Towards an Enhanced Quality Management Framework for the A&T Sector

Pierre Bonnal
EN-MEF
Agenda
• What is **quality**?
• The **needs** in matter of quality
• The **responses**:
  • The **QAC** (Quality Assurance Committee)
  • The **EN-MEF-QOP** section
  • The **QMF** (Quality Management Framework) editorial project
• Some key features of the QMF
• Conclusions
Quality

Two meanings:
1. “Quality” means those features of products which **meet customer needs** and thereby provide customer satisfaction;
2. “Quality” means **freedom from deficiencies**.

Joseph M. Juran

ISO 9000:2000

The difficulty in defining quality is to translate future needs of the user into measurable characteristics, so that a product can be designed and turned out to give satisfaction at a **price** that the user will pay.

W. Edwards Deming

**Efficiency vs. Effectiveness**
E.g. Quality at CERN

Quality of our facilities and equipment
Quality of our managerial and operational processes

Freedom of deficiencies
Stakeholder satisfaction
Effectiveness
Quality at a glance

Quality Management

Quality Planning  Quality Assurance  Quality Control
Quality at a glance

"I say what I will do
Someone checks that it is appropriate
I do what I have said
I provide evidence of compliance"

"I also identify defects in the processes and seize the opportunity to improve them"
Quality at a glance

1. **Policy** = strategic level
2. **Standards & Processes** = tactical level
3. **Procedures** = operational level
4. **Records**
Quality at a glance

Quality Planning vs. Quality Control
Standards to apply
- ISO
- CEN
- CSS

Tools to use
(IT tools, templates, forms...)

Roles to assign

Processes to follow

Quality Planning
For releasing documents
For managing configuration
For managing projects
For managing operations
For ensuring safety
For handling non-conformities
For managing risks, crises
For acquiring
More broadly: for decision making
Standards to apply

Managerial process

Engineering process

Product-related

Process-related

Quality Planning
V&V
(verification & validation)

Traceability
of performed tasks and deliverables

Change
requests, decisions and implementation

Non conforming
products and deliverables
The QA Trade-off

<table>
<thead>
<tr>
<th>1970’s</th>
<th>1980’s</th>
<th>1990’s</th>
<th>2000’s</th>
</tr>
</thead>
</table>

- **TQM**
- **6 sigma**
- **Lean**
Agenda

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• Conclusions
The Needs – Need #1
The Needs – Need #2

Great IT tools but insufficiently mature processes
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The Response from the Management

**a Body**

**QAC**

- Needs
- Strategy
- Steering
- Validation
- Trends

**a Section**

**EN-MEF-QOP**

- Implementation
- Support
- Dissemination
- Verification
QAC ➔ Continuation of QAWG

1st meeting in March 1998
Chair: P. Faugeras
Sci. Sec.: M. Mottier

- 1998-2003 Marcel Mottier period
- 2004-2005 Elena Manola period
- 2006-2013 Tadeusz Kurtyka period
MANDATE

QUALITY ASSURANCE COMMITTEE

CONTEXT
The efficiency of the programs, projects and activities of the Accelerators & Technology Sector also relies on a quality framework. During the LHC design and construction, an effort was made to define processes, to agree upon key conventions and standards and to specify and develop the appropriate software tools. This effort should now be refined and enhanced to adjust it also to the current phase of operations, maintenance and upgrades, in a way that is coordinated and promoted throughout the A&T Sector.

PURPOSE
The Quality Assurance (QA) Committee receives the mandate from the Director for Accelerators and Technology and the Heads of the BE, EN and TE Departments. The QA Committee coordinates the overall QA strategy for the A&T Sector. It provides a place for discussion and coordination of QA-related activities, projects and issues in order to ensure a common accelerator-wide strategy shared by the equipment groups and the engineering support services of the A&T Sector.

