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# Platform Based Test System Development

## NIDays 2014

**Tero Leppänen**
**Espotel Oy**

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# Espotel as a company


The leading engineering services company in the field of embedded systems.

- More than 25 years in operation, founded in 1986.
- ISO9001 and ISO13485 certified.
- Gold Alliance partner of National Instruments
- Operations in Finland, Sweden and Poland. Approximately 300 employees.
- Espotel values are honesty and openness in professional, customer oriented activity that leads to profitability.
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# Espotel – Our Development Partner

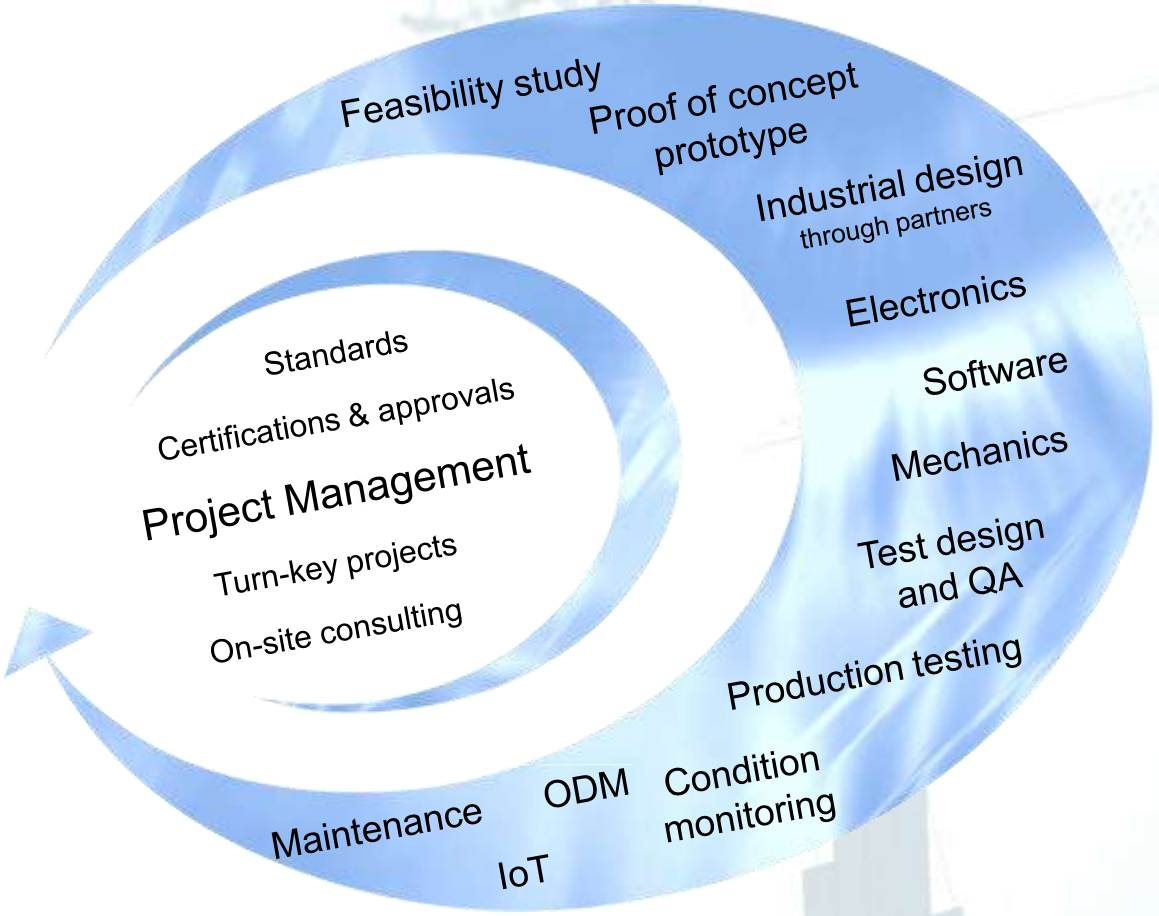
NATIONAL INSTRUMENTS Gold Alliance Partner

Industrial applications

Medical devices

Telecom

Defence



# The Lifecycle of Product Testing


**Design phase**

- Unit testing, module testing, SW testing, HW testing, Integration testing
- In order to support upcoming phases, apply DFT here!

