



Building a project with NI TestStand

Architectures and methodologies
illustrated by case studies



Summary

- ❑ **TestStand : reminders**
- ❑ **TestStand : selection criteria**
- ❑ **Case studies**
- ❑ **Architectures**
- ❑ **Methodologies**
- ❑ **Conclusion**



TestStand : reminders (1)

□ Definition

« NI TestStand is ready-to-run test management software designed to help you develop automated test and validation systems faster ».

□ Standard as a fact

- TestStand establishes itself as a test bench development platform since version 3.0 (2004)
- 14 of the top 15 electronics manufacturers use NI TestStand (Electronic Business, 2004)



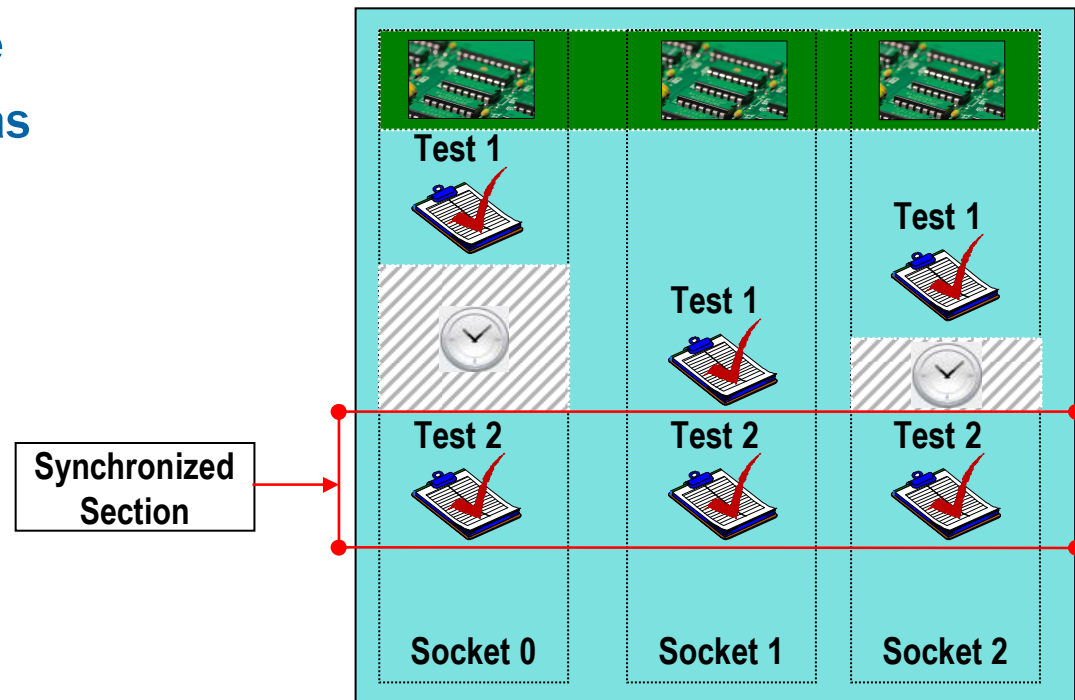
TestStand : reminders (2)