SCOPE
The scope of responsibility covers the QA-related activities and projects for the Accelerator Complex (LHC and injectors, and their experimental facilities) and technical infrastructure, within the A&T Sector and GS Department. The QA Committee is also the reporting body of all on-going QA-related projects of the A&T Sector.
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Key Deliverable

Modular and Scalable Quality Management and Systems Engineering Framework “Quality Management Framework”

Identify the appropriate modular and scalable quality management and systems engineering framework suited to the programs, projects and activities of the A&T Sector which shall supersede the long lasted LHC Project Quality Assurance Plan; produce a Conceptual Design Report; ensure its endorsement by the various stakeholders: i.e. equipment groups and engineering support service.

By the end of year 2014

CDR by end of 2014
Key Deliverable → QMF

1. Policy = strategic level
2. Standards & Processes = tactical level
3. Procedures
4. Records = operational level
Key Deliverable → OME

cern.ch/quality
QMF Editorial Project

Documents are discussed in relevant forums + with relevant stakeholders

Check

QOP & others (via QOP)

Approve

QAC + additional committees + A&T Mngt (via QOP)

QOP drafts documents

Project Roadmap approved by QAC
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Practical Need #1

How to enhance the document handling process?
Enhancing the Document Handling

**Authoring**
Templates
Generic documents

**Circulating**
Verification = check
Validation = approval

**Identifying**
Coding/numbering + Versioning

**Archiving**
Retrieving
<table>
<thead>
<tr>
<th>Legal people approach:</th>
<th>One-digit/letter approach:</th>
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<tbody>
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<td><strong>First release:</strong></td>
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<td>1234 – L (\ldots) (Z, AA)</td>
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**CM M.m approach:**

First release:
- **1234 v. 0.1** DRAFT
- **1234 v. 0.2** DRAFT
- **1234 v. 1.0** RELEASED

First revision:
- **1234 v. 1.1** DRAFT
- **1234 v. 1.2** DRAFT
- **1234 v. 1.3** DRAFT
- **1234 v. 2.0** RELEASED

Next revision:
- **1234 v. 2.1** DRAFT
- **1234 v. 2.2** DRAFT
- **1234 v. 2.3** DRAFT
- **1234 v. 3.0** RELEASED

**CM M.m.b approach:**

First release:
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- **1234 v. 1.0** RELEASED

First revision:
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- **1234 v. 1.2** DRAFT
- **1234 v. 1.3** DRAFT
- **1234 v. 2.0** RELEASED

Next revision:
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- **1234 v. 2.3** DRAFT
- **1234 v. 2.0** RELEASED

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**Doct. ID ➔ Should not be a problem**

**identifying**

**Coding/numbering**

**versioning**

**circulating**

**Verification = check validation = approval**

**Carnegie Mellon University**

M = major
m = minor
b = built
Stakeholders
Need of a new document
Discuss the scope and content of the document

Authors
Draft the document

version tracking by means of date, date+time, authors initials...

Good enough?
Yes
No

Check required?
No
Yes

Check the document

Checkers
Check the document

Approvers
Approve the document

Recipients
Informed

Prepare for release

Approved

Reject

Re-check required?
Yes
No

Integrate comments & corrections

Integration of comments?
Major
Minor

Approval required?
No
Yes

i = previous i+1

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Enhancing the Document Handling

Archiving + Retrieving
Two Families of Documents

Documents of personal interest

VS.

Documents of general interest

Engineering docts.

Safety docts. + O&M docts.

Scientific publications
## The “5 Roles”

<table>
<thead>
<tr>
<th>Role</th>
<th>Title</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author</td>
<td>auteur</td>
<td>Authors “Prepared by”</td>
</tr>
<tr>
<td>Proofreader</td>
<td>correcteur</td>
<td>Checkers “Checked by” (~ “Verified by”)</td>
</tr>
<tr>
<td>Editor</td>
<td>resp. de collection</td>
<td>Approvers “Approved by” (~ “Validated by”)</td>
</tr>
<tr>
<td>Publisher</td>
<td>éditeur</td>
<td>Releaser “Released by” (the Appro Leader)</td>
</tr>
<tr>
<td>Librarian</td>
<td>bibliothécaire</td>
<td>e-Librarian / Cataloguist “Cataloged by”</td>
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</tbody>
</table>
Verification vs. Validation

from Software Engineering but also applied to documents
from Barry W. Boehm (1981)

Verification:
Are we building the product right?

