Presented by Scott Gardiner, Senior Consultant, Information Balance to the Ottawa Software Quality Association (www.osqa.org), Jan. 31, 2002, Ottawa, Canada.

Agenda

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- Software Architectures
- The Zachman Architecture Framework
- Expanding Framework for Testing
- Using the Framework for Testing Artifacts
- Sample Project
- Q & A

Software Architectures

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- At Information Balance, we use architectures to understand the key aspects of a system:
  - Information Architecture - data / structure, process / behaviour
  - Application Architecture - transforming data / process requirements into an application system
  - Technology Architecture - using specific technology products to implement the application systems

Software Architectures

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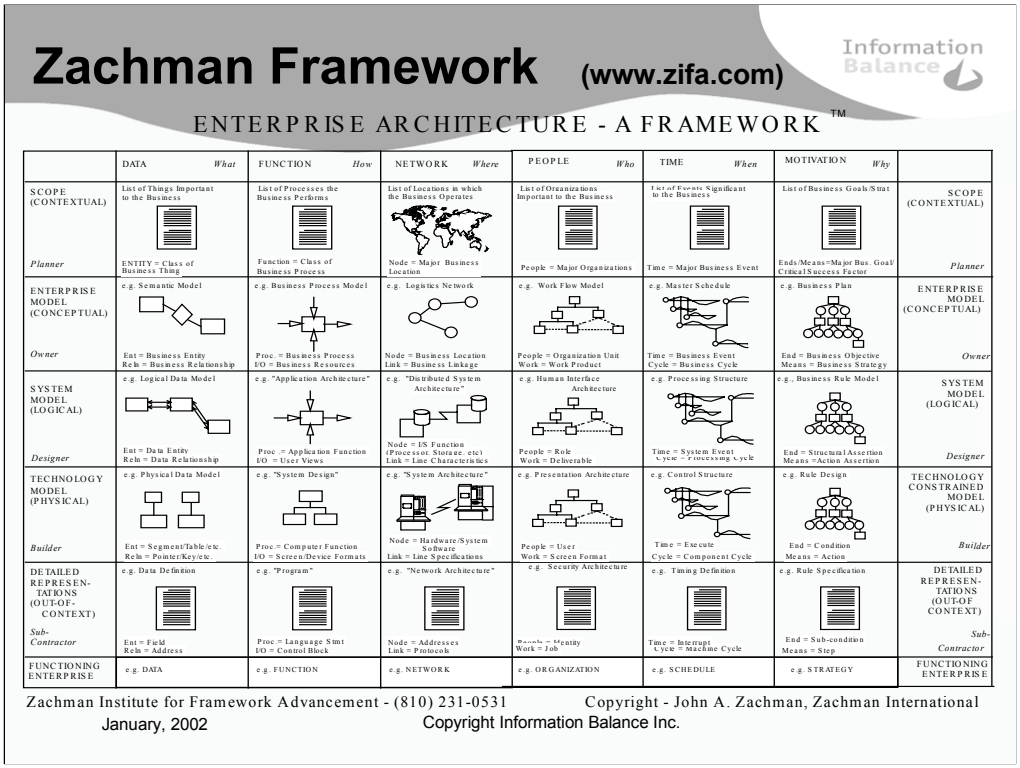
- We build architectures to:
  - Better understand the software system being built
  - Identify opportunities for simplification and reuse
  - Communicate the structure and behaviour of the software system
  - Manage risk of building the system
- We use an Architecture Framework to:
  - Organize architectural components or artifacts
  - Ensure consistency of deliverables from project-to-project
  - Consistency assists in estimating project efforts



This diagram shows the standard presentation of the Zachman framework.

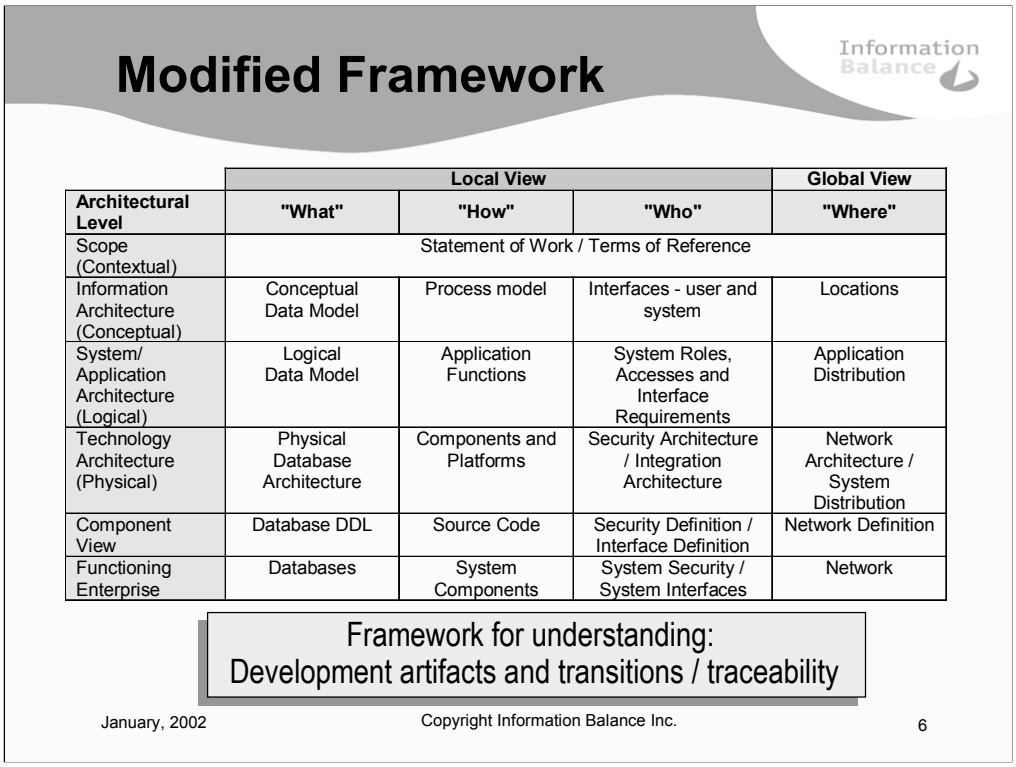
The framework **partitions** the knowledge that defines an application system.