**Verification and Validation**

- System testing, Hardware-In-Loop (HIL)

**Manufacturing**

- Production testing
- Test data management and analysis

**Design Maintenance**

- Re-verification and re-validation
- Production testing maintenance

**Repair and field return analysis**

# Lifecycle of Product Testing: DFT Targets

**Easing testability in R&D and Production**

- Optimum blend of test methods, with best quality, best possible cost, largest amount passed and in shortest possible time

**Detecting defects as early as possible**, keeping the “rule of tens” in mind

- Improving reliability of testing and diagnosis

**Utilizing known solutions**; avoiding reinventing the wheel

- Test concepts, re-use of existing test cases, test libraries, etc.
- Standardizing existing testing solutions, paying close attention to product features to get everything needed tested

**Speeding up the time to market**

- Standardize test processes and automated test systems also in R&D

**Platform: Standardized DFT process / Check-lists in use**

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PROCKET
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# Modular Test Platform

- Turnkey solution for functional testing
- Fast and low risk production ramp-up
- EMS independent testing solution
- Efficient test system development process
- Uses commercial off-the-shelf instrumentation and industry standard SW tools
- Minimized costs over the product life cycle
- The Procket family provides cost effective production testing solution for a large production volume range

## Technology Partners

NATIONAL INSTRUMENTS Gold Alliance Partner
WATS
ATX
virinco
NATIONAL INSTRUMENTS TestStand
JTAG TECHNOLOGIES
LabVIEW Certified Developer
GOPEL electronic

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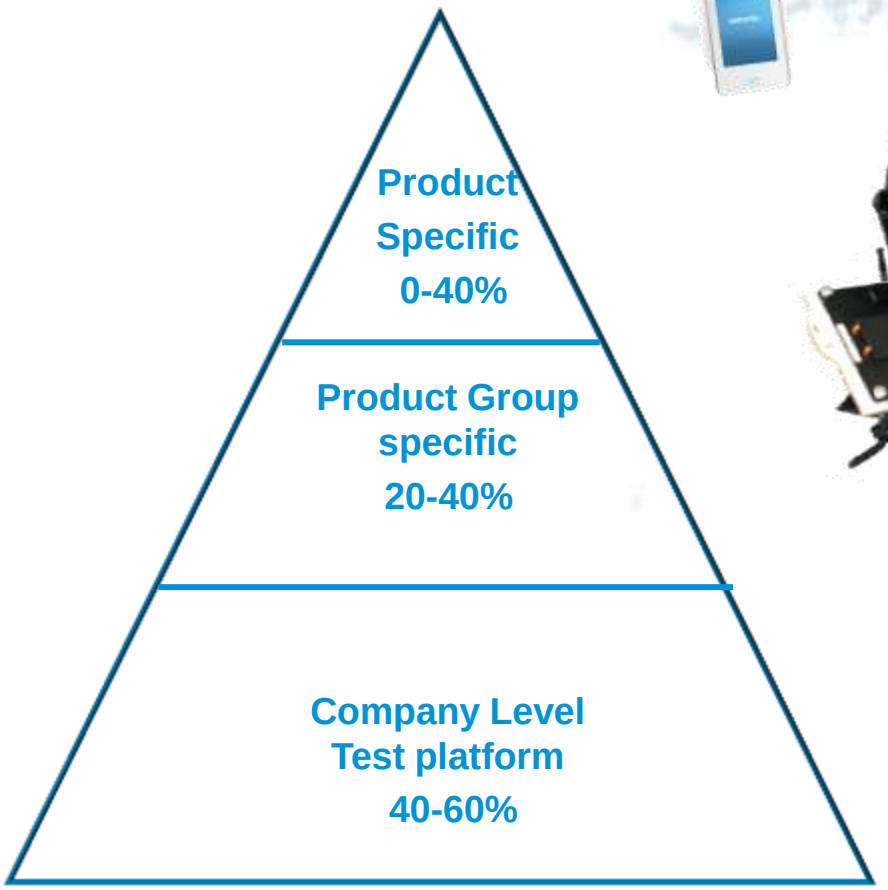
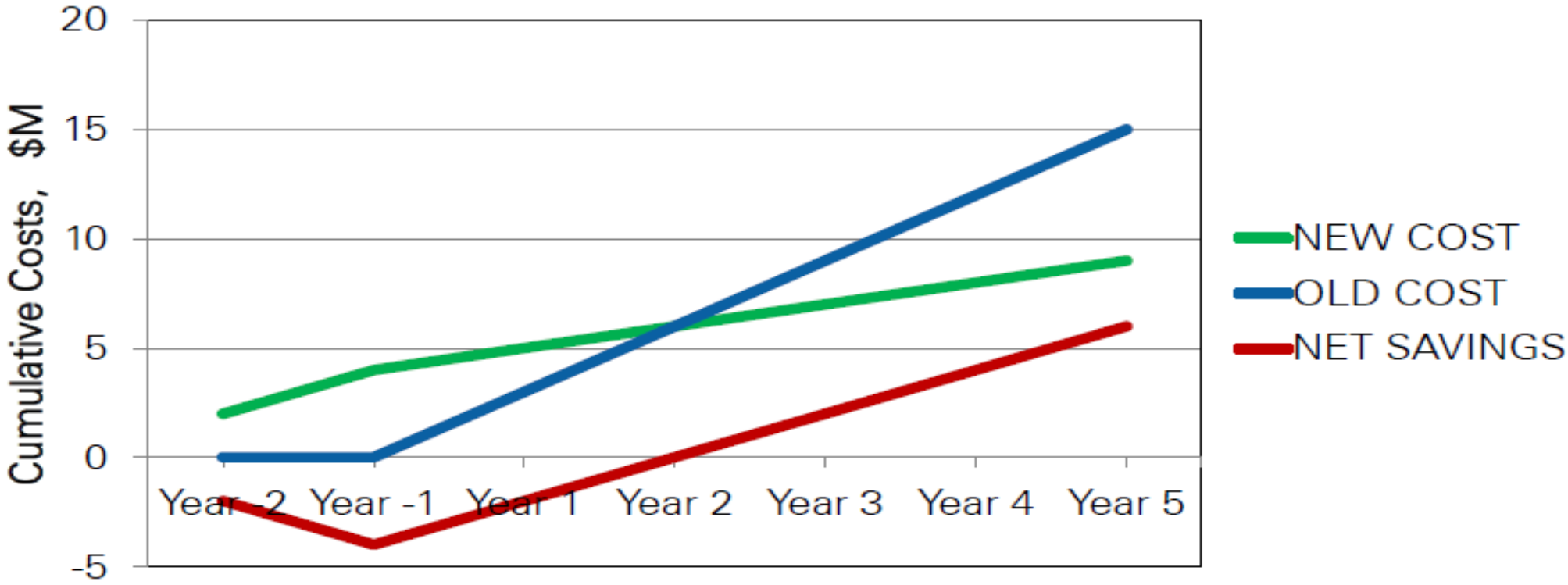
# Levels of Standardization