Validation:
Are we building the right product?
## The “5 roles”

<table>
<thead>
<tr>
<th>Roles</th>
<th>Author</th>
<th>Checker</th>
<th>Approver</th>
<th>Editor</th>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
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## Project Selection

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<tr>
<th>Accelerators</th>
<th>AD - Antiproton Decelerator</th>
<th>Project Management</th>
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<tbody>
<tr>
<td>CERN Departments</td>
<td>AWAKE Project</td>
<td>Working Documentation</td>
</tr>
<tr>
<td>Computing</td>
<td>CLIC</td>
<td>ELENA Hardware Baseline</td>
</tr>
<tr>
<td>Design &amp; Equip. Catalogues</td>
<td>CNGS Project</td>
<td></td>
</tr>
<tr>
<td>EU Projects</td>
<td>CTF3 (Cic Test Facility) Project</td>
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<tr>
<td>Experiments</td>
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<tr>
<td>LHC Machine</td>
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<tr>
<td>HL LHC - High Luminosity LHC</td>
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<tr>
<td>LIU - LHC Injectors Upgrade</td>
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<td>Management &amp; Committees</td>
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<tr>
<td>Operation</td>
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<tr>
<td>Health, Safety &amp; Environment</td>
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<tr>
<td>External Collaborations</td>
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<tr>
<td>Others</td>
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</tbody>
</table>

You've selected: ELENA

- ELENA
- EUROnu
- EuCARD
- EuCARD2
- FCC
- HIE-ISOLDE
- HIE-ISOLDE HARDWARE BASELINE
- HIRADMAT Project
- LHC IR Upgrade Phase I Project
- Linac2
- Linac3
- Linac4
Better Use of the EDMS

A&T Technical Documentation

Technical Management & Support

Studies (on-going + completed)

Projects (on-going + completed)

Facilities (under-construction + in-operation + dismantled)

Items & Assets (under-devt. + in-use + out-of-service)

Depts. (department → group → section → person breakdown)
Practical Need #1 – Implementation

1. Upgrading the “EDMS Starter Pack” to align it with these principles → part of the QMF

2. Refurbishing the EDMS accordingly

Some short term results, some medium term ones
Practical Need #2

How to enhance the management of projects?

Which PM standard to implement?
Which PM Standard or Methodology?

- PMI PMBoK
- ISO 10006:2003
- XP Extreme Programming
- Hermes
- ICB de l’IPMA
- ANSI #748
- RUP Rational Unified Process
- PRINCE2
- GDPM
- SCRUM
- ISO 21500:20??
Which PM Standard or Methodology?

PROJECTS

- computing
- construction
- industrial plant
- new product

- organizational
- training / HR
- events
- new service
Which Systems Engineering Standard?

The research leading to this framework has received funding from the European Commission under the FP7 ITN project PURESAFE, grant agreement no. 264336.
openSE = a lifecycle + key deliverables
Which Projects*?

- **New facility**-related projects*
  CERN-wide, sectorial or departmental projects

- **Equipment**- and **system**-related projects*
  Group-level projects

- **Upgrade**- and **repair**-related projects*
  incl. upgrade and repair projects submitted to ALARA

- **Organizational process**-related projects*

* Projects = \{ studies + development projects + programs \}
Practical Need #2 – Implementation

Four guidelines:

• Governing principles
• Facility-related projects*
• Equipment- and system-related projects*
• Organizational process-related projects*

with insights on: roles, scope, cost, time, quality, risk, procurement

Medium term results
Practical Need #3

How to enhance the procurement process?
Enhancing the Procurement Process

A few years ago

Now: e-Tendering

Tomorrow: Requirements Engineering

2014-05-15
Now: e-Tendering

**Bidder**

- Prepare the bid
- Analyze the bids
- Perform the contract
- Ensure requirements are met
Requirements Engineering

