

Case Study

Integrated Quality Management System for Public Works Authorities

Using the Example of LASTRADA
The Solution for the Quality Management of Production,
Construction, Nation-wide Material Design and
Laboratory Operations

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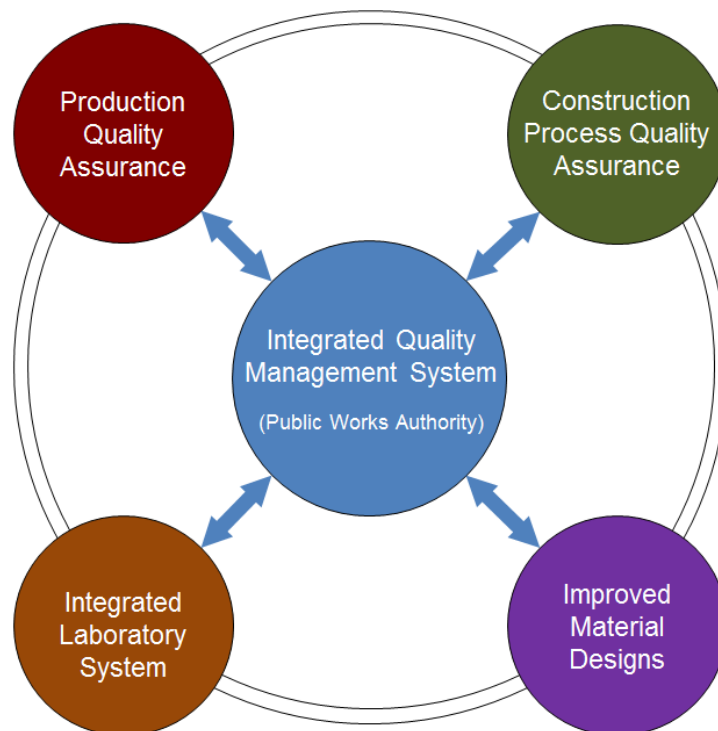
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1 Introduction

Quality management throughout the construction process is complex and unfortunately insufficient quality stays a permanent and critical issue. The installed materials, local boundary conditions, climate, machines and human beings have impact on the installation of construction materials. Hence many initiatives have been started to improve the quality throughout the construction process from different sides and aspects.

This case study describes an ***Integrated Quality Management System*** which focuses especially on the quality of the production, construction, material design and laboratory processes. The facilitated goals are:

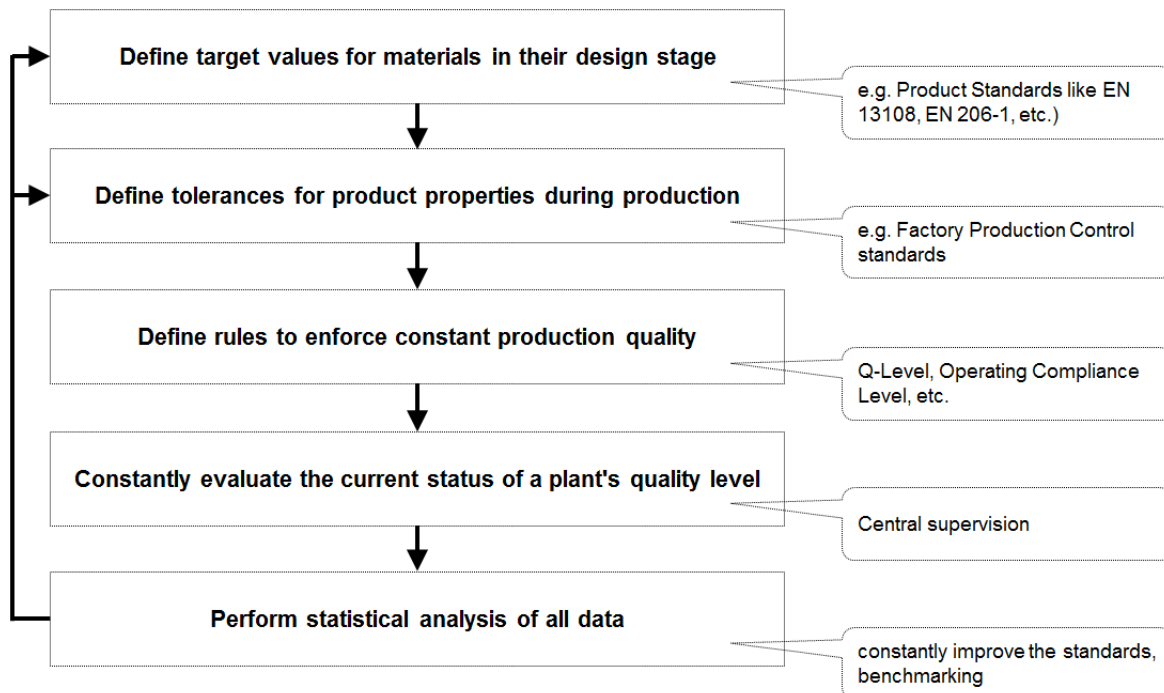
- **Constant and high quality in the production process**
- **Constant and high quality in the construction process**
- **Development of improved material designs, which respond to special climate requirements**
- **Constant high quality, efficiency and speed of the underlying laboratory processes**