## Balancing commonality and flexibility




# Test Standardization Costs & Savings




**Old Cost** : Old/Current Test Implementation Total Cumulative Costs
**New Cost** : New Test Implementation Total Cumulative Costs
**Net Savings** : Old/Current Test Cumulative Costs – New Test Cumulative Costs

# Modules of a test system

- Test Instruments  / Enclosure
- Test adapter / DUT interface
- Software / Data Storage
- Safety instrumentation – CE-mark
- Remote management & maintenance
- Design & Manufacturing process

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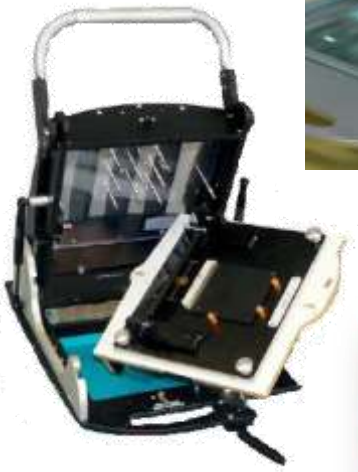
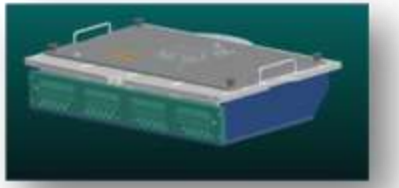
# Test Instruments / Enclosure

- Instrument rack, holes, selfs, cabling, color etc..
- Electric Sypply 1-phase/3-phase + safety circuitry
- Compressed air control
- Controlling computer: industrial PC, PXI etc..
- Measurement instruments boxed, PCI, PXI, USB, Ethernet etc..
- Safety instructions, instruments, labels, lights – CE-mark
- DUT-identification and Operator identification
- Operating & maintenance instructions
- Training material and training sessions
- Documents & document templates
- Maintenance terms & Agreements
- Calibartion plan
- Fixture interface(s)
- Access to internet
- Test adapter for instrumentation
- Transportation packing

