Organization and Activity of a test Lab: Environments, procedures and methodologies, management and maintenance of a testing center covering different kind of C&I testing areas

Carlo Mogavero (Testing Labs - Tilab – Italy)

Scope of the presentation

To describe environments, procedures and methodologies to be adopted to establish, manage and maintain a testing center covering different kind of conformance and interoperability testing areas.

Best practices are reported in this document covering all relevant aspects not only related to test campaign activity, but also to all activities necessary to manage and maintain a large test center. A particular attention is devoted to procedures to manage mobile terminal incoming quality process.

part 1: Organization of a test center focusing in particular on incoming quality management procedures - (Carlo Mogavero)

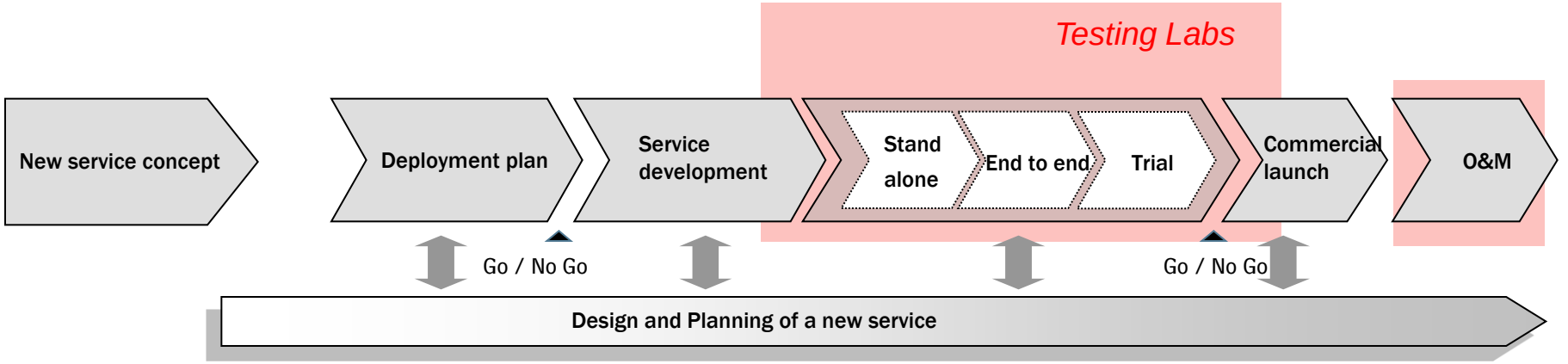
part 2: Description of the labs and test plant of a test center in particular focusing on mobile terminal testing– (Robert Farotto)

Summary

1. ***'Testing Lab' presentation***
2. ***Test center organization***
3. ***Market surveillance & Incoming quality monitoring***
4. ***Feasibility study & training for ZICTA***
5. ***Lab investment strategy and cost tables***

Testing Labs – Tllab - Telecom Italia

Testing Labs & TIlab



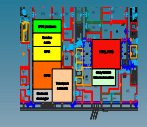
Labs

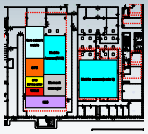
- Mobile and fixed access
- Testing Automation
- Fixed CPE and IPTV
- Core Network
- Energy
- WIFI
- User experience
- Service Stability
- Mobile and fixed access
- Testing Automation
- Vertical IT solution testing

- Mobile VAS
- EMC
- Quality of mateiral
- Radio lab
- PAN
- Powering
- Safety & protection
- Elettroacustic
- SAR

LAP Laboratorio Accreditato Prove

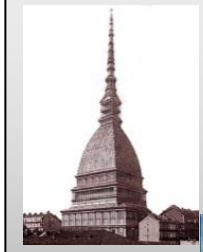
Test Plant





Fixed and mobile Test plant

Location and resources



Torino

Roma

Napoli

Housing Assets

Test Plant "Via Reiss Romoli"

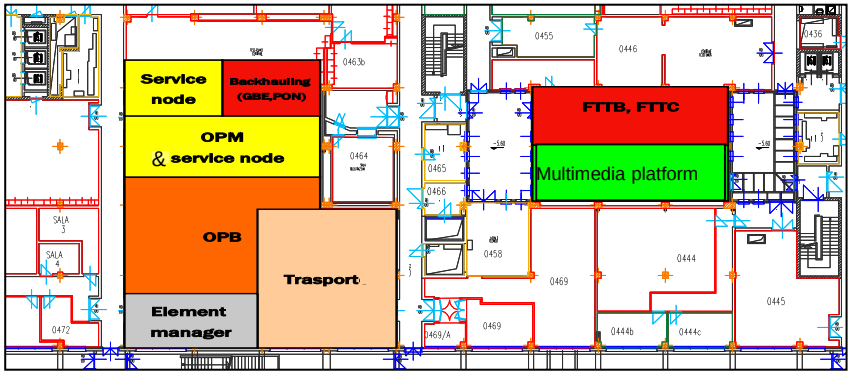
Fixed Network

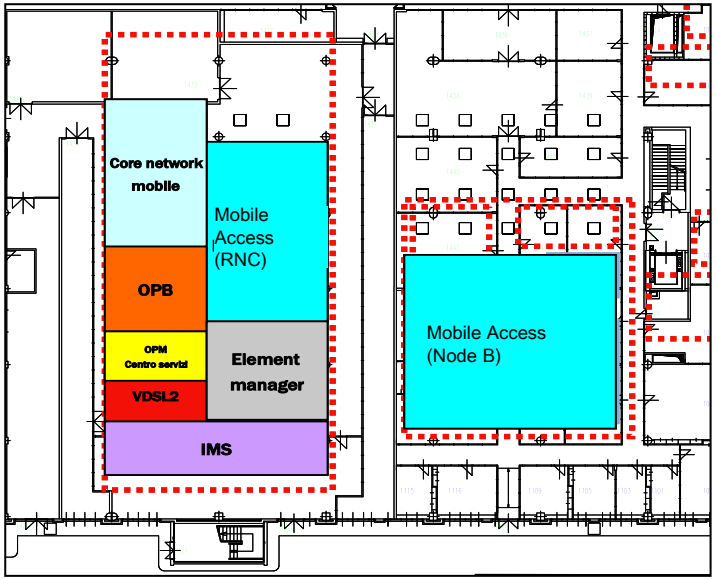
- **1000 m²**
- **100 rack**
- **200 equipment**