❑ Customization

- Callbacks
- Operator interface
- Database Schemas

❑ Process models

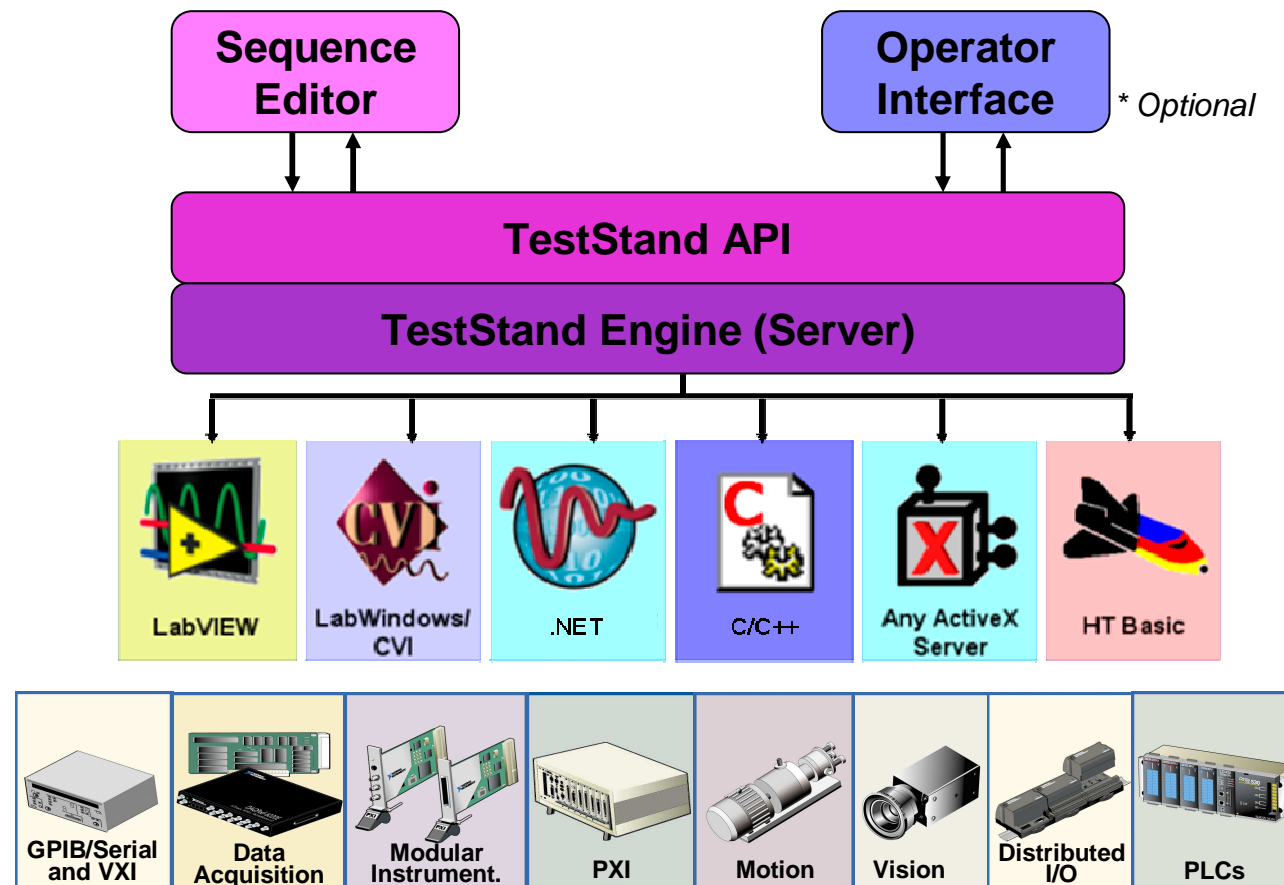
- Sequential
- Parallel
- Batch





TestStand : reminders (3)

General architecture





TestStand : selection criteria (1)

- ❑ **A test sequencer is recommended:**
 - if the test sequence depends on product under test
 - if the test sequence has to be modified

- ❑ **TestStand advantages**
 - Modularity which facilitates « re-use »
 - Scalable et durable
 - Forma structure, error management
 - « Core » robust et customizable
 - Parallelism, multi-thread, multi-execution
 - Login, user management, UUTs management
 - Execution report, database results logging
 - Multi-languages resources files



TestStand : selection criteria (2)

❑ TestStand disadvantages

- Requires Microsoft Windows
- Run-time license at least on each station
- « Insufficient » native Step Types palette
- Complexity



❑ Carrying out TestStand

- Training essential
- NI partner assistance

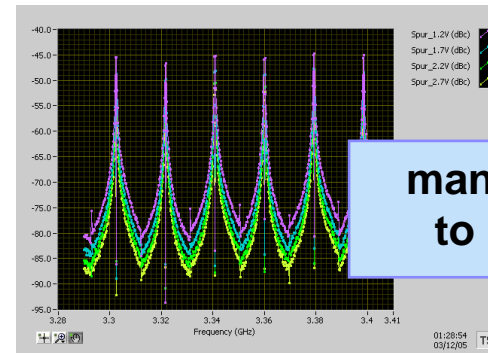




Using TestStand

❑ In laboratory

- Characterization bench
- Validation bench



❑ In production

- Input control bench
- Assembly bench
- Functional test bench



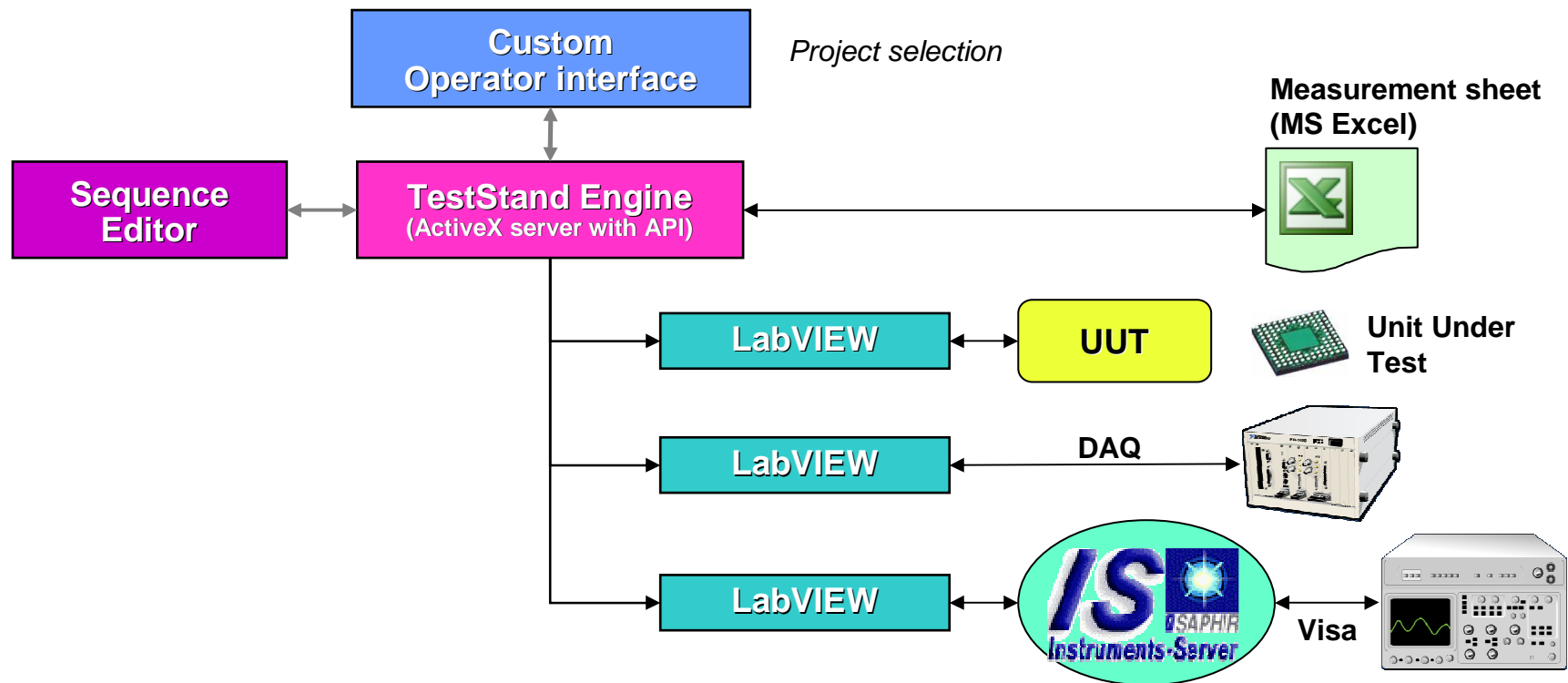
FAIL

PASS



Case studies (1)