# Test Adapter / Dut Interface





- Part of a platform that is usually most product specific
- A lot can still to be done and standardize
- Adapter mechanics
  - Few sizes, RF option, Cassette option, PCBA framework
- Safety sytems, recharge of capacitors, HV indicators, Adapter locking
- Standardized component library for needles, mechanics, cables and electronics
- Transportation packing
- Documents & document templates
- Adapter interface(s)
- Design & manufacturing process
- Qualification process, MSA

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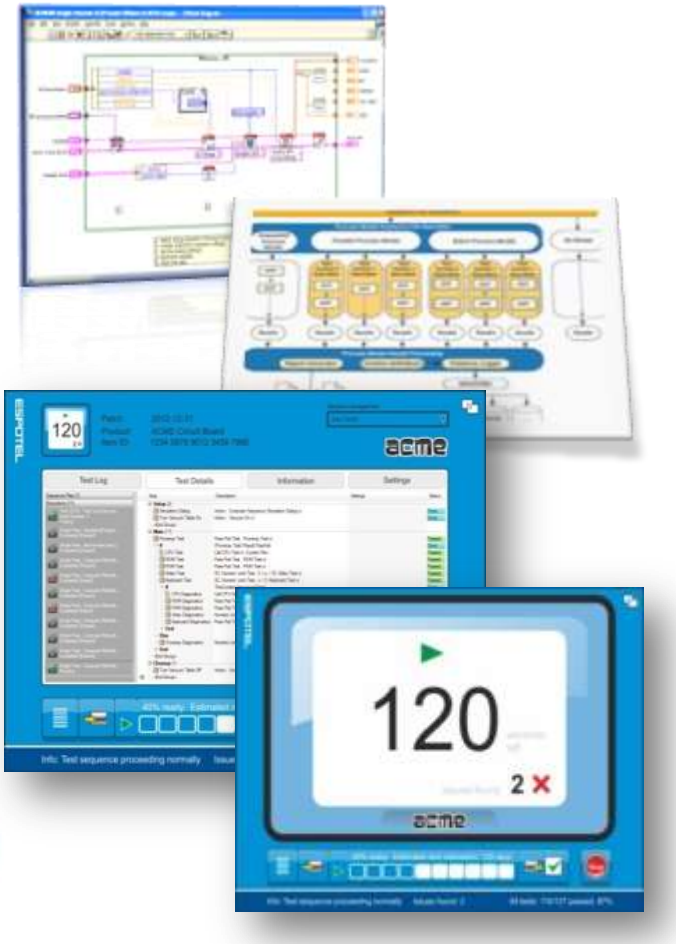
# Test Software




- Modular Structure, easy to use and maintain
- Verified and tested drivers for most popular instruments: DAQ, DIO, CAN, DMM, power supply, RF-instruments, electronic load, serial, CAN, BSCAN etc...
- Support VIs for string handling, time/date, dialogs, file operations etc...
- Modular driver structure, adding new instruments to existing drivers should be easy
- A simple interfaces (top level VIs)
- Use of Test Stand for test execution
- Clear and standardized data structure for local data storage & Handling.
- Remote maintenance tools for test limits and test software
- Remote test data management & analysing tools

# Safety

- Modular Structure, easy to use and maintain
- Needs to fulfill the EU standard(s) ??
- Safe to use and maintain
- Safety Instructions and labels
- Safety circuitry
  - Recharge of dangerous voltages from capasitors
  - Adapter needs to be locked when powerizied (over 60V)
  - Separate supply for control PC and test instruments/adapter
  - Safety Switches
- Needs to be CE-marked
- Needs to be tested against the standars
- Special care is needed when medical and/or safety devices are tested in production