2 Constant and High Quality in the Production Process

This chapter describes how constant and high quality of materials production is realised by using LASTRADA, as an example for an integrated quality management system.

The most fundamental prerequisite of any quality control/ quality assurance system is the definition of standards for the evaluation of the production quality. On the basis of these rules the production process is supervised and its performance may be evaluated. An integrated quality management system, such as LASTRADA, facilitates the following steps:



Definition of own Material Specifications

LASTRADA is able to adopt **any material specifications** for aggregates, asphalts, concretes, binders and cements in accordance with **any product standard**.

It is possible to define the rules for mix design and subsequent quality control in any detail. Therefore, the Public Works Authority can rely on the quality management system to support all its decisions, regarding rules for material design.

Definition of own Factory Production Control Standards

LASTRADA is able to adopt any rules for the supervision of the production process. For example, it can enforce the rules of the various interpretations of the advanced European Standard for Factory Production Control:

- Tolerances for produced material based on declared product properties
- Sampling and testing frequencies depending on single and mean value criteria
- Customisable sampling and testing frequencies for components (aggregates, binders, reclaimed material, additives, etc)
- Concise sampling plans for all performed tests

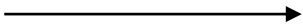


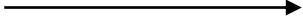


On the basis of those facilities, which are constantly expanded, it is possible to implement and enforce any FPC framework.

Centralised Monitoring the Conformity of all Plants

The conformity of all plants can be monitored centrally by using an integrated quality management system. The Authority monitors, assesses, approves and compares the FPC of any plant in any wished detail - from the administration of FPC certificates to the continuous evaluation of the daily test results. The producer's quality data will be imported into the Authority's central system via a standardised format (e.g. XML).

The following chart shows FPC activities and how each of them can be supervised by means of LASTRADA. The chart is based on the example of Asphalt Production Control but can be seen as an example for aggregate and concrete production control (with some differences).

FPC Activity at all Plants		LASTRADA Support for the Public Works Authority
Inspection & Certification of the FPC by the Authority		<ul style="list-style-type: none"> - Central register for inspection protocols - Central management of certificates
Quality Plan	<i>Send quality plans</i> 	<ul style="list-style-type: none"> - Central register of all quality plans
Quality Control of Constituent Materials	<i>Import sample and test data of constituents of all plants (regularly or on demand)</i> 	<ul style="list-style-type: none"> - Instant evaluation of compliance to sampling plans
Target Composition and Initial Type Test	<i>Import target compositions and results of the type tests (regularly or on demand)</i> 	<ul style="list-style-type: none"> - Instant evaluation of compliance to product specifications
Quality Control of Produced Mix	<i>Import sample and test data of the produced mix.</i> 	<ul style="list-style-type: none"> - Central overview of compliance of every tested product and possibility to compare to other quality data from the destination site.
Record of FPC Data		<ul style="list-style-type: none"> - Real time access and archive of the FPC data of all plants
Evaluation and Declaration of Conformity		<ul style="list-style-type: none"> - Central overview of constancy and quality of production. - Continuous and up-to-date information about conformity status of all plants.