Test Plant "Via Borgaro"

Mobile Network

- **2000 m²**
- **200 rack**
- **400 equipment**





Main Technologies and Measurement Equipment

Some of the technologies installed in our Test Plants:

GPON: Huawei, ZTE, NSN

NGAN: Italtel CL4-CL5 Nodes

DSLAM IP and ATM: ALU, NSN, Ericsson, Huawei, ECI

CPE: Pirelli, Telsey, Cisco, and many others

Edge IP: Cisco, Juniper, Nortel, ALU, Huawei, Tellabs

Transport Network (SDH, xWDM): Ericsson, ALU, Huawei, NSN, Pirelli

Backbone OPB (Terabit Router and Gigabit Router): Cisco, Juniper

GbE and IP/MPLS Metro: Cisco, Juniper, ALU, ZTE

ATM: Cisco

Gateway: Tellabs, T-VIPS

Mobile Access Network: Ericsson, NSN, Huawei

ENAV: Marconi, Elsag, Juniper, Selex

Mobile Core Network: Ericsson, Huawei

Mobile VAS Platform: Ericsson, HP, Acision, Openwave, Novarra, Mobixel

IMS Platform: Ericsson, Huawei, NSN

CL5 Node: Italtel

Main measurement equipment available at our Test Plants:

xDSL line simulators

Spectrum Analyzers

Noise Generators

Arbitrary Wavelength Generators

Traffic and Signaling Generators (Spirent, IXIA, Agilent, Tektronix, Catapult, Radcom)

Network Generators (i.e. SDH, ...)

Protocol Analyzers

Diagnostic Software (e.g. ASCOM Monitor Master)

Application Loading Software (e.g. HP LoadRunner)

Monitoring Software

LAP – Laboratorio Accreditato Prove

(Accredited Testing Lab)

- LAP is Telecom Italia/Tilab entry point authorized to offer testing services and facilities on TLC systems to external customers
- has a multi-lab structure, organized in accredited and not accredited labs offering testing services in different fields of application
- has a management structure coordinating:
  - Accreditation processes
  - Economical aspects (commercial offers and orders)
  - Economical evaluations
  - Quality monitoring and customer satisfaction
  - Testing work flow
  - Design of new accredited test environment

LAP Mission

- to manage labs according to standard EN17025
- to design new testing services/labs to increase offer portfolio and quality
- to manage existing labs improving quality and KH
- to make revenues

LAP Current Accreditations (UNI CEI EN ISO/IEC 17025)

Lab	Service	Accredit. body
Electroacustic	PSTN CPE, Access requirements for PSTN CPE.	
Electromagnetic Compatibility	System and Equipment for Radiocommunication Terminal for TLC System and Equipment for TLC public network	
Safety Protection & Mechanical	TLC terminal protection , terminal electrical safety Radiocommunication equipment Electrical Safety	
Metrology	Instrumentation calibration for the following standards: current, voltage, resistance in c.c. in a.c., frequency, optical power, fiber attenuation, wavelengh	
Powering (PSM)	Powering testing of TLC equipment in off mode and stand by conditions (IEC standard)	
Value Added Services	Testing Value Added Services (VAS) for mobile terminals (standard CASP)	
SAR dosimetry	Specific Absorption Rate (SAR)	
Personal Area Network	Functional testing of Zig Bee protocol	
Quality of Materials & Environments	Enviromental Parameters testing (Temperature, Salty Fog, Humidity)	
Radio Over-The-Air Performance	Wireless device Over-the-Air 3G performance (TRP & TSR measurements in free space within an anechoic chamber, with head phantom only or head and hand phantom)	

Organization of a test center

The value of testing
Service portfolio
The solution and verification process
Periodical reporting
Investment & cost estimation
Support systems
Bugs tracking
Investment priorities
Intrumentation maintenance & management

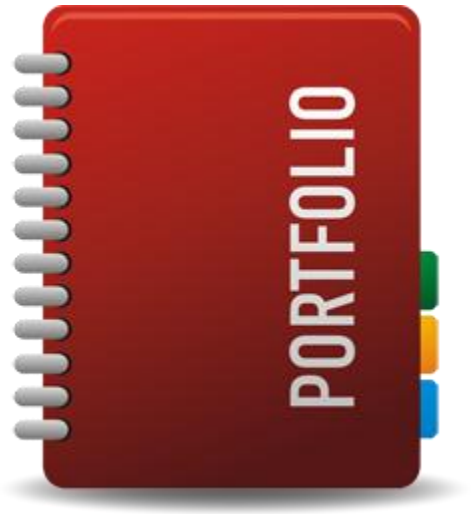
The value of testing

The most straightforward way to estimate the value of testing is represented by the calculation of losses avoided (in terms of money, time and human life) thanks to the preventive performance of testing activities.