# Remote management

- UUT Reporting
- Repair
- Yield & Trend Analysis
- Product & Production
- Workflow
- Test sequence update and version control
- Dashboard
- Manual inspection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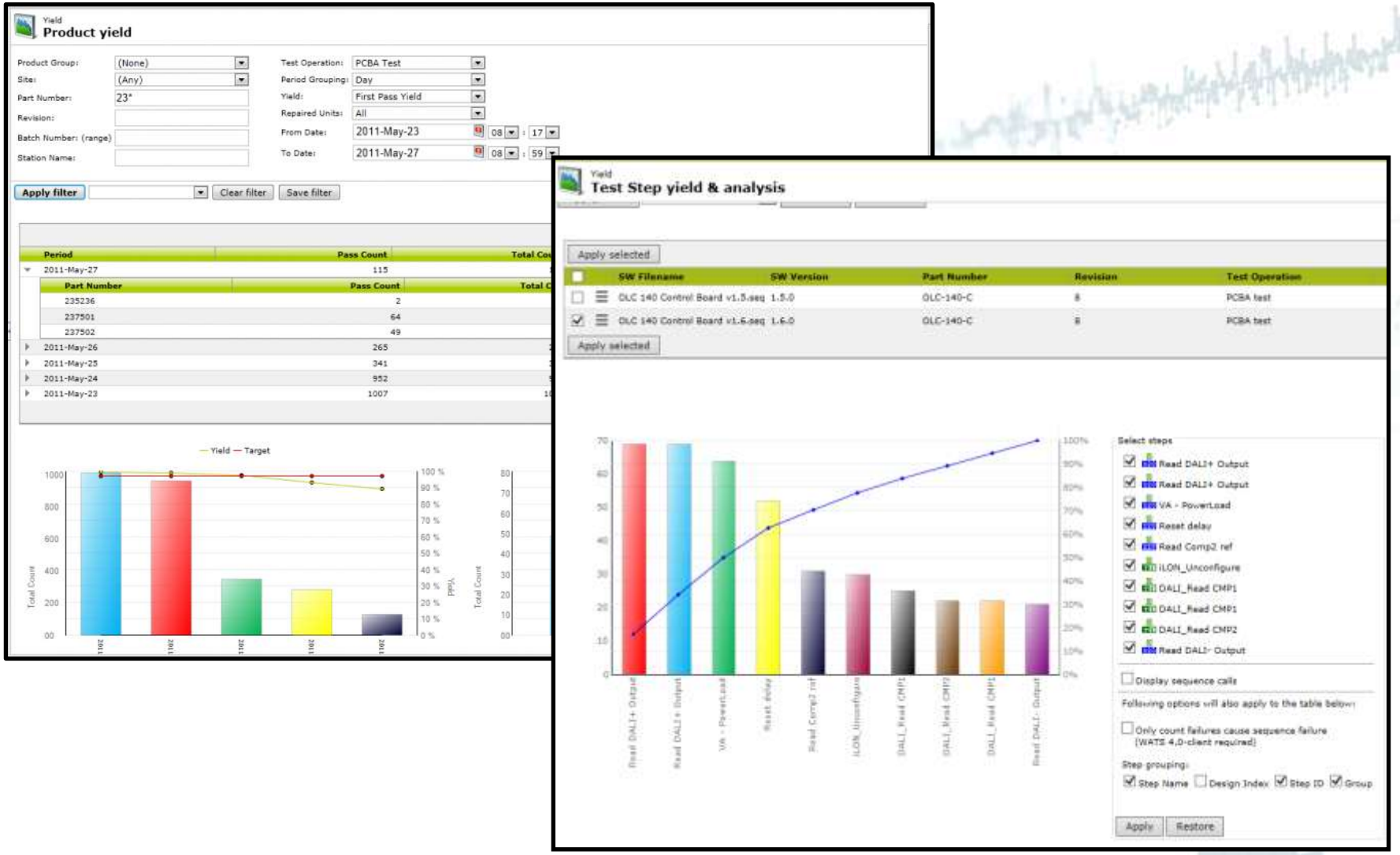
# Yield & Trend Analysis