The **columns** of the framework provide the common sense rules that describe a story or explain an object. These rules are: Who? What? When? Where? How? and Why?

The **rows** of the framework provide increasing greater level of detail as required by various observers or listeners to a story. Some observers require only a very high level of detail, while some require an in-depth, technical description of the story.

The Zachman Framework is not the only framework available, but any framework that is adopted should be easy to explain to management and to IT development and testing professionals.

For more information on the Zachman Framework, refer to **www.zifa.com.**



This slide shows a modified framework showing a subset of the columns, from one of our projects. To make the slide more readable, we have left off the "When" and "Why" columns.

Columns:

The **What? column** describes the **Data** used in the application.

The **How? Column** describes the **Functions or processes** performed by the application.

The **Who? Column** describes the **people, roles and organizations** within the business processes supported by the application.

The **Where? Column** describes the **locations** in which the business processes are performed, on a global basis.

Rows:

The **Scope Row** presents the **high level vision** for the project. This is often contained in a Statement of Work or Terms of Reference document.

The **Conceptual Row** presents the **subject matter expert's understanding of the subject area**. This row contains the first modeling efforts.

The **Logical Row** presents **more detailed, logical models**. This row is still independent of the chosen technology.

The **Physical Row** extends the logical models to account for **targeted technology platforms**. This row prepares the model for implementation.

The **Detailed Representations Row** presents **source code**.

The **Functioning Enterprise Row** presents **executing systems and executable code**.

The last 2 rows may be combined into "Components".

What about QA / QC tasks ?

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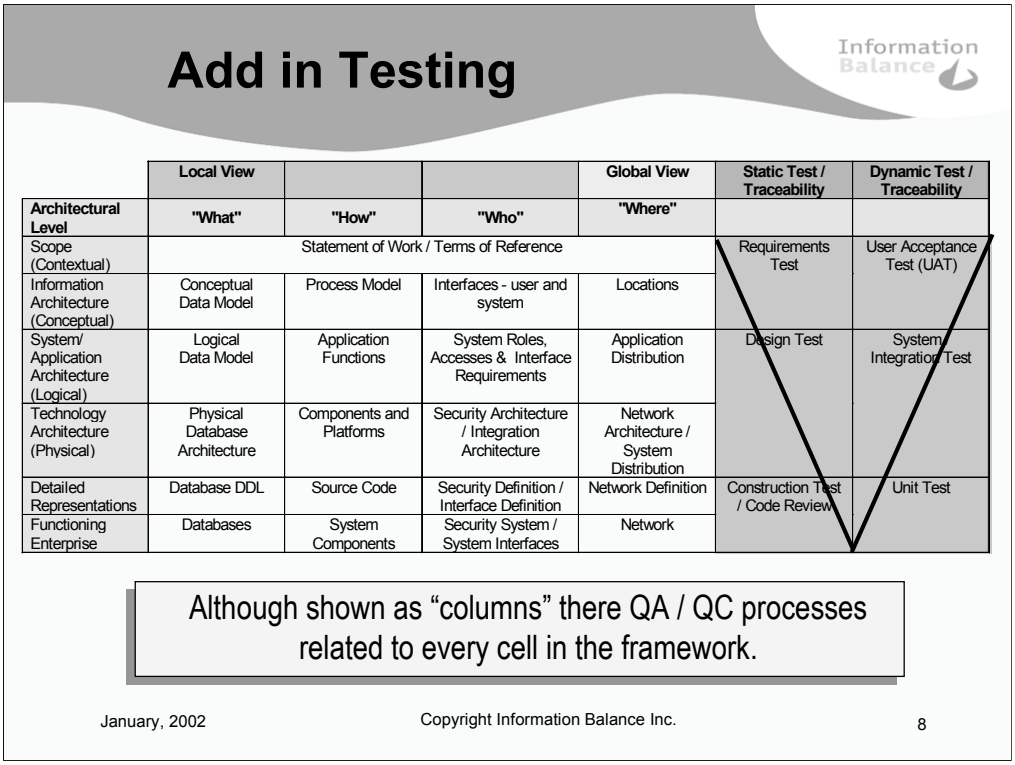
Can the Framework be used as a means of:

- Understanding QA / QC processes related to development artifacts?
- Understanding the completeness of QA / QC processes?



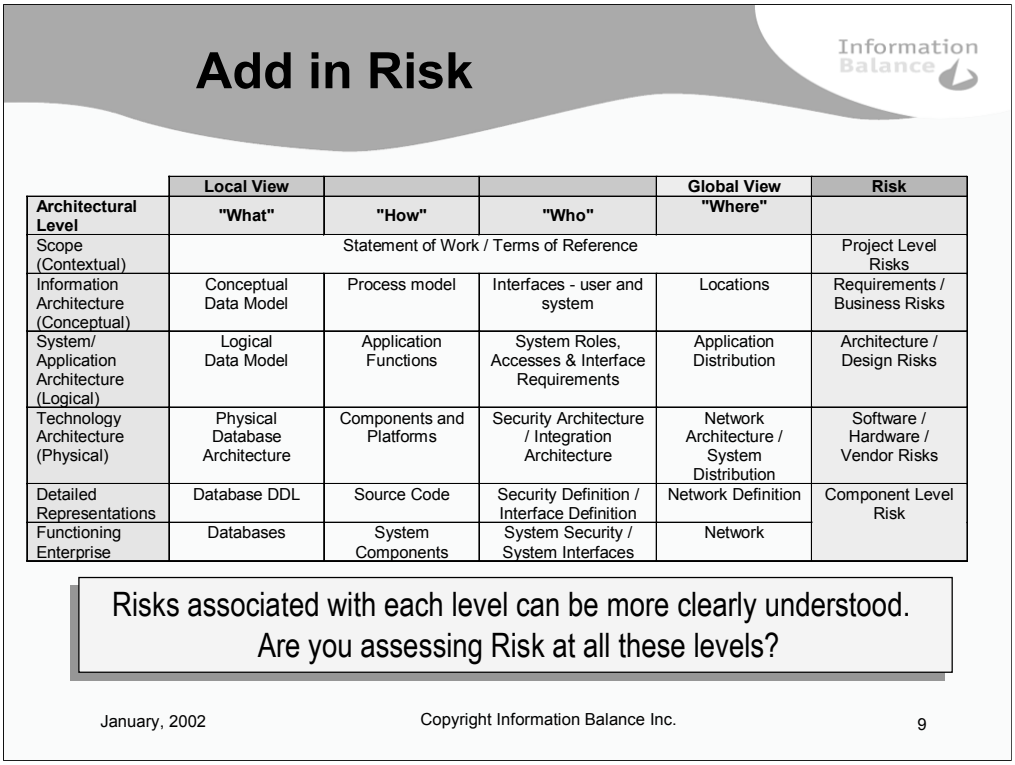
We considered how to add Testing to the Framework. In this view, we consider Testing as an evaluative activity that evaluates the development products created in the other columns.