Main advantages:

- **Acquire knowledge (configuration, system, processes)**
- **Integrated vision (complete chain)**
- **Risk analysis**
- **Availability of test environment**
- **Organized documentation description**

Service portfolio of a test center



Conformance testing

to a standard (international, national or provided by the customer) – accredited or not

Credibility test

for quality evaluation of a product – pre-assessment

Testing park

locations and test plant usage to perform test event with or without TI internal resources support

Co-making and consultancy

Cooperation in developing new products

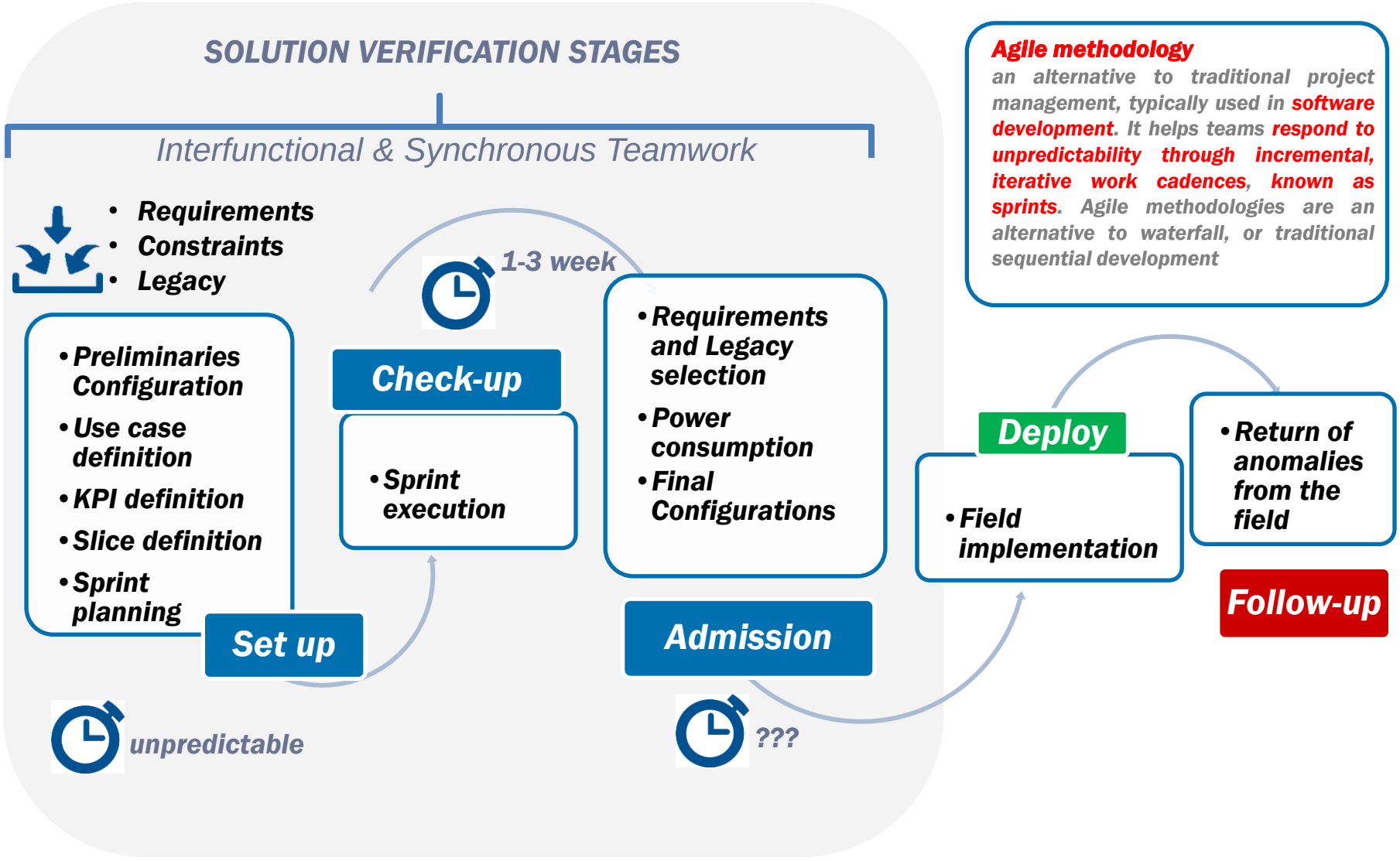
Joint Testing (outsourcing - insourcing)

Sharing with vendor test activity

Calibration and instrumentation management

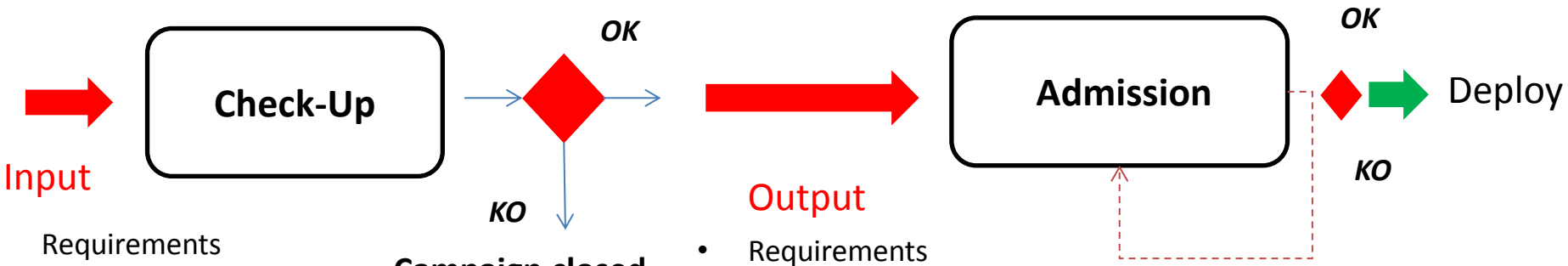
Instrumentation calibration of electrical and optical quantities.

