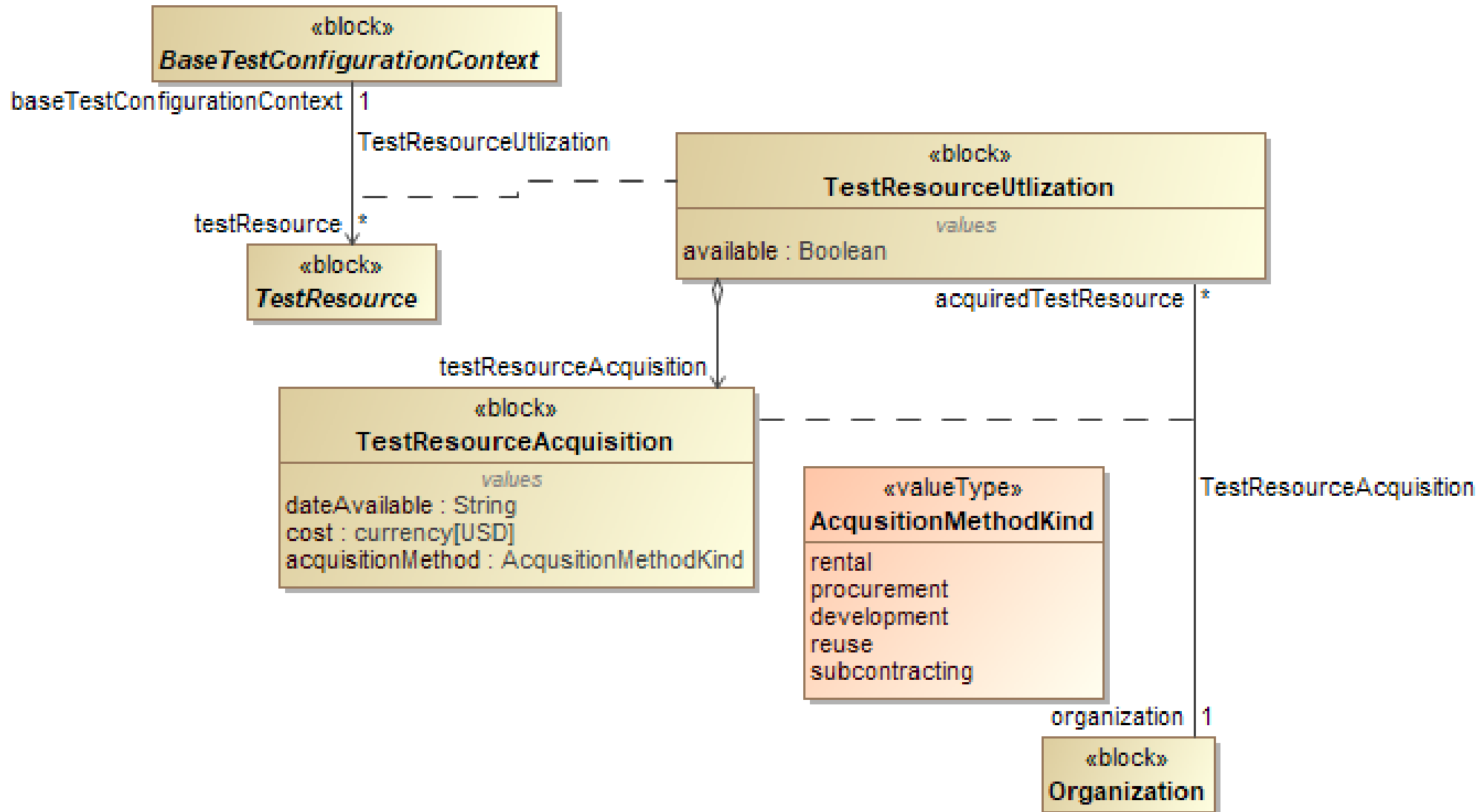
# Test Resources



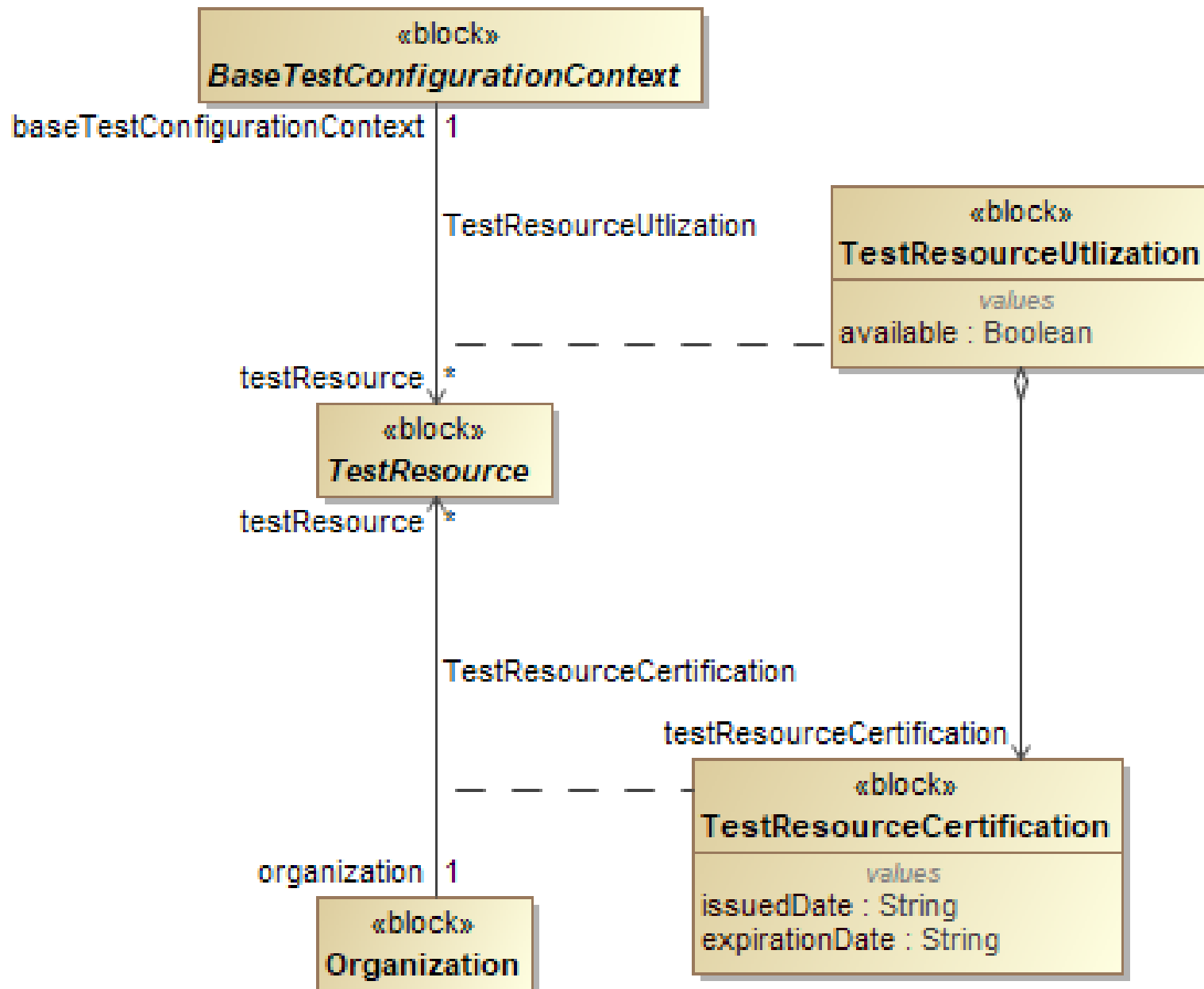
# Test Resource Utilization



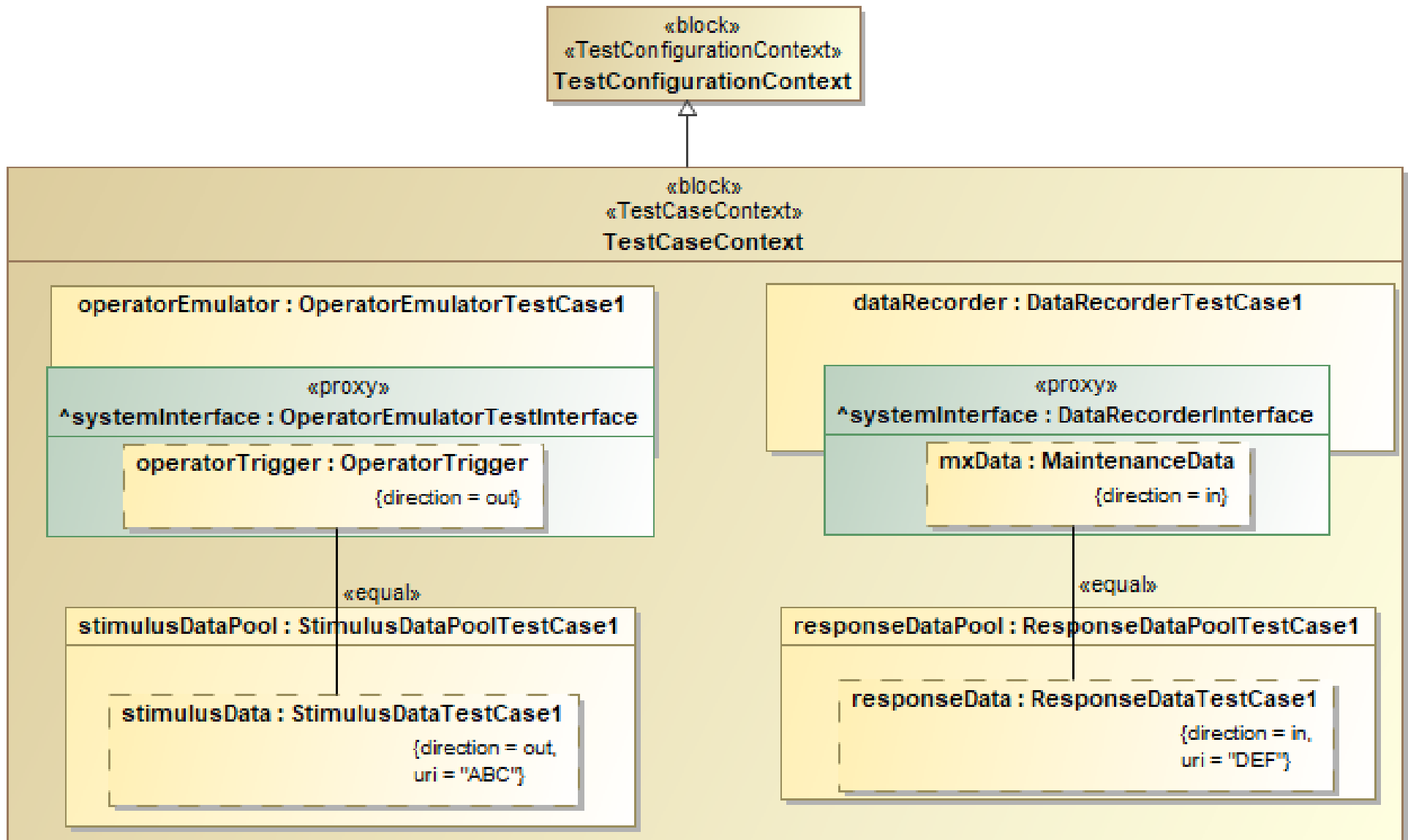
# Resource Acquisition



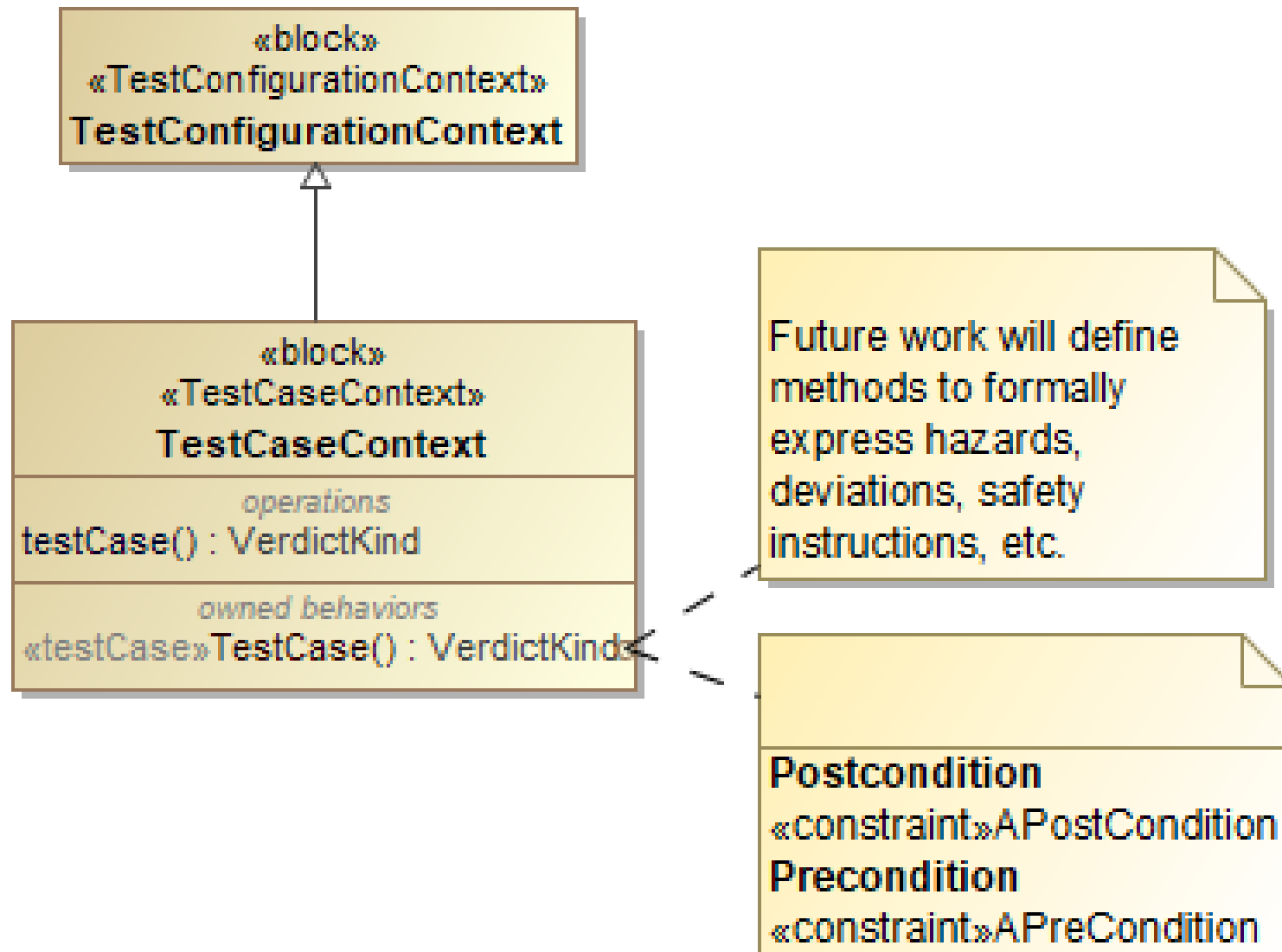