Data Analysis

As all quality data is combined and organised within one system, it can be subjected to statistical evaluations within the integrated quality management system. LASTRADA offers the following tools among others:

- Visual data mining tools to find relationships between test results across all plants, projects and products
- Customisable statistical tables to create on-the-fly-analyses for any purpose
- Customisable graphs to display quality data in time-series, distribution functions and charts

With these tools at hand, the Public Works Authority can

- **Evaluate the effectiveness of the imposed production standards**
- **Perform benchmarking for certain material designs with respect to their performance**
- **Perform benchmarking of suppliers of construction materials per plant**
- **Perform interlaboratory tests for factory production control laboratories**

Conclusion

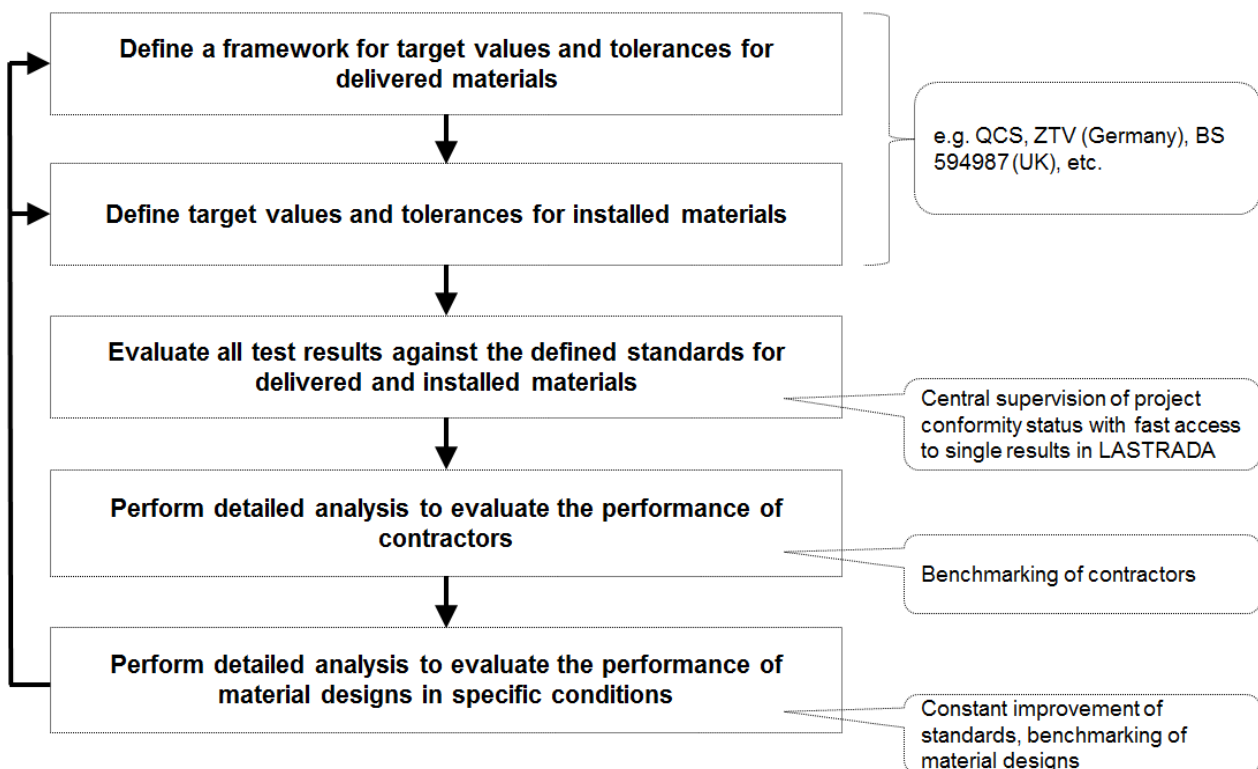
An integrated quality management system offers the Public Works Authority a powerful solution to define own FPC standards and to monitor and analyse the FPC of all plants.