The **Static Testing column** outlines the static analysis that should be performed to verify the development products in each row.

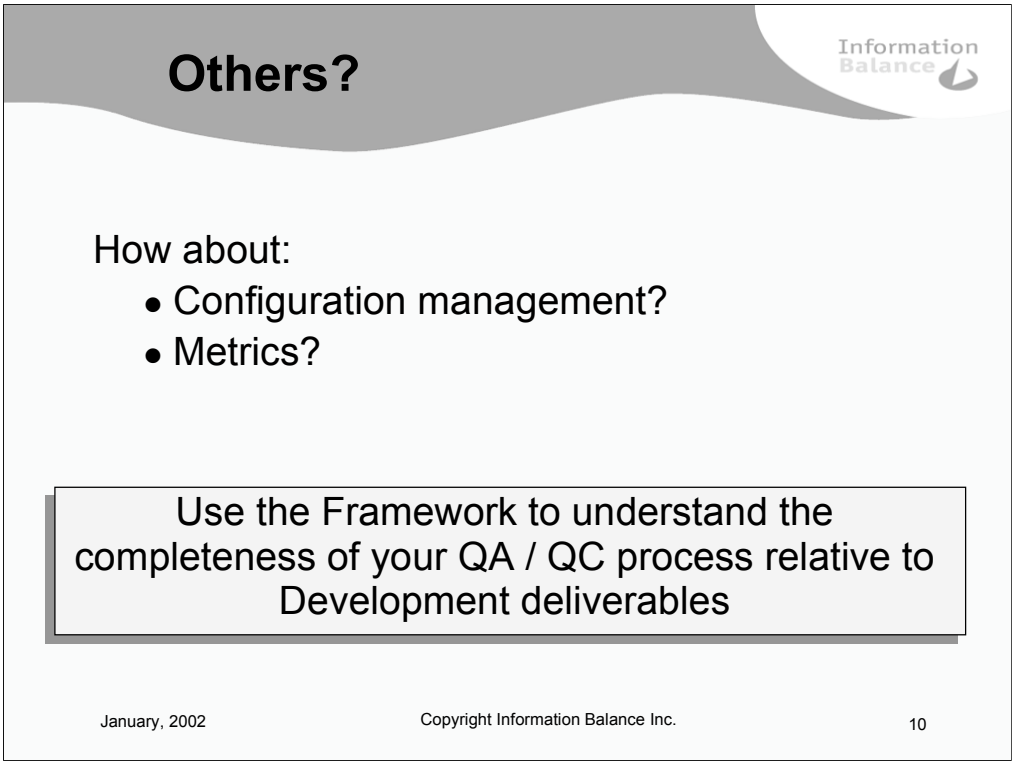
The **Dynamic Testing column** describes the tests that should be executed to validate the development products in each row.

In fact, these columns bear a strong resemblance to the standard "V" model used to describe testing activities.

This view provides an excellent checklist of the scope of testing to be completed.

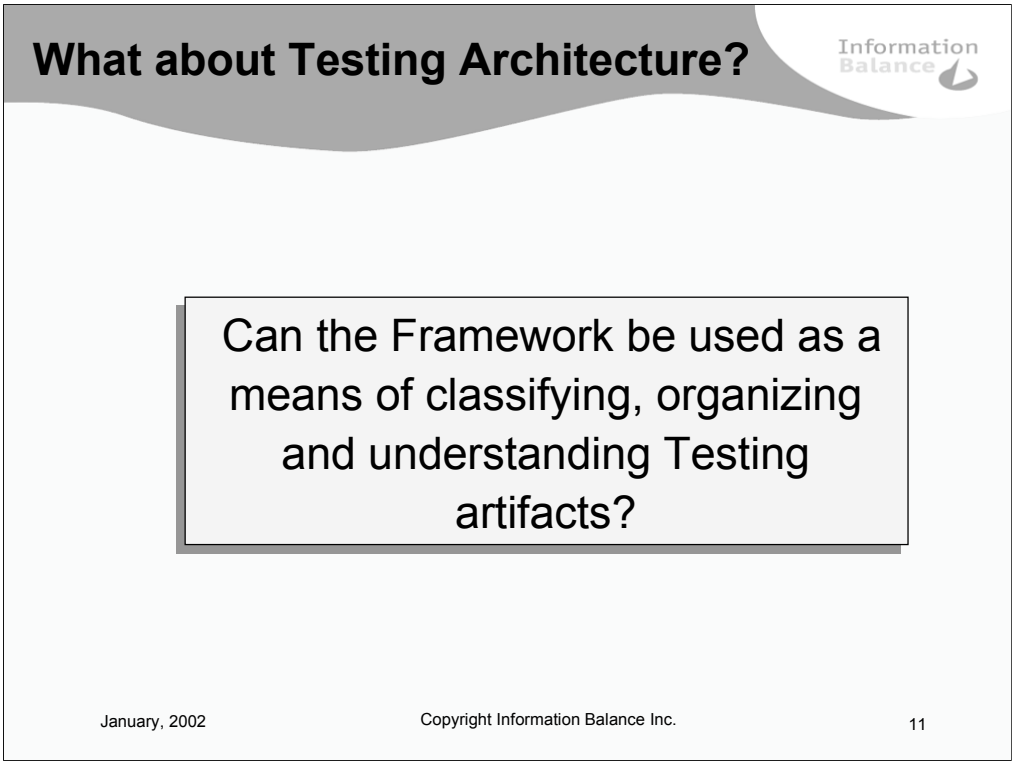


Risk can be added to the framework. Project Level Risks and Component-Level Risks are part of the spectrum of risks through the levels of the project architecture.