The testing process



Process Responsibilities

Engineering *Vendor*	*Testing Labs* *Vendor* *Engineering*	*Management*	*Engineering* *Testing Labs*	*Testing Labs* *Vendor* *Field* *Engineering*	*Engineering*	*Planning* *Field*



Input

- Requirements
- Constraints
- Legacy
- Preliminaries Configurations

Campaign closed

– possible new issuing in 'optimized' form

Output

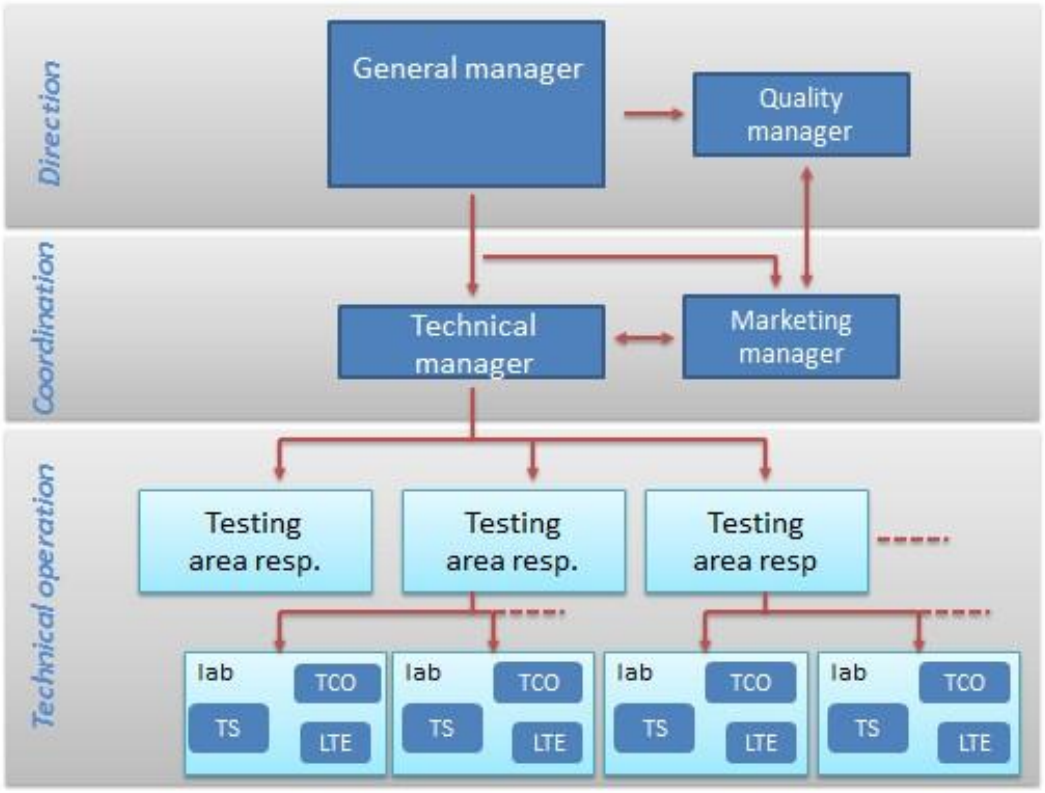
- Requirements and Legacy selection
- Power consumption
- Final Configurations

The field implementation is decided after the phase of admission, possibly partially overlapping activities in LAB and Field, with flexibility, on the basis of the maturity of the solution and of the TTM. The need to recycle should be drastically reduced by the first evaluation phase

Resource management and organization

A conformance testing center should be independent of any companies, so it guarantees its impartiality as a third-party provider of conformance testing services.

EN17025



The most significant management & technical roles

General Manager (GM)

The General Manager has the overall responsibility test center's development.

Technical Manager (TM)

The Technical Manager is responsible to General Manager for the overall technical activities of the laboratory in accordance with the standards and procedures indicated in this Quality Manual and the requirements of national/international accreditation bodies.

Testing Area Responsible (TAR)

Testing Area Responsible is responsible to the Technical Manager for coordinating and supervising the testing activities performed by the personnel in his or her area in compliance with the requirements indicated in this Quality Manual.

Testing Specialist (TS) – test campaign responsible

Testing Specialist is responsible to the Testing Area Responsible for the implementation of related conformance assessment in compliance with the requirements indicated in the Quality Manual.

Test campaign operator (TCO)

The test campaign operator is responsible of executing the test campaign

Laboratory Technical Experts (LTE)

This expert can be external to the laboratory and, in complex organization is not usually involved in the testing activity but can be part of the innovation or engineering department

Quality Manager (QM)

The Quality Manager is responsible for establishing and verifying the adequacy of the Quality System described in the Quality Manual, ensuring that the requirements of the ISO/IEC 17025 are met on a day-to-day basis, and advising the Technical Manager and General Manager accordingly.

Periodical reporting

A good procedure to be adopted in order to manage in an efficient way the testing center is to held a periodical reporting session between the TM and the TAR to verify the status of the different activities. The QM can summarize the result of the weekly reporting session in a status report document. The status report document must be organized in order to keep track of:

- ***Status of each test campaign***
- ***Salary policy***
- ***Main fault identified during the test with gravity status***
- ***Top issue of the week to be shared with other engineering department***
- ***Critical point to be solved concerning the test center management***
- ***Liaison with other bodies or company entities and departments***

Investment & cost estimation

The availability of proper assets is a topic of paramount importance for a test center. In particular, the areas of competence and the technological evolution determine the need of acquiring and maintaining the proper test equipment, required for the setup of the desired test benches.