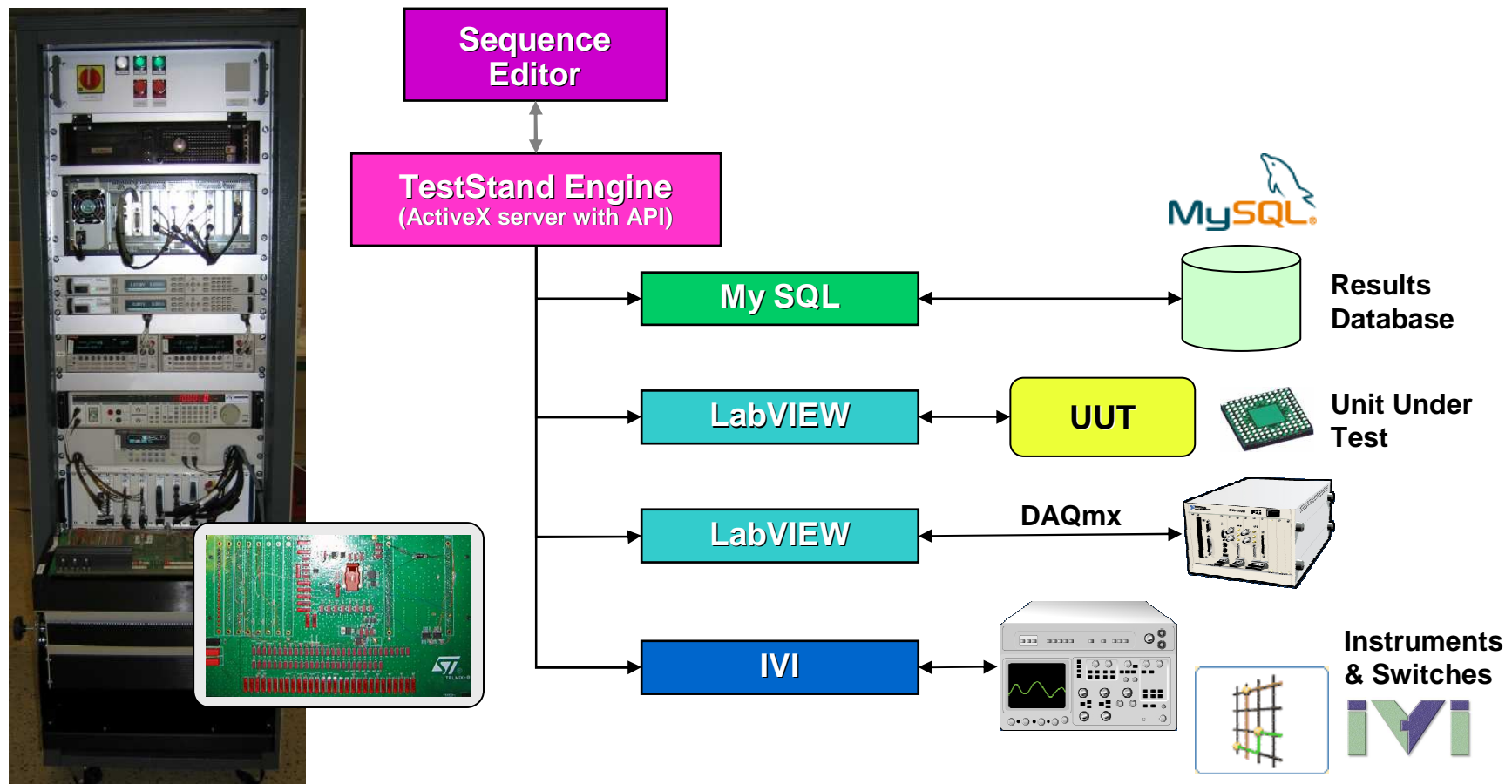
ATMEL : IC characterization bench





Case studies (2)