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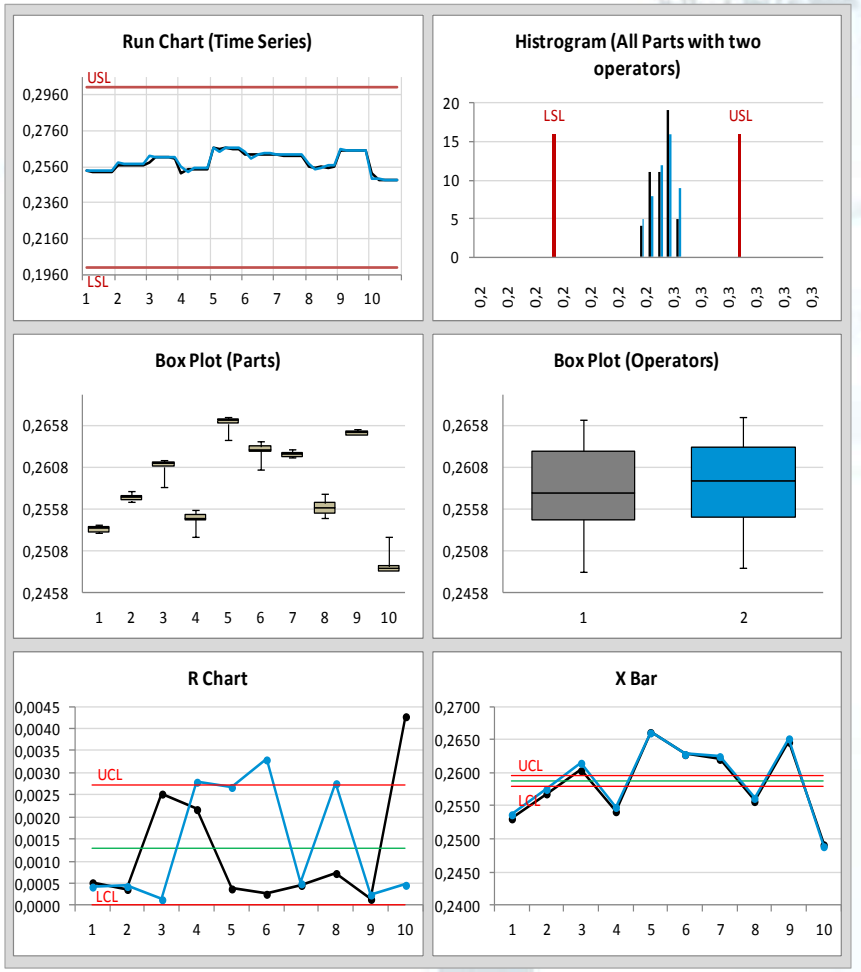
# MSA / Gage R&R

- Measurement System Analysis (MSA) is a vital part of Test System delivery project
- **Gage R&R** method shall be used to ensure **repeatability** and **reproducibility** of the measurements performed by Test System
- Gage R&R stydy is applied for each Test System and the results are reviewed as a part of Factory Acceptance Test (FAT) prior the delivery of system

| Anova Report | StDEV (SD) | Study Var (6*SD) | %Study Var | VarComp | %Contribution (VarComp) |
|---|---|---|---|---|---|
| Total Gage R&R | 0,000823 | 0,004939 | 14,70 % | 0,000001 | 2,16 % |
| Repeatability | 0,000775 | 0,004651 | 13,85 % | 0,000001 | 1,92 % |
| Reproducibility | 0,000277 | 0,001661 | 4,95 % | 0,000000 | 0,24 % |
| Operator | 0,000277 | 0,001661 | 4,95 % | 0,000000 | 0,24 % |
| Operator*Part | 0,000000 | 0,000000 | 0,00 % | 0,000000 | 0,00 % |
| Part-to-Part | 0,005537 | 0,033224 | 98,91 % | 0,000031 | 97,84 % |
| Total variation | 0,005598 | 0,033589 | 100,00 % | 0,000031 | 100,00 % |
| | | | | | The test system is acceptable |
| Number of distinct data categories (ndc) = | | 9,49 | | | |
| Sigma limits | +5σ | 0,29 | | | |
| | -5σ | 0,23 | | | |