# Resource Certification



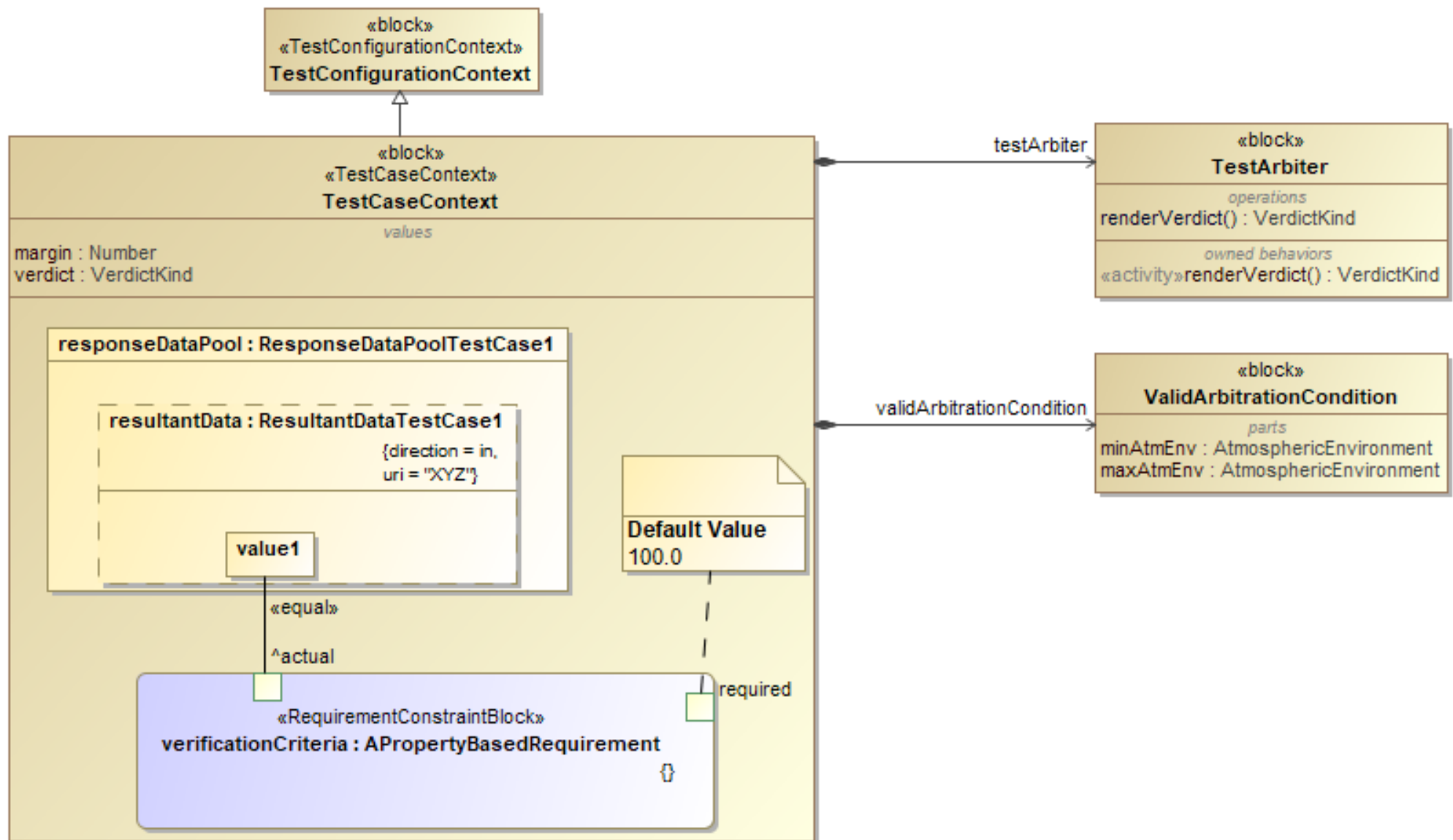
# Binding Data to Test Interfaces



# Test Procedure



# Test Case Arbitration



# Summary and Future Work

- Test architecture description addresses T&E considerations in all four conceptual aspects
- Baker's UTP approach extended beyond strictly software testing to systems test and evaluation
  - Reconfigurable SUT through bound references
  - Additional test resource definitions
  - Resource utilization, acquisition, and certification through association blocks and helper activities
  - Data bound to test interfaces via binding connectors
  - Use of embedded requirements such as requirement constraint blocks
- Future Work:
  - Possible explosion of SUT configurations representing integration steps
    - Need better "helper" mechanisms to manage configurations
  - Define methods to formally express test procedure hazards, deviations, safety instructions, etc.



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