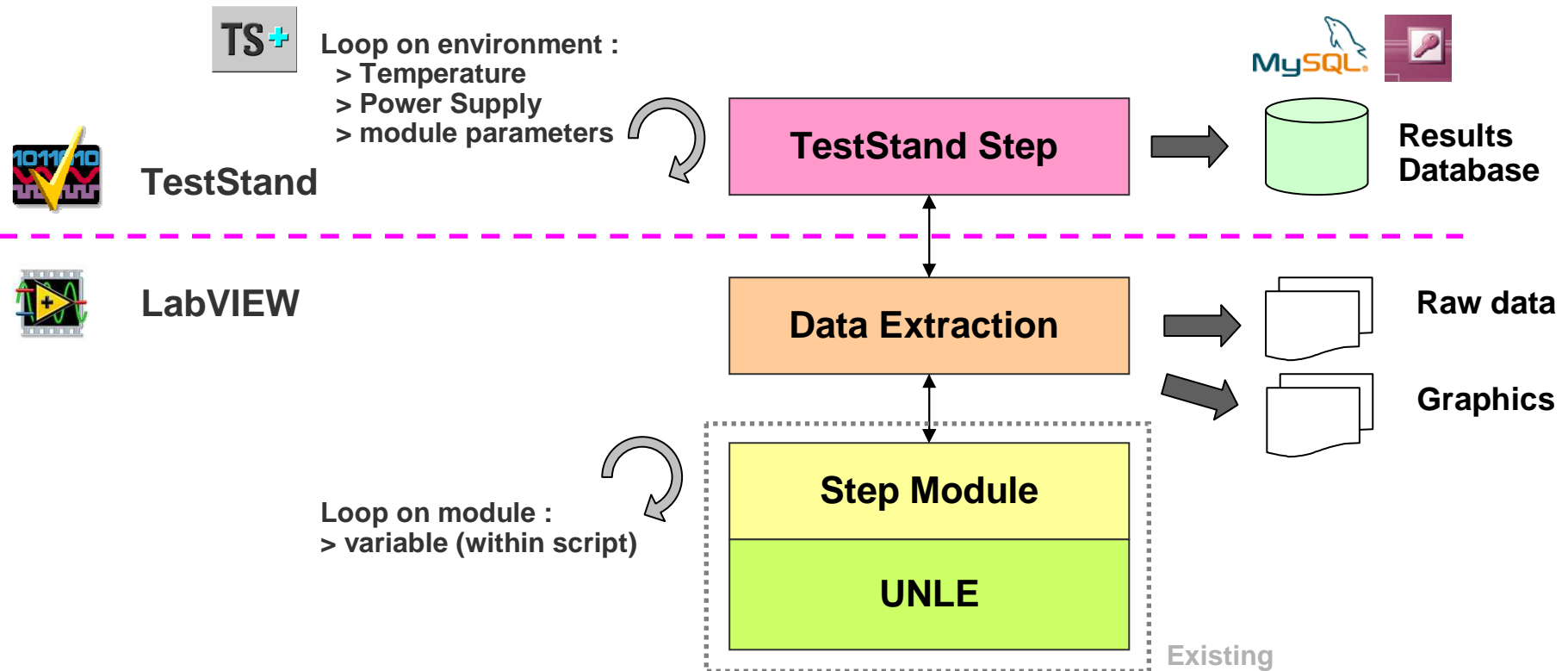
STMicroelectronics : TELMIX bench





Case studies (3)

STMicroelectronics : RFTS characterization bench





Case studies (4)

❑ AREVA T&D : Sensor input control bench



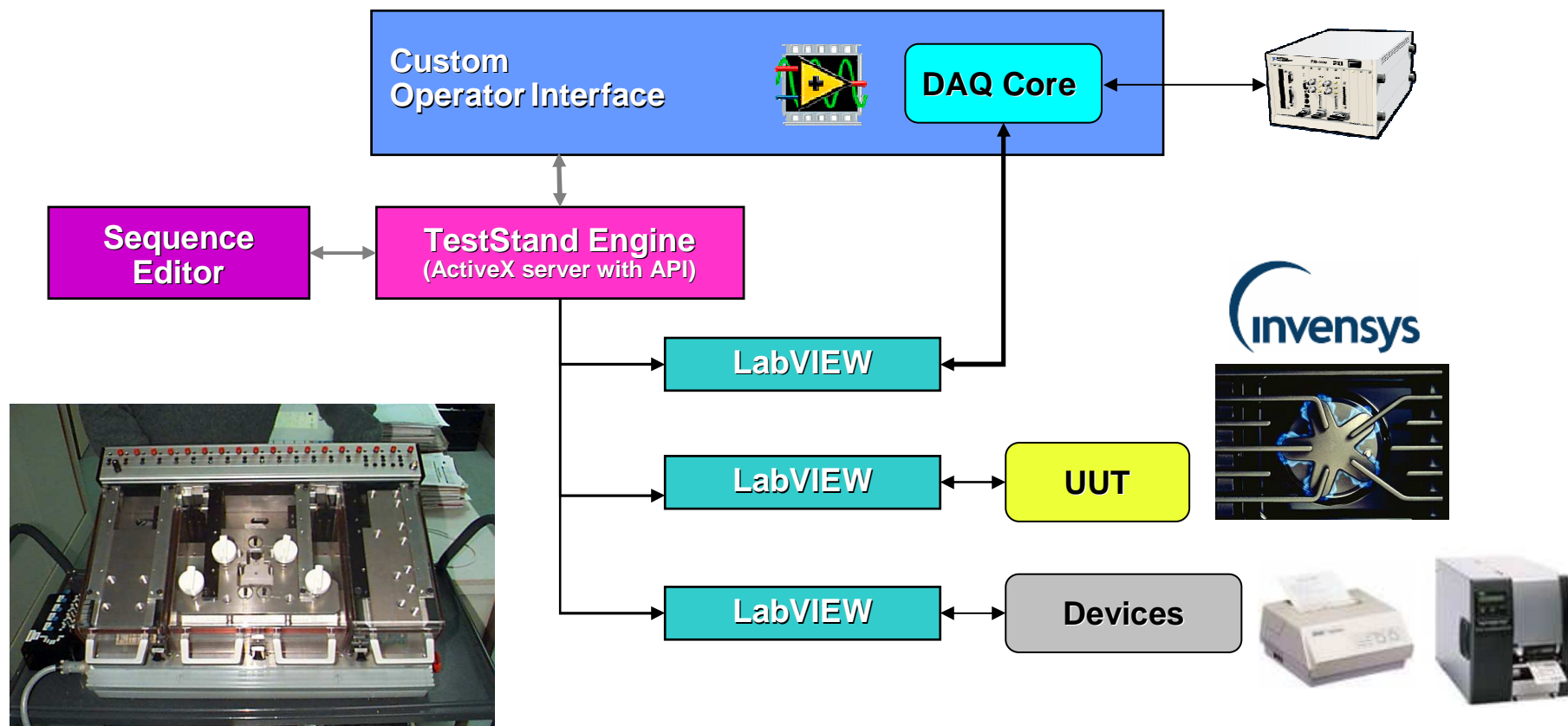
- Impossible challenge: five days delay
- Use of generic configurable steps
- Saving sensor lot results into ASCII file then results analysis with MS Excel