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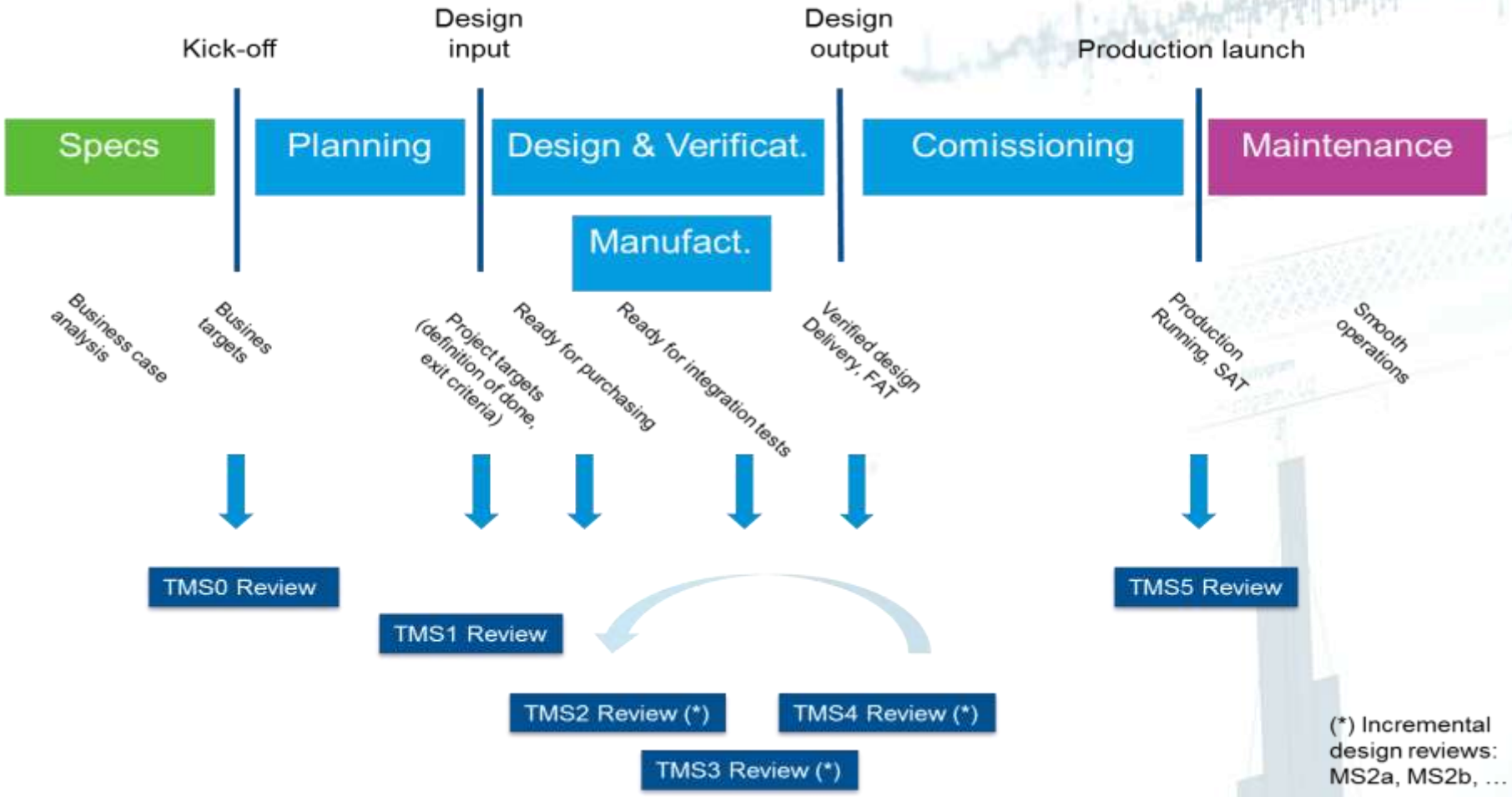
# Design, Manufacturing and Verification process



# The Ultimate Production Testing System

**Standardized**

- Overal testing cost optimization
- NRE optimization for a new product
- Enables fast production ramp-up with minimum risks
- Similar and known testing methods in all factories → Equal quality

**EMS Independent**

- Equal acceptance criteria for all factories
- Allows real competition between EMS companies

**Easy to maintain, minimized costs over the life-cycle**

- Cost-of-the-self instrumentation
- Robust
- Comprehensive documentation including maintenance instructions
- Spare parts and calibration services available
- Remote management

**Flexible & Scalable**

- Supports different product types (PCBA and box-built end products)
- Supports different intrusion / accessing methods (connectors, test probes, etc.)
- Supports additional testing methods to increase test coverage: AOI, RF, Boundary Scan, LED testing etc.)