CAPEX: investments related new asset
OPEX: Instrumentation maintenance

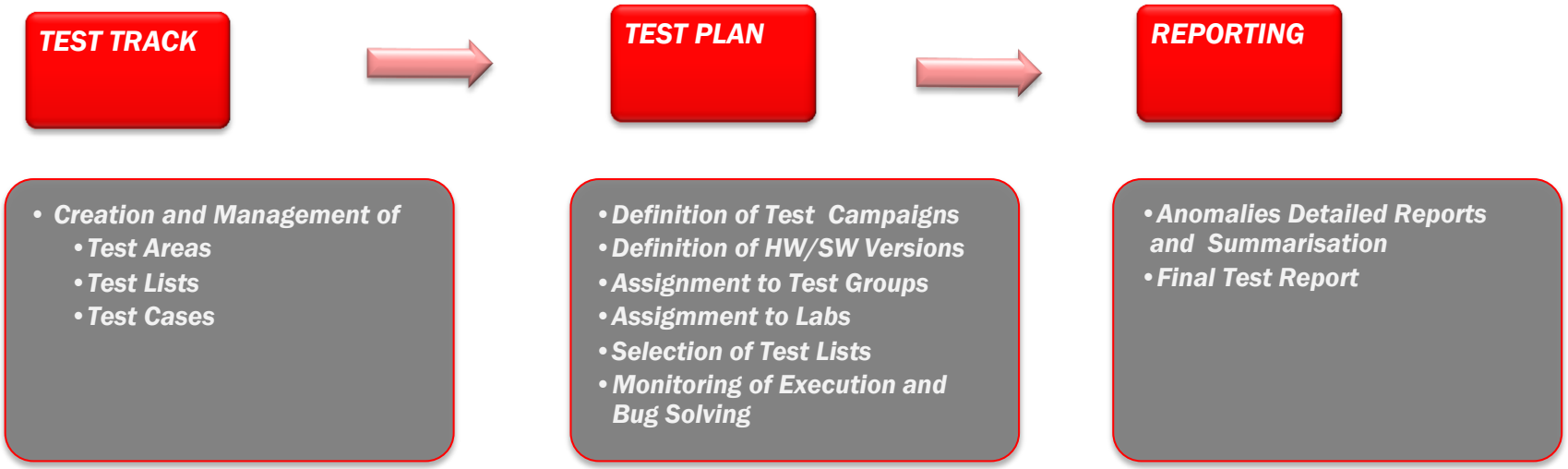
Key aspects

The most important key aspects to be taken into account are:

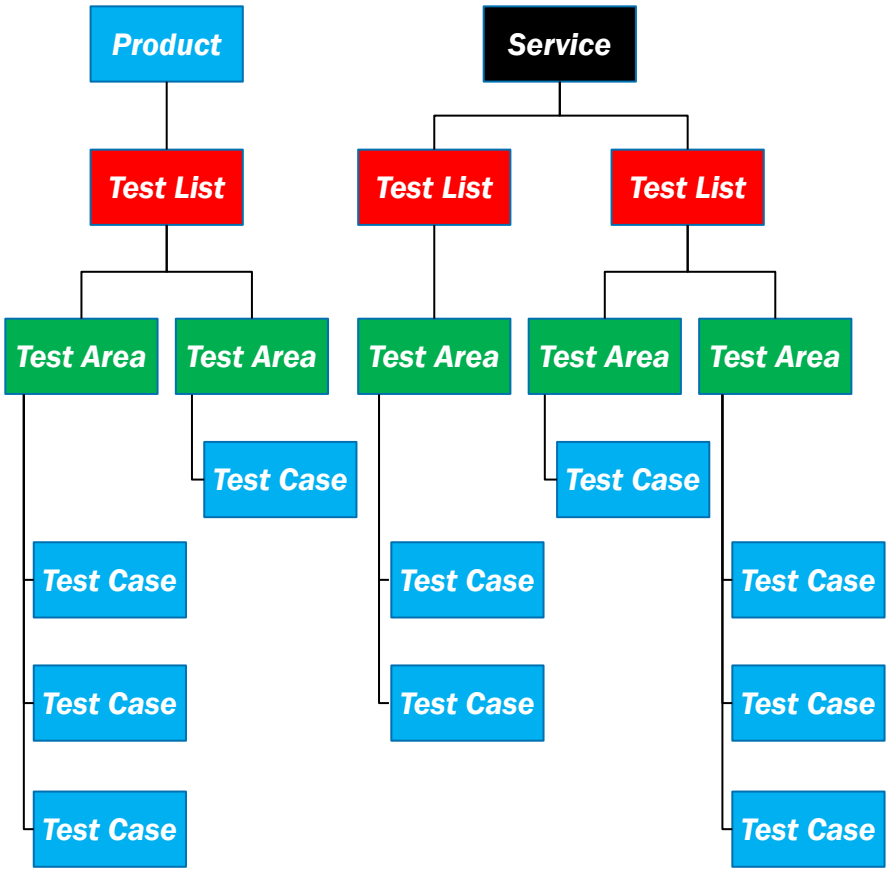
- ***Technological gaps***
- ***Evolutionary maintenance***
- ***Instrumentation duplication (efficiency improvement)***
- ***Instrumentation management and support systems (simplification and automation)***

Support systems for testing

- ***COMMON REPOSITORY for all the information** related to the project (Test List, Bugtracking, Release management)*
- ***Accessible to ALL the people** involved in the project (operator and vendors)*
- *Information **updated in REAL TIME** (test execution, anomalies management)*
- *Creates **AUTOMATICALLY test execution** reports (status of the tests…), bug reports and bug notification e-mails*
- ***Archives information** so it can be accessible also in the future*.



