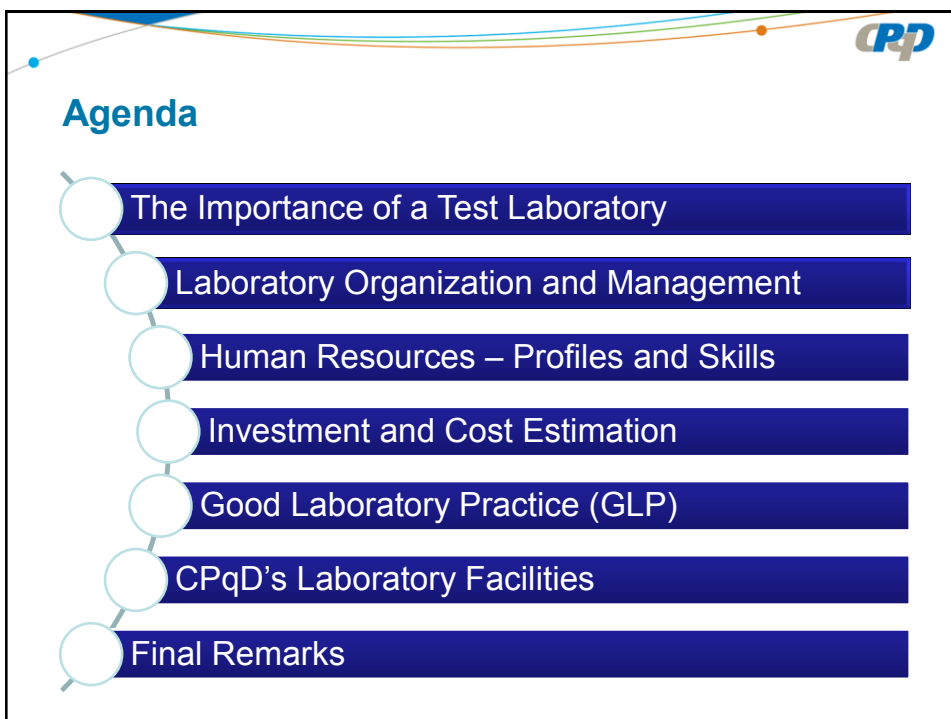**Organization and activities of a test lab environments, procedures and methodologies to be adopted to establish, manage and maintain a testing center covering different kinds of conformance and interoperability testing areas**

TURNING
INTO REALITY

Rubens Fujiki Maeda, CPqD – Brazil
Workshop – Conformity and Interoperability Assessment Study
for the Caribbean Region
St. Augustine – Trinidad and Tobago, 2-4 December, 2014

Agenda

- The Importance of a Test Laboratory
- Laboratory Organization and Management
- Human Resources – Profiles and Skills
- Investment and Cost Estimation
- Good Laboratory Practice (GLP)
- CPqD's Laboratory Facilities
- Final Remarks

The Importance of a Test Laboratory

- A local test laboratory contributes to the development of the national industry by providing inputs that enable projects validation and improvement. In addition, a test laboratory promotes the growth of knowledge and supports the regulatory agencies in the certification process.