**COST SAVINGS**

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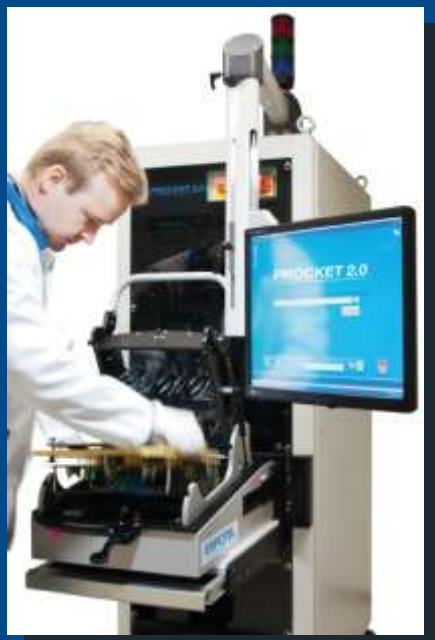
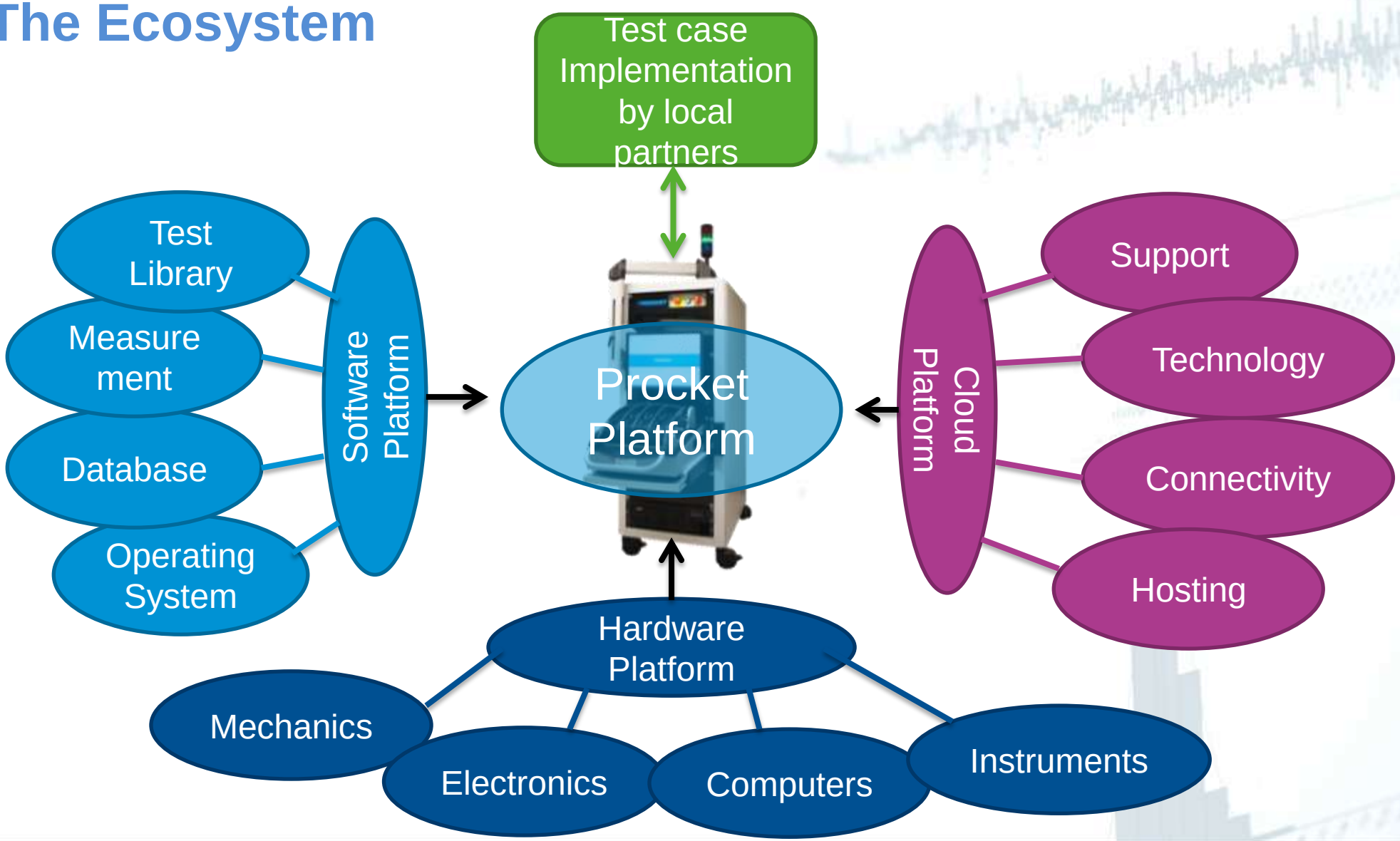
# PROCKET

**More than 600 Procket test applications**

**in over 40 locations around the world.**




# The Ecosystem



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# *Thank You!*

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