Hierarchical Organisation of Test Tracks



Bug Severity and Priority management

- ***SEVERITY: Level of technical non-conformancy of the bug***

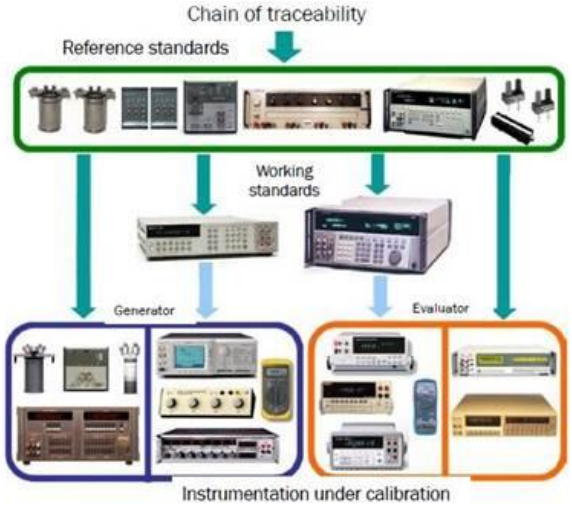
Severity	Description
HIGH High technical non-conformance.	Very critical anomaly impacting one of more of the following functionalities: service, capacity/traffic, charging, O&M. Typically they cause a total or critical lack of service not avoidable with a workaround solution.
MEDIUM Medium technical non-conformance with respect to the attended results.	Important anomaly seriously impacting functionalities or performance of the system or the service offered, and/or O&M functionalities. Typically these anomalies can produce a low functional or performance degradation.
LOW Low technical non-conformance with respect to the attended results.	Anomalies not impacting the main system functionalities or the offered service. Typically these anomalies don't produce degradation in the quality of service or O&M procedures.
Informative Remark	Point of attention. Typically this behavior has no impact on the final service, but it is important to be taken into account for future requirements and specifications.

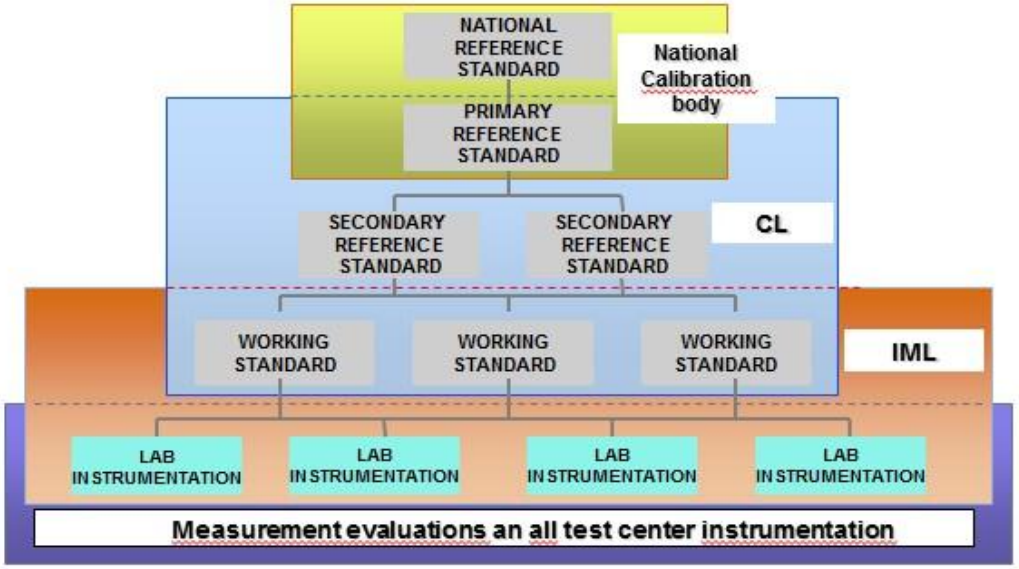
- ***PRIORITY: Level of solving priority for the bug. Three levels are defined: A (higher priority), B (medium priority) and C (lower priority).***

Instrumentation maintenance and management

The maintenance and management of the quality and metrological characteristics of a test center instrumentation, for the correct testing process execution and for the support to quality system for certification (ISO 9001:2000 and ISO/IEC 17025), are usually granted by two kinds of labs: the calibration lab and the instrumentation and management lab.

These labs, in order to provide a correct instrumentation management service, must operate according to the well know metrological chain described below representing the correct use of reference and working standards used by the different labs operating on instrumentation at different levels