Case studies (5)

INVENSYS : Gas products functional test bench





Case studies (6)

☐ AREVA T&D : PLC monitoring

- Semi-auto
- Validation by operator

The screenshot displays the Mesulog software interface for the AREVA BWatch3 Test bench. The interface is divided into several sections:

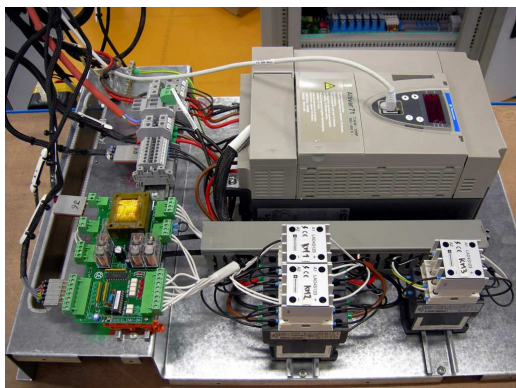
- Header:** Mesulog logo, title "AREVA BWatch3 Test bench", version "V1.0.0.50804", and timestamp "16:34:15 08/11/05".
- Product S/N:** A field for entering the product serial number and a "Terminate Execution" button.
- Current sensor:** A field for the sensor label, currently set to "GOA/0".
- Test Execution Table:** A table with columns for Name, Comment, and Status. The table lists various checks such as "CPU's Configuration", "Sensors Activation", and several threshold tests (1st, 2nd, 3d thresholds for Decrease and Increase). All listed tests have a "Passed" status.
- Simulator and CPU Data:** Two panels showing real-time data. The Simulator panel shows Pressure (bar) at 9.491 and Temperature (°C) at 20.00. The CPU panel shows Pressure (bar) at 9.491, Temperature (°C) at 20.00, and Density (g/l) at 64.809. A "Responding" indicator is shown as a green light.
- Control Panel:** A "Software HMI" section with a large cyan button labeled "GOA/0 : Check density value" and a "Validate" button with a green checkmark.
- Footer:** User: MESULOG, Number of Tests: 10.



Case studies (7)

❑ SODIMAS : Lift electrical control box

- Initially intended in LabVIEW
- Only one generic Step Type
- Sequences easily written by a technician



Etape	Description	Commentaire	Mode Exec.	Status
Message	"Raccordement"			
TestUnit #1	Test, Tensions = 24VDC, 10VDC, 230VAC, <N... Relais = 00010010 01000110 01100001 00000010			
TestUnit #2	Test, Tensions = <NC>, 10VDC, 230VAC, <NC... Relais = 00011010 01000101 01110001 00000010			
End				



Case studies (8)

❑ HONEYWELL : Assembly and functional sub-assemblies test bench

- PLC and tester
- 3 UUTs in parallel
 - Assembly
 - Functional test
 - Packaging vision test
- Videos display for novice operator

Honeywell ATP Bench Operator Interface

VI.D.5.70120 10:40:16
MESULOG 2007 02/06/07

Product under Test
Class: TCB Type: TCB0004
Technical Reference: EAN13: 62400AA 3603940002881
Embedded software 1: QW2018000A Embedded software 2: xxx
Work Order: Quantity:

Action
Single Pass Test UUTs

Test Statistics
Since: 01:00:00 01/01/1904
Nb PASSED: 47
Nb FAILED: 20
Total Tested: 67
% PASSED: 70,1

Status
Calibration: OK
Maintenance: OK
Components: OK

Positions
1) Assembly: Waiting Detected
2) Pre-Funct. Test: Waiting Detected
3) Funct. Test: Waiting Detected
4) Pre-Packaging: Waiting Detected
5) Packaging Test: Waiting Detected
6) Scale: Waiting Detected

Evacuation Ramps
Assembly: Waiting Detected
Functest: Waiting Detected
Fiability: Waiting Detected