- Main benefits
  - Enhances user safety and protection of consumer rights
  - Increases national industry competitiveness
  - Provides knowledge acquisition
  - Contributes to knowledge exchange programmes with universities and R&D centres
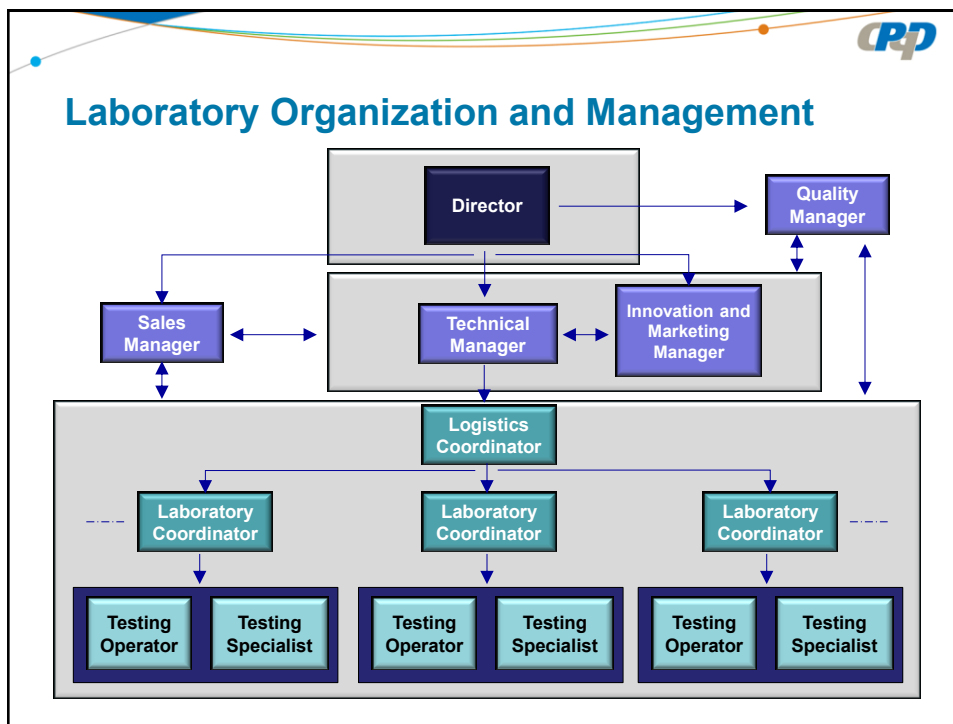 - Ensures that products commercialized or used meet the minimum quality requirements

The Importance of a Test Laboratory
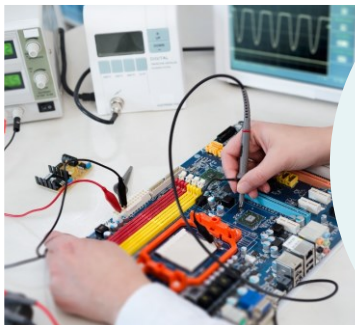
Typical Service Portfolio

- Standard conformance testing
- Product quality assessment
- Tests to support the operator procurement process
- Interference analysis of communication systems
- Consultancy for the development of new products
- Calibration of optical/electrical equipment

Laboratory Organization and Management

Laboratory Organization and Management – Roles/Responsibilities

- Director
  - Overall responsibility for the management and development of the test laboratory.
- Quality Manager
  - Establish quality policies, make sure day-to-day lab activities comply with ISO/IEC 17025 requirements, identify new accreditation needs and organize inter-laboratory tests.

- Technical Manager
  - Manage and develop human resources, provide infrastructure and elaborate investment strategies based on marketing studies.

- Innovation and Marketing Manager
  - Map market and competitors, identify new opportunities and customer needs, and analyse/indicate investment priorities.

Laboratory Organization and Management – Roles/Responsibilities

- Sales Manager
  - Manage the sales team and define cost and market-based pricing.
- Logistics Coordinator
  - Coordinate the logistics team – sample receipt and tracking within testing centre.
- Laboratory Coordinator
  - Coordinate (schedule and work shifts) and supervise testing activities performed by his/her team, in compliance with quality standards and meeting customer requirements.
- Testing Specialist
  - Develop and implement new testing services in compliance with quality standards, and provide training.
- Testing Operator
  - Execute the test campaign activity.

Laboratory Organization and Management

- Management – Periodical Reporting Session
  - A recommended procedure to be adopted in order to efficiently manage the test laboratory is to conduct periodic follow-up reviews, under the director's leadership, to assess and report on progress and completion of different activities:

- Monitor laboratory service sales
- Monitor market demands
- Verify the need to hire more staff and have more investments
- Elucidate critical points concerning technical and management processes

Human Resources – Profiles and Skills

Technical Manager	• People management, activity planning and monitoring, business plan development, cost and budget planning, negotiation skills, understanding of business trends (market, regulatory and political), equipment/technology expertise, knowledge of quality standards and basic knowledge of foreign languages (English/Spanish).
Laboratory Coordinator	• Strong ability to coordinate teams and monitor activities, knowledge of quality standards, test methodology, test report analysis, elaboration of technical proposals, management reports, workflows, knowledge of Good Laboratory Practice (GLP), technology expertise.
Testing Specialist	• Strong ability to train people, high level of technology/equipment expertise, excellent operational skills, use of statistical techniques, test methodology development, interpretation of test standards.
Testing Operator	• Test methodology, elaboration of test reports, interpretation of test standards, knowledge of Good Laboratory Practice (GLP), technology/equipment expertise, operational skills, basic knowledge of quality standards and statistical techniques.