Tomorrow: Requirements Engineering

Bidder

- Prepare the bid
- Analyze the bids
- Perform the contract
- Ensure requirements are met

ReqIF
STEP

Analyze
the bids

Perform
the contract

Ensure
requirements
are met

2014-05-15
ATS Seminar on Quality — Pierre Bonnal
Structured list of requirements (specification items):

- Req. ID + category
- Req. statement (a “shall statement”)
- Bidder compliance { C, PC, NC, TBD }
- Req. status { Planned, Qualif. Stage, Accept. Stage }
- Deviation request(s) and decisions(s)
- Verification method { T, A, I, ER }
- Verification level
- Verification execution document
- Verification reporting document
- Verification status { Planned, C, NC }
Requirements Engineering

Off-the-shelf Requirements Authoring Tool

IBM Rational DOORS

Requirements management for complex and embedded systems

Effective requirements management practices have a positive impact on the success of systems and product development.

IBM Rational DOORS® software is designed to capture, trace, analyze and manage changes to requirements and helps you comply with industry standards.

**Intuitive, collaborative and scalable requirements management**

Successful management of requirements starts by documenting them in a way that's easy to interpret and navigate. In Rational DOORS, the hierarchical organization of requirements—in a familiar, document-style list—shows each individual requirement in context, while a convenient user interface and advanced search tools of the information. And built-in collaboration tools make it easier to gather input from stakeholders, maintain version control, and track changes.
Requirement Engineering

**INCOSE Systems Engineering Handbook** - a guide for system life cycle processes and activities, version 3.2.1 January 2011, INCOSE-TP-2003-002-03.2.1 (374 pages)  
[www.incose.org](http://www.incose.org)


**Guide to the Systems Engineering Body of Knowledge (SEBoK)**, version 1.2, 2013 (816 pages)  

[http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20080008301_2008008500.pdf](http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20080008301_2008008500.pdf)

**Space Engineering – Verification**, European Cooperation for Space Standardization  
ECSS-E-ST-10-02C, March 2009 (45 pages)  
[www.ecss.nl](http://www.ecss.nl)

**A Glossary of Requirements Engineering Terminology**, IREB, v1.5, May 2013 (116 pages)  
[www.ireb.org](http://www.ireb.org)

**Get It Right The First Time: Writing Better Requirements**, IBM Rational DOORS, 2011 (68 pages),  
[http://publib.boulder.ibm.com/infocenter/rsdp/v1r0m0/topic/com.ibm.help.download.doors.doc/pdf92/get_it_right_the_first_time.pdf](http://publib.boulder.ibm.com/infocenter/rsdp/v1r0m0/topic/com.ibm.help.download.doors.doc/pdf92/get_it_right_the_first_time.pdf)
Practical Need #3 – Rationale

- High/good quality products/services
- Low/affordable cost products/services
Practical Need #3 – Rationale

- High/good quality products/services
- Low/affordable cost products/services

Competitive advantage ⇒ They can choose their customers
Well organized ⇒ They prefer well organized customers
Have adopted or adopting requirement engineering tools

Longer term
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• Some key features of the QMF

• **Conclusions**
Many other quality-related topics!

• Enhancing the management of **maintenance**
• Enhancing the management of **configuration** (incl. items, assets, ECRs, non conforming products…)
• Enhancing risk-based decision processes
• Enhancing the use of **ERP-PLM tools**

…
Conclusion (1/3)

- High-end research results
- Research results at affordable costs

Research Funding Agencies

Satisfaction = Value
              Price

Lean Quality Management Framework
Quality Management refers to many processes
A few addressed in a lean perspective (e.g. Lean Project Management, Lean Systems Engineering)
Other not yet proposed in a lean perspective
Challenge: creating these lean processes! (e.g. Lean Process Diagramming, Lean Requirements Engineering)
Conclusion (3/3)

Quality Management implies the use of many IT Tools

They shall grow coherently and be correctly interfaced

The “plaster strategy” be avoided

Regular reengineering of the processes
Thank you for your attention