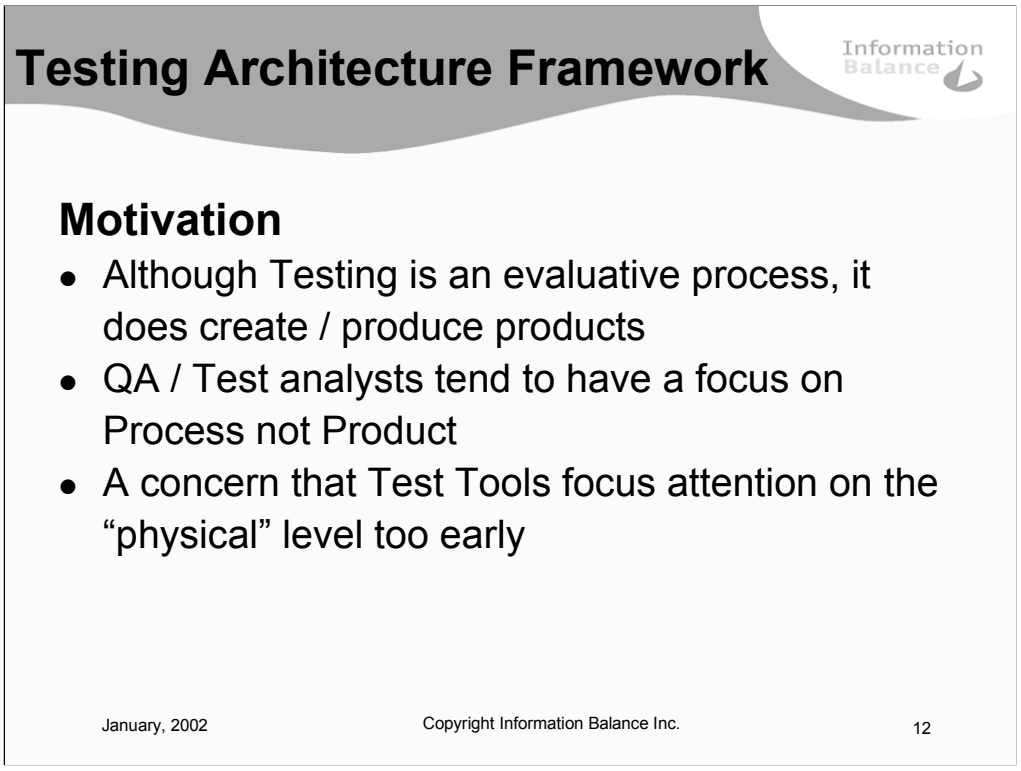
Are there other views that can be added on to the Framework that will provide additional insights into various QA / QC aspects?

You probably didn't think you would have homework coming home from this presentation, but I would like you to consider how other aspects such as Metrics, Configuration Management or Problem Management could be added.



What we have discussed up to this point is primarily extending the Development framework to show Testing / QA / QC activities.

However, Testing produces many products or artifacts of its own. Can we use this framework to describe the levels and transitions of testing artifacts that comprise a Testing Architecture?



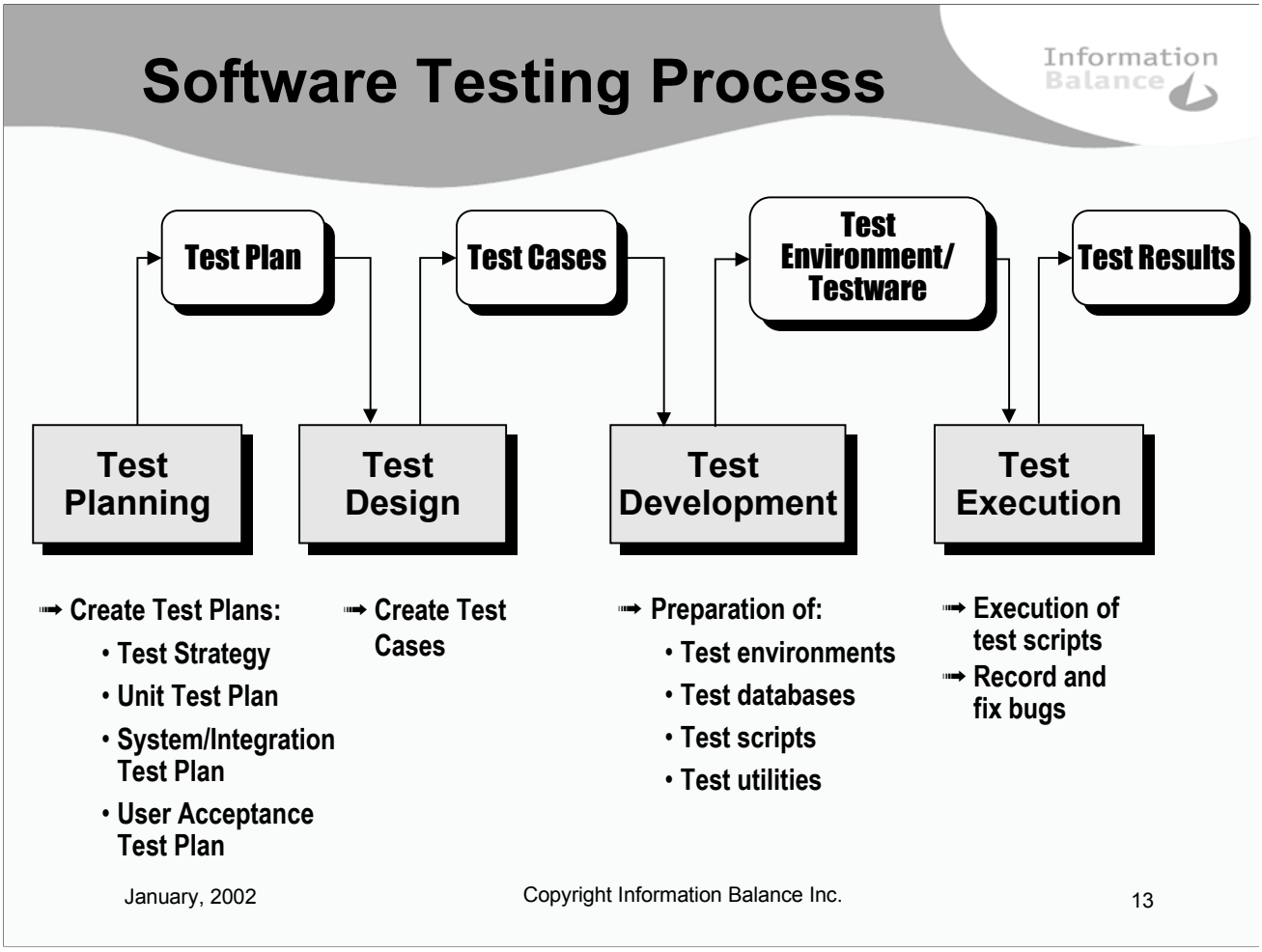
My original motivation for this presentation was a presentation given by Ed Kit at the EuroStar'99 conference in which he described a process of logically understanding test cases and then physically translating them into automated test cases.