Packaging Test Step

Container
Nb Products: 0
Weight: 0,447 kg

User Group: Administrator Path: E:\Test\Bench\Common\Sequence\seq

User message: Scale initialisation : Zero

Sequence Description:
Generic Sequencer V2.2.0.70131

Step	Description	Flow Properties
Lock0	Acquire(FieGlobal: Lock0)	
Assembly Test	Call Assembly_Test in <Current File>	
Evacuation Ramp Assembly	Call Evacuation Ramp Assembly in <Current File>	Precondition
Unlock0	Release(FieGlobal: Lock0)	
If Assembly Test FAIL	Goto End Group	Precondition, Post...
Lock1	Acquire(FieGlobal: Lock1)	
Handler1 Lock	Call Handler1 Lock in <Current File>	Post Action
Lock2	Acquire(FieGlobal: Lock2)	
Handler1 Unlock	Call Handler1 Unlock in <Current File>	
Fixed 3D Label	Call Fixed 3D_Label in <Current File>	Precondition
SafetyBox Lock	Call SafetyBox Lock in <Current File>	Precondition
Unlock1	Release(FieGlobal: Lock1)	
Functional Test	Call Functional_Test in <Current File>	
Lock3	Acquire(FieGlobal: Lock3)	
SafetyBox Unlock	Call SafetyBox Unlock in <Current File>	
Evacuation Ramp Funct Test	Call Evacuation Ramp Funct Test in <Current File>	Precondition
Unlock2	Release(FieGlobal: Lock2)	
If Functional Test FAIL	Goto Unlock3	Precondition, Post...
Handler2 Lock	Call Handler2 Lock in <Current File>	
Handler2 Unlock	Call Handler2 Unlock in <Current File>	
Packaging Test	Call Packaging_Test in <Current File>	
Evacuation Ramp Packaging	Call Evacuation Ramp Packaging in <Current File>	Precondition
Scale Increment	Call Scale Increment in <Current File>	Post Expression
Nb Scale Print Lot Label	Call Scale Print Lot Label in <Current File>	Precondition

User: administrator Model: ParallelModel.seq No Tests Selected Number of Tests: 25



Case studies (9)

- ❑ **VALEO : Assembly and functional test bench**
 - Different sequences launched in parallel
 - Components control, picking indication for the operator
 - Replacement of three PLC
 - Monitoring of vision station and acoustic station





Architecture (1)

❑ Instruments driving

- Interchangeability (IVI, IS, others) ?
- Switch Executive ?

❑ Database

- Tests parameters (configuration)
- Tests limits (specifications)
- Tests results (→ report)

Direct link
to ERP ?

❑ Additional servers

- NI Shared Variable Engine
- OPC



Operator interface
indicators
automatically
updated



Architecture (2)

❑ Stations

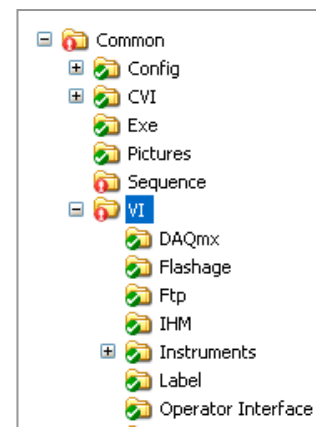
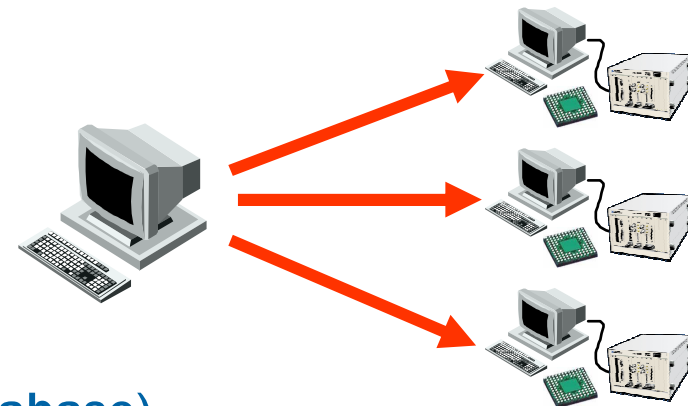
- Single station
- Deployment on many PC

❑ Network

- LAN : server connection (file or database)
- WAN : remote control, database

❑ Source Code Control

- Tortoise SVN
- Synchronicity
- Others...

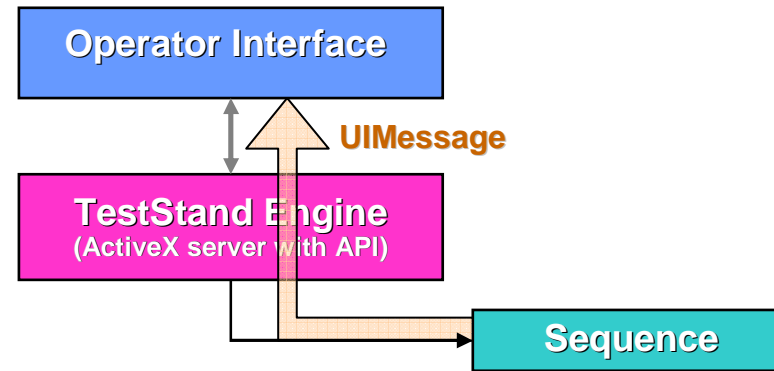




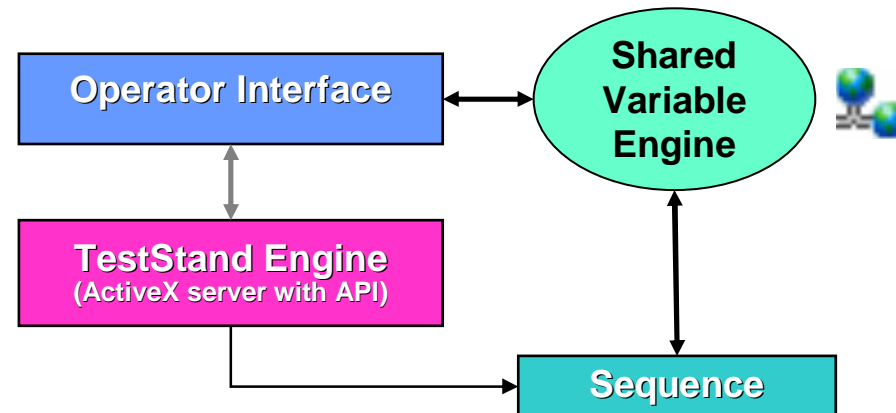
Architecture (3)