Investment and Cost Estimation

- The investment required (CAPEX) to implement a testing centre is significant. In general, components that require greater investment are:

  - Instrument Asset
  - Laboratory Facilities
    - Laboratory rooms, offices and meeting rooms
    - IT infrastructure
    - Air conditioning system
    - Security system
    - Parking area
    - Canteen and restaurants
    - Common areas
  - Human Resources
    - Hiring specialized personnel
    - Training

Investment and Cost Estimation

- The costs to maintain (OPEX) a testing centre are mainly composed of:
  - Payroll
  - Training
  - Equipment calibration
  - Equipment maintenance
  - Equipment upgrade
  - Location rent
  - Audit
  - Utilities

- There are two main ways for addressing the high investment issue:
  - Public-private partnerships
  - Partnership between countries

Investment and Cost Estimation

- Investment and cost estimation to implement an infrastructure for mobile devices type approval tests

Laboratory	m²	Instrument Asset [EUR]	Number of staff	Personnel [EUR/year]	Instrument Opex [EUR/year]	Location Rent [EUR/year]	Utility [EUR/year]
EMC	300	1.600.000	5	350.000	5.000	39.000	56.000
Radio Signalling	250	2.000.000	12	840.000	10.000	32.000	46.000
Safety	80	1.200.000	4	280.000	25.000	10.000	15.000
SAR	150	800.000	4	280.000	25.000	19.000	28.000
Management			5	350.000			
Other activities (*)			12	840.000			
Total	780	**5.600.000** **USD 7.000.000**	42	**2.940.000** **USD 3.700.000**	**65.000** **USD 82.000**	**100.000** **USD 125.000**	**145.000** **USD 182.000**

(*) Other activities: Security, maintenance, sales, logistics, ICT management, quality, secretariat

Source: Adapted from *Feasibility study for a conformance testing centre – ITU – December 2013*

Investment and Cost Estimation

- Process optimization for operation/costs reduction
  - Automated test execution and report
  - Use the infrastructure 24 hours per day (more than one shift per day)
  - Instrumentation duplication

- Investment priorities
  - Target investment on new instruments based on the market needs
  - Consider the total cost of ownership (not only the instrument price/initial cost) before purchasing a new instrument

Good Laboratory Practice (GLP)

- GLP is a set of recommended activities to ensure the quality and reliability of test results
  - Factors contributing to the reliability of results
    - Human factors
    - Accommodation and environmental conditions
    - Test, calibration and validation methods
    - Measurement traceability
    - Sampling
    - Handling of test and calibration items
  - Quality control procedures
    - Between calibration intervals, perform periodic measurements to monitor equipment performance (control chart)
    - Compare results of the same test performed by different test operators
    - Inter-laboratory comparison of test results

Good Laboratory Practice (GLP)

- To meet the requirements of ISO/IEC 17025, the laboratory shall establish and maintain procedures for:

  - Management system
  - Document control
  - Identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records
  - Selection and purchasing of services and supplies
  - Implementing corrective actions when non-conformity is identified

Good Laboratory Practice (GLP)

- The laboratory shall:
  - Continually improve its management system
  - Periodically conduct internal audits of its activities
  - Be independent of any companies – guaranteeing its impartiality as a third-party provider of conformance testing services
  - Ensure the protection of its customers' confidential information and proprietary rights (including protection of electronic storage and results transmission)