My contribution then is to attempt to expand upon this concept to encompass all testing products.

Some other motivations for utilizing such a framework are:

• To understand "product" as well as "process". QA / QC people are often completely focused on process, with little regard for products. However, Project Managers are keenly interested in the products to be produced by testing activities.

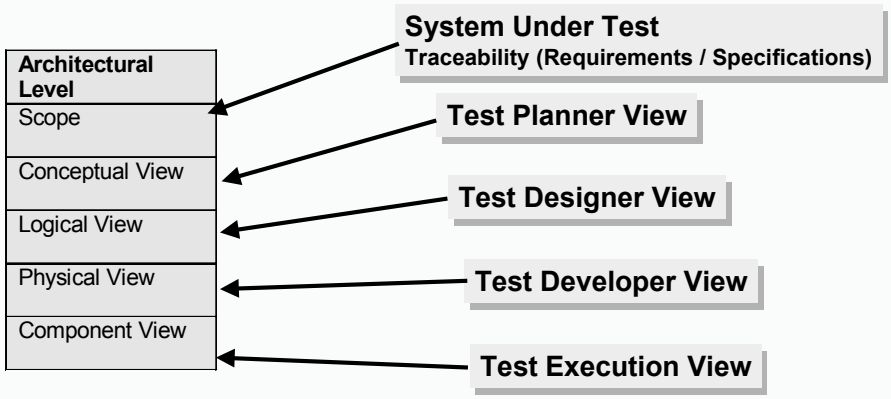
• As with all Tools, there is a tendency to rush into the "physical" level too early without first understanding what is needed.

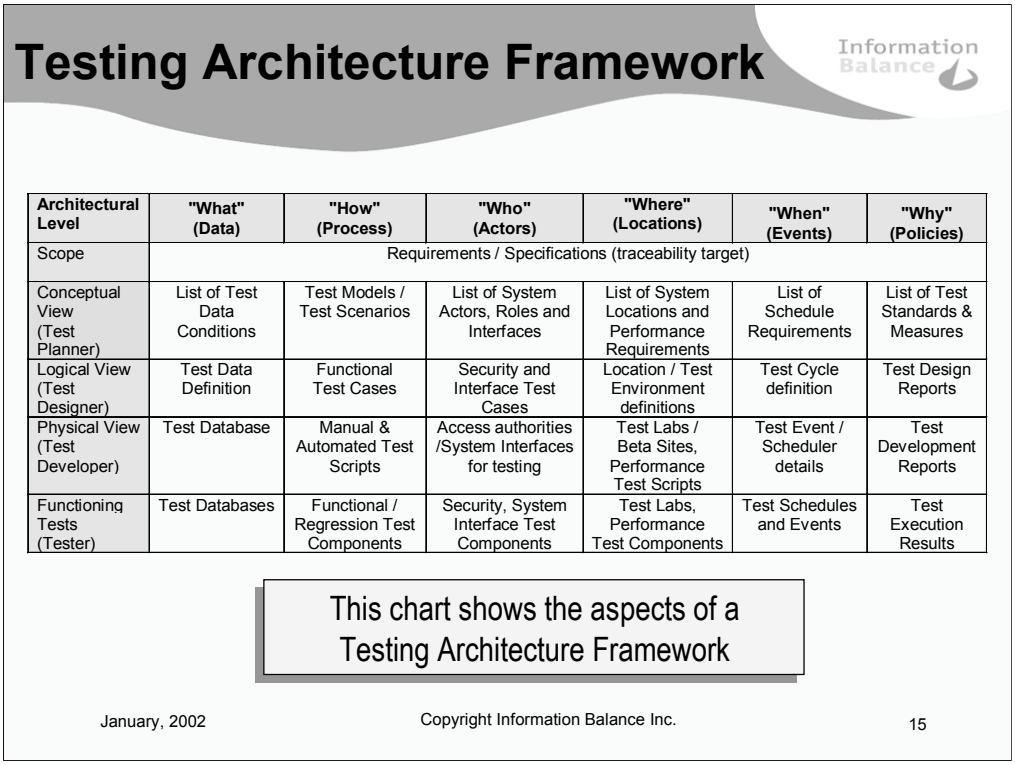


The Software Testing Process involves the planning, design, development and execution of all levels of software testing. The slide above depicts these major activities and the key products produced by these activities.

- Test Planning activities include the creation of test plans for each level of testing: the Master Test Plan, the Unit Test Plan, the System/Integration Test Plan and the User Acceptance Test Plan. These documents are critical to the success of the software development project as they serve the purpose of receiving clarification and consensus on "what" is to be tested.
- Test Design activities involve the creation of test cases. The test cases are the key to good testing.
- Test Development activities include the preparation of the test environments, the test databases and the test scripts.
- Test Execution activities include the execution and evaluation of the test cases. The goal is to ensure that expected result equals the actual result for all test cases.

Testing Architecture Levels





This chart shows the overall view of the testing architecture and testing artifacts.

The **How? Column** describes the **Tests** to be performed by the application.

The **What? column** describes the **Data** used by the tests.

The **Who? Column** describes the **people, roles and organizations** who will be performing the tests.

The **Where? Column** describes the **locations** in which the testing will be performed.

The **When? (Testing) Column** describes the **schedules** for the testing activities.