Operator interface

- TS : UIMessage



- Additional Server





❑ Recommendations

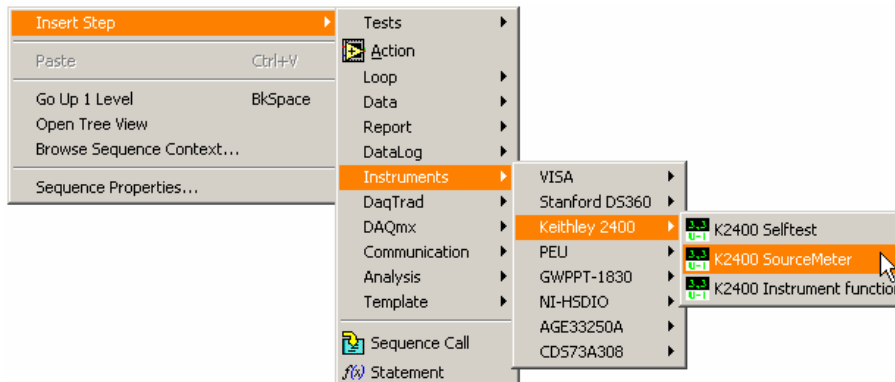
- **Modularity**
 - Use containers (= LabVIEW cluster)
 - Create sub-sequences
- **Data zones**
 - Sequence « Parameters » and « Locals »
 - « File Globals », « Stations Globals »
- **Setup and Cleanup**
- **Documentation**
 - Use labels
 - Use comments



Methodology (2)

Step Types libraries

- Generic modules creation
 - Configuration dialog box
 - Execution Module (PostStep)
- Use of validated independent modules
 - Different Step Types versions can coexist
 - Different Run Time Engine versions can coexist
- Version management



Step Type	Version
Frequency_Count	1.2.4.0
Frequency_PowerInBand_1_2	1.2.4.0
Frequency_Measurement_1_2	1.2.4.0
EditSubstep	3.5.0.725
PostSubstep	3.5.0.725



□ Project tree

- **Search directories**
 - By default
 - Be careful when adding new search branches
- **Folder organization**
 - Generic
 - Specific to a bay
 - Specific to a product
- **Types**
 - Sequences (process model, callbacks, test sequences)
 - Code modules
 - Executables
 - Data



Methodology (4)

Execution status

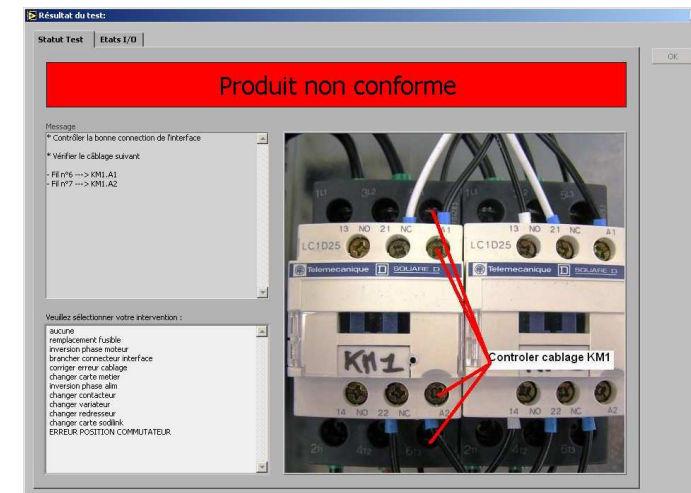
- PASS
- FAIL
- ERROR
- TERMINATED

Status management

- Post Step
- Post UUT

Error management

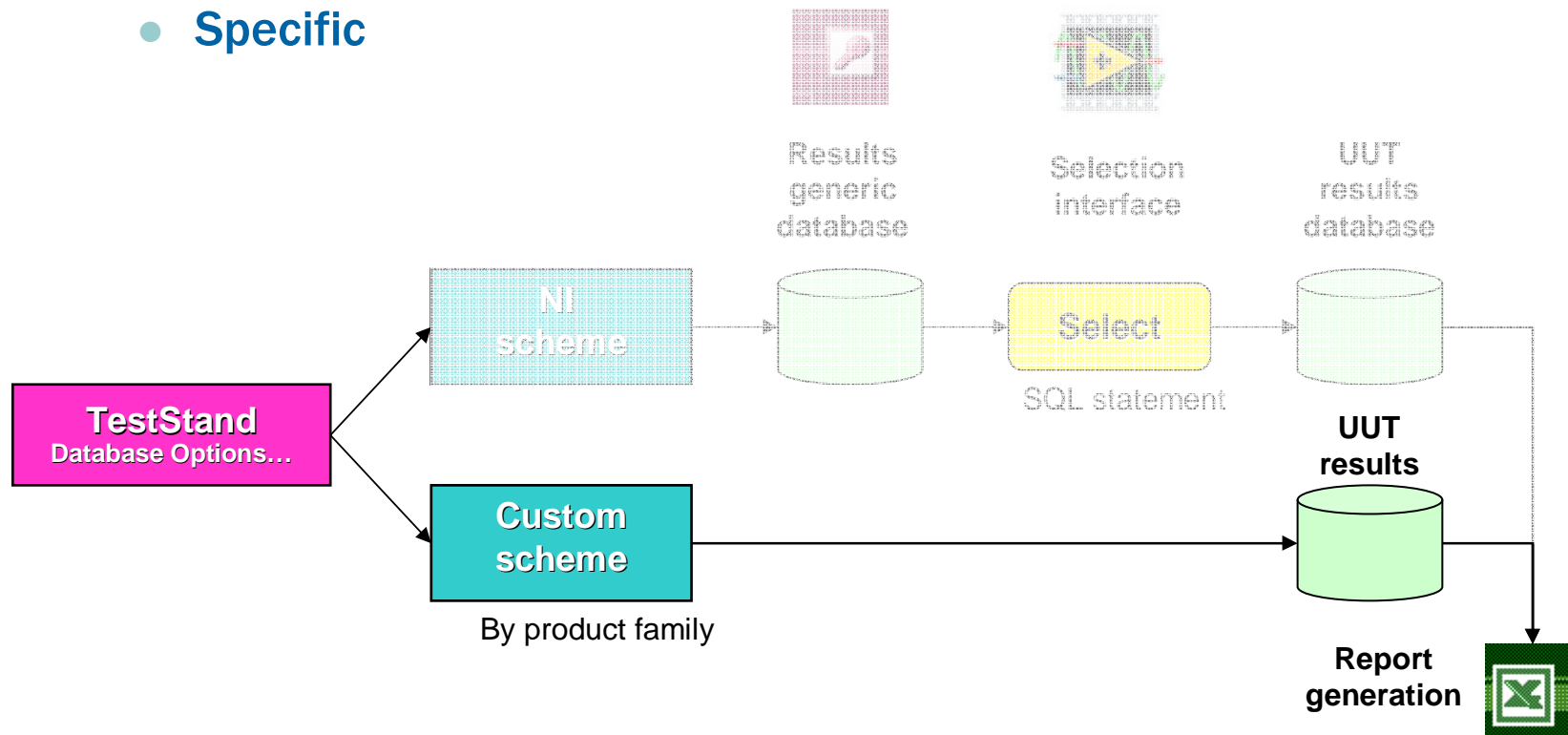
- Resume after operator action
- Stop test execution