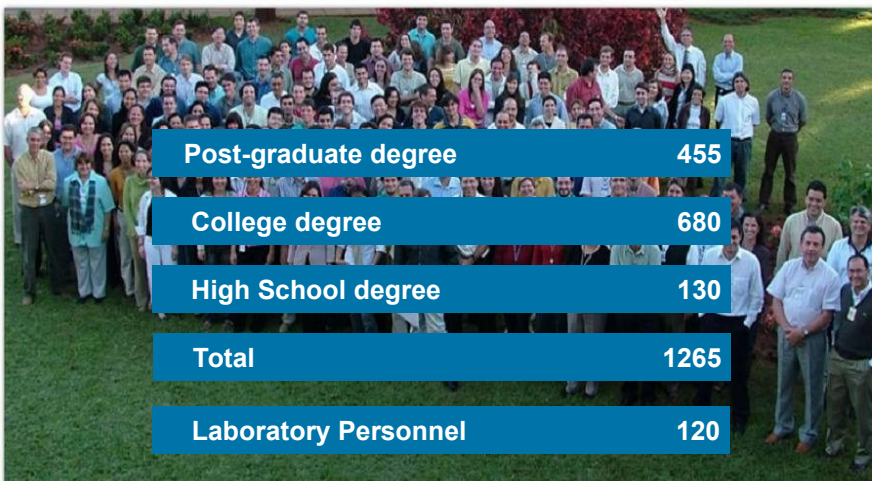## CPqD's Laboratory Facilities

CPqD Facilities

Total area:
Over 360,000 m²

Building area:
Over 86,000 m²

Laboratory area:
Over 5,000 m²

CPqD's Laboratory Facilities

Post-graduate degree	455
College degree	680
High School degree	130
Total	1265
Laboratory Personnel	120

CPqD's Laboratory Facilities

ISO/IEC 17025 / ISO 9001 / ISO 14001

- Acoustic
- Antennas
- Batteries
- Cables
- Colorimetry
- Corrosion
- Chemical
- Climatic
- Digital TV
- EMI/EMC
- Pre and Full Conformance – LTE and LTE-A
- Physical
- Protocol and Communication Interfaces
- Optical Fiber an Optical Equipment

- Materials
- Mechanical
- Radio and Signaling
- RFID
- Safety
- SAR
- User Experience
- Field Tests
- Calibration

More than 850 tests accredited by INMETRO*

*Brazilian accreditation body

CPqD's Laboratory Facilities

SAR

Electroacoustic

RFID
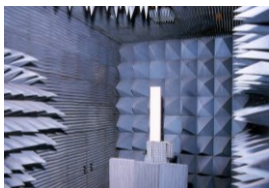
Antennas
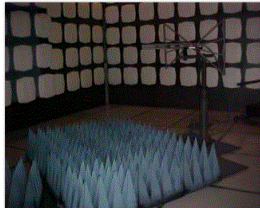
EMI/EMC
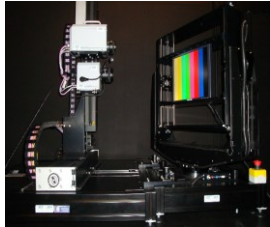
CPqD's Laboratory Facilities

Pre and Full Conformance LTE and LTE-A

Calibration

Electrical and RF

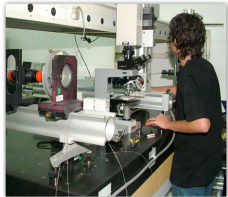Optical

Colorimetry

Digital TV

CPqD's Laboratory Facilities

Optical Equipment

Cables

Mechanical Tests

Climatic Tests

Temperature and Humidity Chambers
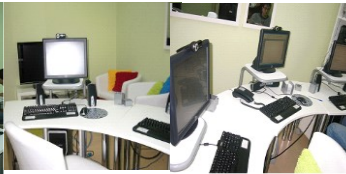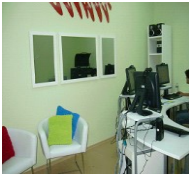

Aging chamber

Salt Fog Chamber

CPqD's Laboratory Facilities

Physical, Chemical, Corrosion

Batteries

User Experience

Final Remarks

- For establishing and maintaining a test centre, it's necessary to have:
  - Established Accreditation Bodies which are signatories to ILAC
    - Brazil: INMETRO – National Institute for Metrology, Standardization and Quality www.inmetro.gov.br
  - A metrology institutes to provide calibration services
  - Demand for testing
    - Regulatory policy (certification and type approval)
    - National industry
    - Network operators
  - Funding support from both public and private sectors (partnership between countries)
  - Local support for equipment maintenance – local representation of equipment vendors

Thank you!

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