The **When? (System) Column** describes the **schedule- or event-based testing** to be performed.

The following slides will explain these contents in detail.

Testing Architecture Framework

Test Planner View

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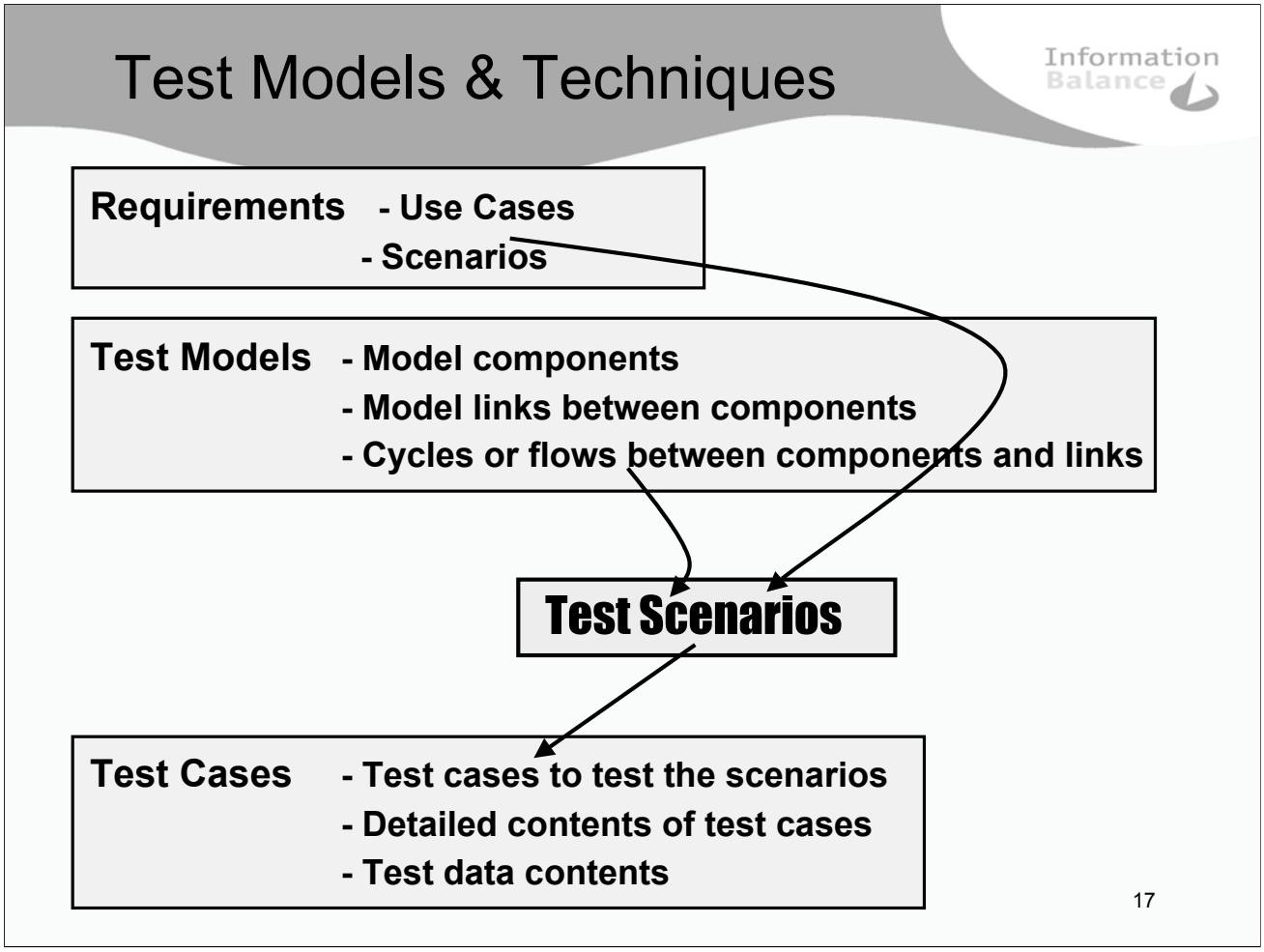
Specific resource planning aspects for Who, When, Where+