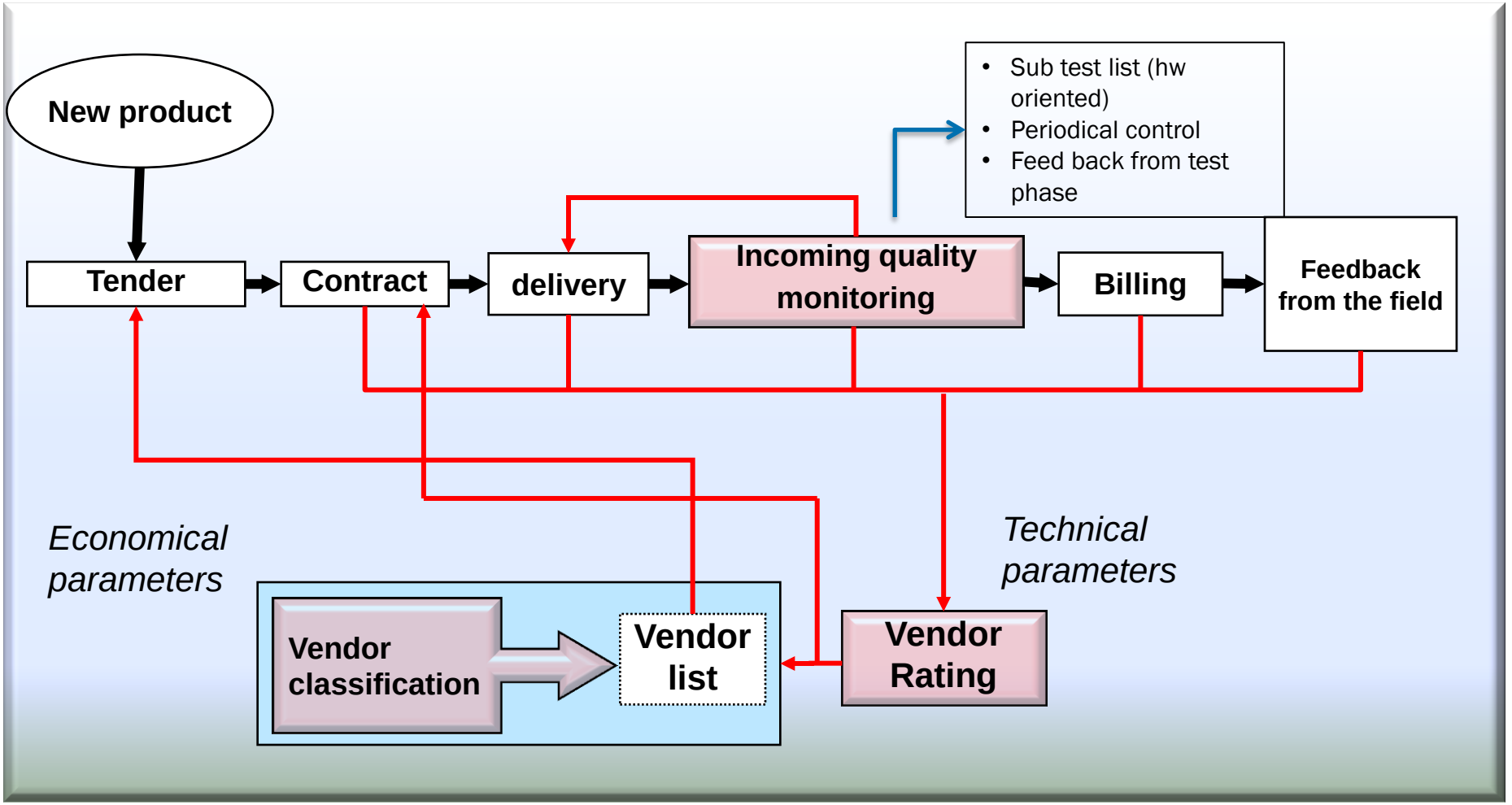


Other important best practises

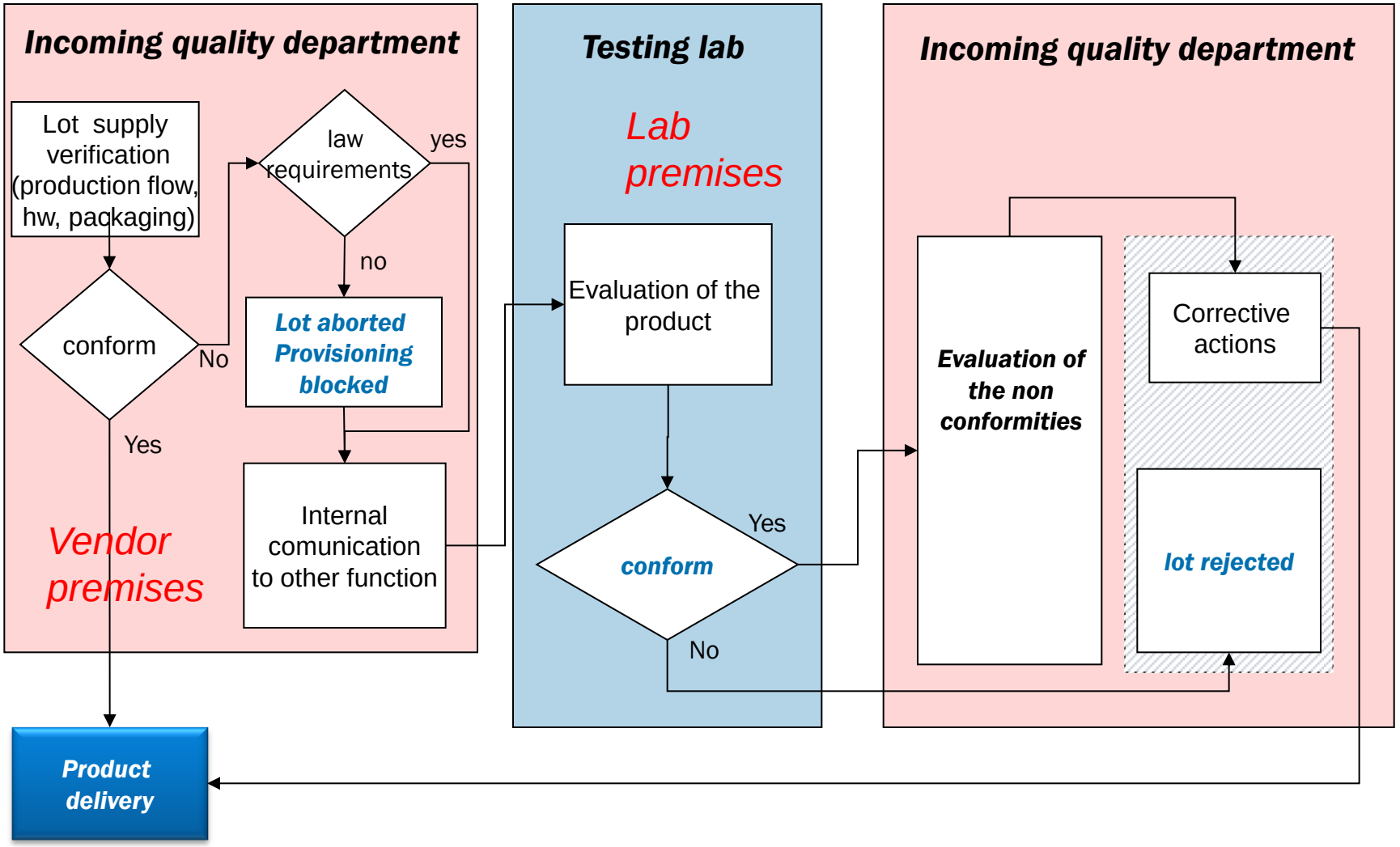
- *Design of air conditioning / free cooling*
- *Low power lights*
- *Renewable sources*
- *Safety aspects*
- *Security and access control*
- *Instrumentation remote control*
- *Automation of test suites*
- *Use of control rooms*
- *Tele-working*