Database – Automatic logging

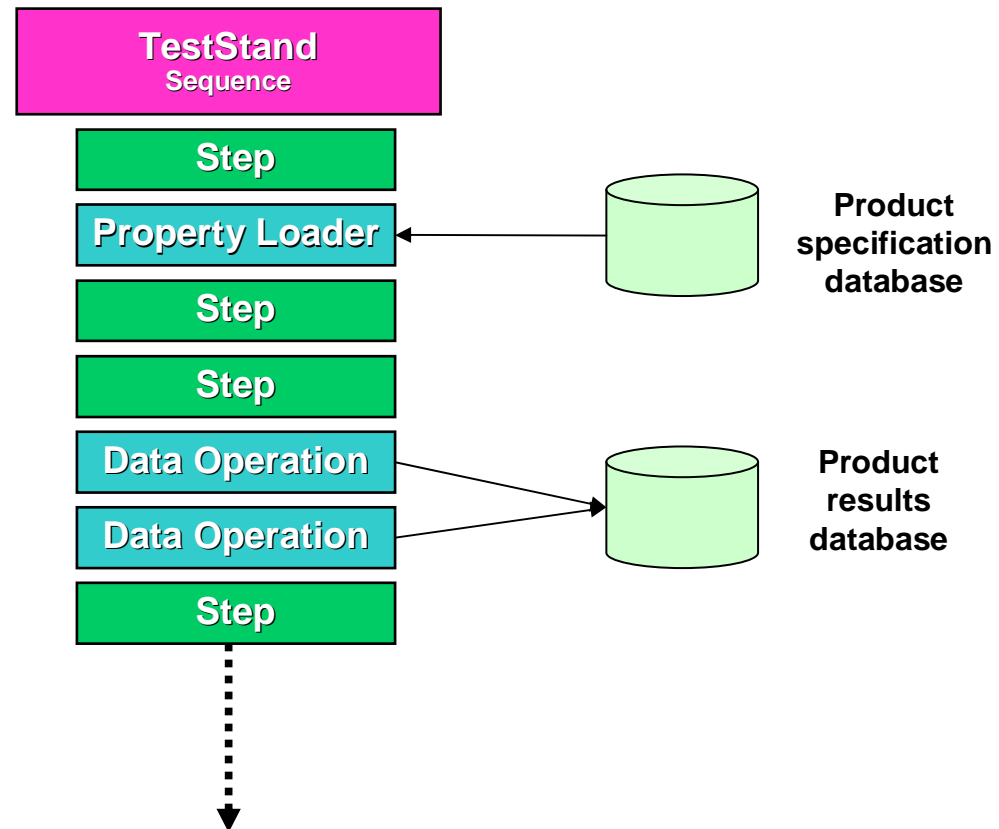
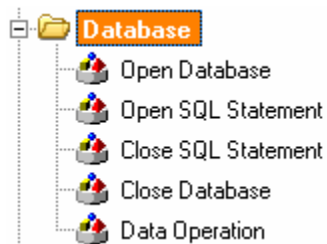
- Generic
- Specific





Database – Occasional access

Database steps





□ Test report

- Enable ↔ Disable
- Automatic report generation = execution trace
 - ASCII
 - HTML
 - XML → ATML ?
- Custom report generation

□ Printing

- Default label
- Tested product label
- Lot packaging label





□ Debug and maintenance tools

● Tools



- Breakpoint ⇔ Step Into / Step Over / Step Out / Terminate
- Watch Expression → « Online » variables modification
- Skip / Passed / Failed
- Interactive Loop
- Next step

Watch View			
Watch Expression		Value	Type
Locals.Count_1	f(x) ✓	<input type="text"/>	Number
Locals.Count_2	f(x) ✓	0	Number

● Using Sequence Editor



● Using Operator Interface





Conclusion

- ❑ **TestStand is a powerful but complex tool**
- ❑ **There is no universal architecture**
- ❑ **Not ONE programming method, but...
... use methodology !**

- ❑ **With a suitable architecture and a good methodology, NI TestStand is always a good choice.**



Questions





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