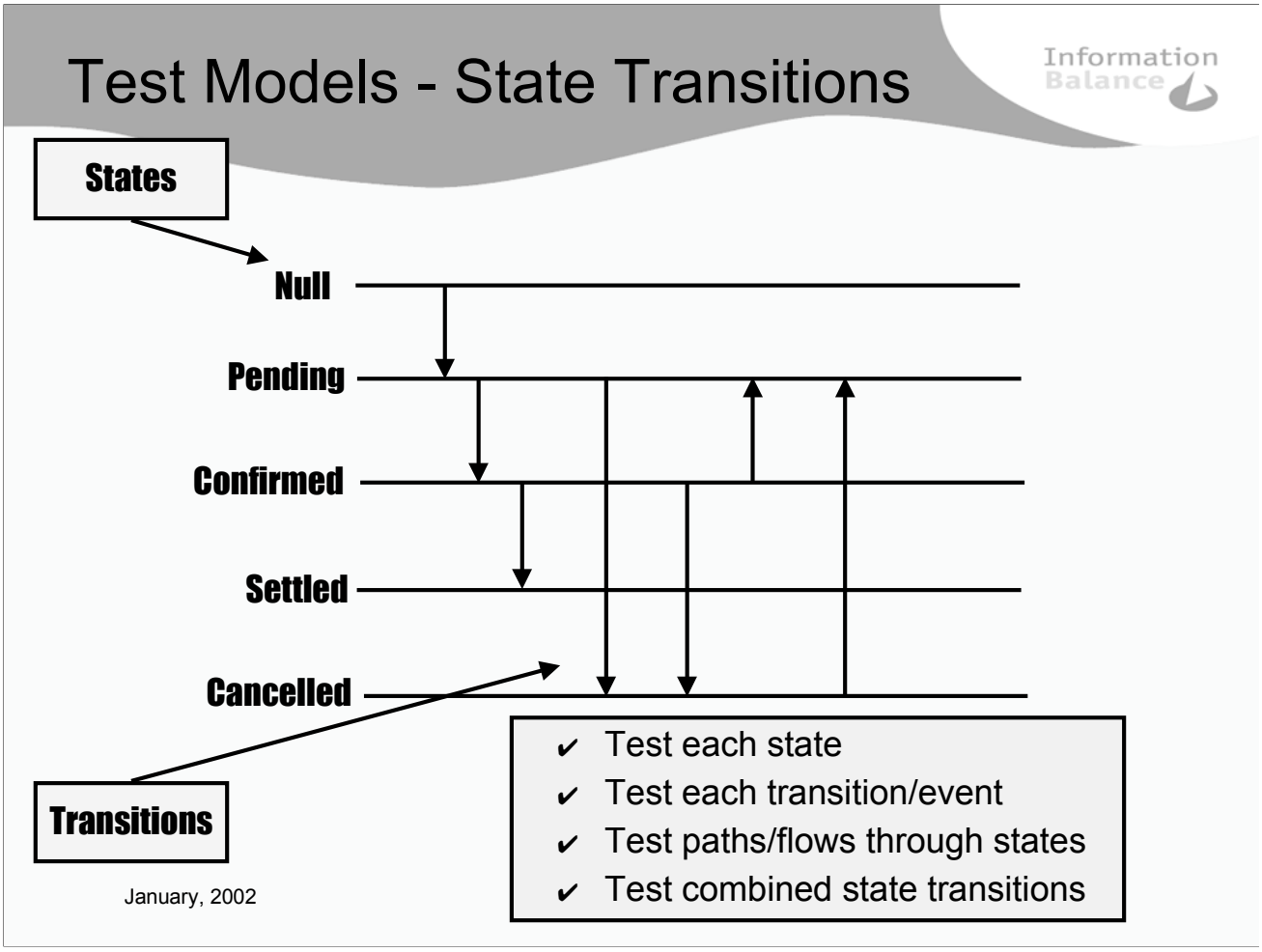
Architectural Level	"What" (Data)	"How" (Process)	"Who" (Actors)	"Where" (Locations)	"When" (Events)	"Why" (Policies)
Scope	Requirements / Specifications (traceability target)					
Conceptual View (Test Planner)	**List of Test Data Conditions**	**Test Models / Test Scenarios**	**List of System Actors, Roles and Interfaces**	**List of System Locations and Performance Requirements**	**List of Schedule Requirements**	**List of Test Standards & Measures**
Logical View (Test Designer)	Test Data Definition	Functional Test Cases	Security and Interface Test Cases	Location / Test Environment definitions	Test Cycle definition	Test Design Reports
Physical View (Test Developer)	Test Database	Manual & Automated Test Scripts	Access authorities /System Interfaces for testing	Test Labs / Beta Sites, Performance Test Scripts	Test Event / Scheduler details	Test Development Reports
Functioning Tests (Tester)	Test Databases	Functional / Regression Test Components	Security, System Interface Test Components	Test Labs, Performance Test Components	Test Schedules and Events	Test Execution Results

Conceptual View presents components of the Test Plan



Key concepts on this slide:

- Requirements or specifications describe the behaviors required in the software system. These requirements must be unambiguous, consistent, complete, feasible, and testable. Test Cases are written based on these requirements and must be traceable directly back to these requirements.
- Use Cases or user scenarios present ways that users will actually use the system. This allows the software to be tested in realistic situations.
- Test Models represent the software system as a model of components and links between the components. User scenarios can then be used to select appropriate paths or flows through the components that represent user usage situations.



Any component, object, or entity that has a state or status has a object life cycle. This life cycle moves through the various states or status' as external events or actions are executed on that object. The slide above shows the simplified example of a stock trade. The trade (object) starts in a *pending* state when it is first created, moves to a *confirmed* state when approved by one trader and then to a *settled* state when the originator of the trade also approves.

The diagram shows how the states change in response to the *events* (such as the approvals). There are also additional states such as *cancelled* that add additional paths through the states.

If a system or part of a system can be described through State Transition model, then test cases can be derived by testing:

- Each state.
- The transitions/events that cause the state to change.
- Various paths or flows through the various states.
- There can also be interrelated states (i.e. two objects which have related states. As an example, the transmission object in a car will only move from 'Park' to 'Drive' if the Engine object is 'on'.)

Remember to include invalid events/transitions in your test cases.

Other Examples of Test Models

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- Full / partial Site Map for links / interfaces
- Workflow Model for role-to-role interaction
- Behaviour diagrams (sequence, activity) for class / component interactions

For more ideas, refer to
www.model-based-testing.org

Testing Architecture Framework

Test Designer View

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Architectural Level	"What" (Data)	"How" (Process)	"Who" (Actors)	"Where" (Locations)	"When" (Events)	"Why" (Policies)
Scope	Requirements / Specifications (traceability target)					
Conceptual View (Test Planner)	List of Test Data Conditions	Test Models / Test Scenarios	List of System Actors, Roles and Interfaces	List of System Locations and Performance Requirements	List of Schedule Requirements	List of Test Standards & Measures
Logical View (Test Designer)	**Test Data Definition**	**Functional Test Cases**	**Security and Interface Test Cases**	**Location / Test Environment definitions**	**Test Cycle definition**	**Test Design Reports**
Physical View (Test Developer)	Test Database	Manual & Automated Test Scripts	Access authorities /System Interfaces for testing	Test Labs / Beta Sites, Performance Test Scripts	Test Event / Scheduler details	Test Development Reports
Functioning Tests (Tester)	Test Databases	Functional / Regression Test Components	Security, System Interface Test Components	Test Labs, Performance Test Components	Test Schedules and Events	Test Execution Results

Logical View provides a logical definition of Test Cases prior to creating Automated Test Scripts

Testing Architecture Framework

Test Developer View

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Architectural Level	"What" (Data)	"How" (Process)	"Who" (Actors)	"Where" (Locations)	"When" (Events)	"Why" (Policies)
Scope	Requirements / Specifications (traceability target)					
Conceptual View (Test Planner)	List of Test Data Conditions	Test Models / Test Scenarios	List of System Actors, Roles and Interfaces	List of System Locations and Performance Requirements	List of Schedule Requirements	List of Test Standards & Measures
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Physical View presents Test Environments and introduces Automated Test Languages