Market surveillance & Incoming quality monitoring

Market surveillance and incoming quality monitoring
The process



Non conformity management process for incoming quality



Joint Audit Cooperation (JAC)

Priciples:

- **Collaboration agreement** based on common consciousness of the risk of loss of quality
- **Verification methodologies** shared for audit and follow up
- **On site verifications** performed in vendor premises by third party auditor
- **Common management of Corrective Action Plan** (CAP) for the continuous incrementation of the quality of the product

Objectives:

- **Optimization** of the vendor verification process
- **Promoting** the international standard respect
- **Promoting** best practices application
- **Assuring** the supply chain continuity in order to reduce the risk

Feasibility study & training courses for ZICTA (authority of Zambia)

Feasibility study for ZICTA

Main Part

Test center management best practices

Description of the best practices adopted in a large test center in term of test lists and test list life cycle & management, Investment & cost estimation, test campaign management and test plant and lab management.

This first part will be based on the experience gained in TI testing labs and described in the training course hold in Torino but in a more detailed way.

Quality

Overview of the methodologies and criteria to implement the quality policies in a test center as far as concern: ISO 9000, ISO 14000, EN 17025 and international contest (ILAC),

This section will not describe the quality procedures in an abstract way but in a real contest focusing on best practices adopted in a large test center regarding internal and external auditing management, accreditation procedures, round robin procedures, instrumentation and calibration management

Economics

Overview of the possible criteria and approach to make revenues with testing services as far as concern services portfolio, cost rate modulation, service chart, offert term & conditions

Incoming quality and supply chain

General guidelines to handle the purchasing process applying vendor rating procedures, incoming quality tests, management of non compliances, sub test list utilization, joint audit cooperation agreements with vendors.

3 Annexes on SAR, Safety & Protection Battery Energy Lab (mobile terminal testing)

- *Reference standards*
- *Test suite/ Test set up*
- *Cost*
- *Instrumentation*

Training Course description

Duration: ***7 days***

Location: ***Telecom Italia premises – Torino - Italy***

Expected Results: Knowing the best practices to run a type approval lab in relation to resource and instrumentation management, quality assurance and investment and cost estimation

Module 1 - Preamble

Modulo 2– Test center organization

Module 3– Quality

Module 4 – Economics

Module 5– Focus on mobile terminal testing process

Module 6– Incoming quality and supply chain

Lab and test plant tour & training on the job

Lab investment strategy and cost tables

Conformance Testing development strategy

Scope

To **identify priorities in conformance testing lab implementation** in African countries

Preamble:

It is urgent to **establish the MRA** between different African countries as Africa is the only region without any accreditation scheme similar to ILAC. However implementing an MRA **will take time** due to political and procedural reasons.

Possible approach

A possible approach could be **to start, in parallel to the MRA implementation**, the **development of Mini Labs (focusing on verification of incoming quality of mobile terminals)** in different African countries in order to **promote the KH development** in such regions as far as concern use of instrumentation, lab management, quality and instrumentation purchasing process (quality and instrumentation maintenance). Proceeding in such a way **the countries developing labs could become the reference** for each specific testing area in the African area

In parallel the MRA will be established and **auditing and verification procedures** could be established to monitor the labs implemented in the meantime.

Large test center cost (ITU feasibility study)

lab	activity	m^2	Location Rent K€/year	Utility K€/year	Instrument. Asset K€	Personne Number of people #	Instrument. Opex K€/year
SAR	Specific Absorption Rate lab	150	19	28	800	4	25
USX	User experience lab	130	17	24	100	6	0
BBA	Broadband access lab	300	39	56	1.400	7	5
VAS	Mobile value added services lab	40	5	7	0	3	0
EPS	Electrical safety & protection lab	80	10	15	1.200	4	25
ELA	Electroacoustic lab	250	32	46	800	4	5
EMC	Electromagnetic compatibility lab	300	39	56	1.600	5	5
RSL	Radio & Signalling lab	250	32	46	2.000	12	10
PWR	Powering consumption lab	80	10	15	200	2	5
QML	Quality of material lab	250	32	46	1.300	6	15
WIF	Personal area network lab	170	22	31	500	5	5
TPF	Fixed Test plant	900	117	167	3.000	33	120
TPM	Mobile Test plant	2500	324	463	3.000	55	300
management						10	
cross activities (*)						24	
TOTAL		5.400	700	1.000	15.900	180	520

Example of Mini Lab cost
(for *mobile terminals testing* only)

lab	activity	m^2	Location Rent K€/year	Utility K€/year	Instrument. Asset K€	Personne Number of people #	Instrument. Opex K€/year
EPS	Electrical safety & protection lab	80	10	15	12	3	2
RSL	Radio lab	100	32	46	150	3	6
ANC	Radio lab anechoic chamber				200		
SIL	Signalling radio lab	60	8	12	800	4	4
BCL	Battery charge	80	10	16	230	2	8
SAR	Specific Absorption Rate lab	150	19	28	423	3	4
management						2	
cross activities (*)						1	
TOTAL		470	79	117	1815	18	24

Example: SAR lab cost evaluation

Instrumentation/device	Purpose	Estimate cost (kEuros)
SAR measurement system	Overall measurement system, including probes and phantoms	200.0
Dielectric probe kit	SW and probe used to measure Tissue Simulating Liquids properties	15.0
Network analyser	Instrumentation used to measure Tissue Simulating Liquids properties	25.0
Radio communication tester	Instrumentation needed to set up EUT communication (e.g. 2G, 3G, LTE systems)	80.0
System check components	Instrumentation needed to perform SAR system verification	60.0
Personal computer and printer	Measurement SW is installed on it	3.0
Absorbers	To avoid reflections in close proximity of the measurement area	20.0
Liquid management	Material, instrumentation needed to prepare liquids and storage chemicals	20.0
	TOTAL	423.0

Thank you