Testing Architecture Framework

Test Execution View

Information Balance

Architectural Level	"What" (Data)	"How" (Process)	"Who" (Actors)	"Where" (Locations)	"When" (Events)	"Why" (Policies)
Scope	Requirements / Specifications (traceability target)					
Conceptual View (Test Planner)	List of Test Data Conditions	Test Models / Test Scenarios	List of System Actors, Roles and Interfaces	List of System Locations and Performance Requirements	List of Schedule Requirements	List of Test Standards & Measures
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Functioning Tests (Tester)	**Test Databases**	**Functional / Regression Test Components**	**Security, System Interface Test Components**	**Test Labs, Performance Test Components**	**Test Schedules and Events**	**Test Execution Results**

Functioning Tests View presents the execution of functioning tests and the tracking / correction of bugs

Testing Architecture Framework

Sample Test Project

Information Balance

Architectural Level	"What" (Data)	"How" (Process)	"Who" (Actors)	"Where" (Locations)	"When" (Events)	"Why" (Policies)
Scope	Requirements / Use Cases (traceability target for UAT); User Interface Design / High Level Design (traceability target for SIT); Component Design / Detailed Design(traceability target for Unit Test).					
Conceptual View (Test Planner)	List of Test Data Conditions	Test Models / Test Scenarios	List of System Actors, Roles and Interfaces	List of System Locations and Performance Requirements	List of Schedule Requirements	List of Test Standards & Measures
Logical View (Test Designer)	**Test Data Definition (Word)**	**Functional Test Cases (Excel)**	**Security and Interface Test Cases (Excel)**	**Test Environment definition / Performance Requirements (Word)**	**Test Cycle definition (Word)**	**Traceability Matrix (Excel), Design Scorecard (Excel)**
Physical View (Test Developer)	**Test Database (Oracle utilities)**	**Manual & Automated Test Scripts (JUnit, WinRunner)**	**Access authorities /System Interfaces for testing (JUnit, WinRunner)**	**Test Labs / Beta Sites, Performance Test Scripts (LoadRunner)**	**Test Event / Scheduler details (cron)**	**Development Scorecard (Excel)**
Functioning Tests (Tester)	**Test Databases (Oracle; DBDiff; Access for test verification)**	**Functional / Regression Test Components (WinRunner)**	**Security, System Interface Test Components (JUnit, WinRunner)**	**Test Labs, Performance Test Components (LoadRunner, Performance Monitors)**	**Test Schedules and Events (cron)**	**Problem Tracking (TestTrack), Execution Scorecard (Excel)**

How many Frameworks?

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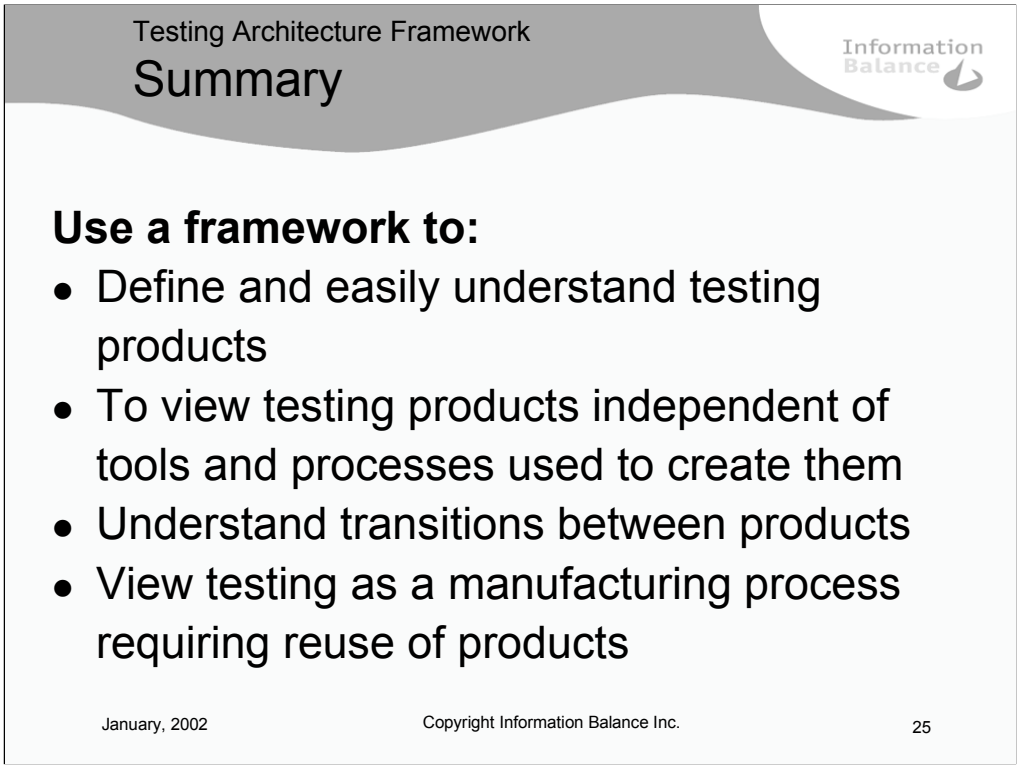
- Do we need a Framework for each level of testing?
  - Unit, Integration, System, Acceptance
- Scope of each level of testing is different
  - As seen in Scope row of previous slide
- Test Models of each level are different
  - State Transition, Site Map, Workflow Model for Acceptance Test
  - Sequence / Activity diagrams for Unit Test
- Determine if a separate Framework provides more understanding



Should you use such a framework at your shop?

Many developers like to use the framework as a way of thinking about a problem. They don't necessarily use it for creating every development product, because they feel it is too confining.

I believe it is a good tool for thinking about your testing process, your testing products and the transitions between products. It is also a good framework for determining where reuse in the form of templates, checklists and reusable test cases would assist in making your testing practice more effective.

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Questions?

Bibliography

- Zachman, J.A., *A Framework for Information Systems Architecture*, IBM Systems Journal, vol. 26, no. 3, 1987.
- Sowa, J.F. & J.A. Zachman, *Extending and Formalizing the Framework for Information Systems Architecture*, IBM Systems Journal, vol. 31, no. 3, 1992.
- Sharp, Dr. John K., *Zachman Framework*, The Journal of Conceptual Modeling, February 1999.
- Kit, Ed, *The New Frontier…Third Generation Software Testing Automation*, EuroStar'99 Conference, 1999.