Remark: Quality, efficiency and speed in the underlying laboratory processes are strongly enhanced by an integrated laboratory system (see chapter 5). The above Factory Production Control processes are fully supported by LASTRADA. This includes customised test data entry dialogues for the various tests and unlimited reporting possibilities.

3 Constant and High Quality in the Construction Process

This chapter describes how constant and high quality in the construction process is achieved with an integrated quality management system.

The basis for a construction process control regime is a set of standards, which define the target properties of the delivered and the installed material. Equally important is an integrated quality management system which allows the evaluation of test results in accordance with these standards. LASTRADA provides facilities to the Public Works Authority to



Definition of a Framework for Material Quality

The Public Works Authority can use LASTRADA to enforce any construction process control regime and centrally oversee all projects: Firstly, the Authority defines specific tolerances, arithmetical means and mandatory statistics for each material. It can subsequently perform an instant evaluation of the quality of delivered and installed materials for any given project.



Centralised Monitoring of all Construction Sites

There are many different scenarios, regarding the division of work between Authority, Contractor and Independent Laboratory. The singular quality of LASTRADA is to provide the flexibility to adopt to many possible distributions of the responsibilities for project authorisation, quality control and evaluation. To give only a few possibilities:

- Independent test houses monitor the quality of the material installation on behalf of the Authority (comparable to the German standard for road construction – ZTV Asphalt).
- The contractor self-monitors the quality of the material installation. The Authority supervises this control (comparable to the Austrian standard for road construction).
- Concrete identity testing of monitoring classes (comparable to the German standard for concrete DIN 1045-3)

In any case, all test results will be transferred to the Public Works Authority via standardised interfaces or file exchange. Here three scenarios for the quality control between the Authority and the external service provider (independent test house) are assumed.

Scenario 1: *Quality control is fully done inside the Authority.*

The project is registered in the system. After sampling the sample is also registered and assigned to the project. Then, after testing and the test data entry, the test data can be analysed in all possible aspects in the central system. All quality data of all tested sites will be archived.

Scenario 2: *The Authority does the sampling; Testing is delegated to a service provider.*

The project is registered in the Authority's system. After the Authority did the sampling, the sample is registered and assigned to the project. The physical sample itself is meanwhile transferred to the service provider. The service provider tests the sample and sends the test results electronically to the Authority via a standardised format. The Authority imports the test data (automatically/semi-automatically). During the import, the testing data will be automatically assigned to the sample, which was registered before. The test data can now be analysed in all possible aspects within the central system of the Authority. All quality data of all tested sites will be archived.

Scenario 3: *Sampling and testing is delegated to a service provider.*

The project is registered in the Authority's system. The service provider does the sampling and testing. The sample and test data are sent electronically to the Authority via a standardised format. The Authority imports the sample and test data (automatically/semi-automatically). During the import, this data will be registered and assigned automatically to the project, which was registered before. The data can now be analysed in all possible aspects within the central system of the Authority. All quality data of all tested sites will be archived.

Of course different scenarios are possible and will be supported by LASTRADA.



Data Analysis

As all quality data is combined and organised within one system, it can now be efficiently overviewed and analysed from all aspects.

In addition to the tools, described in the last chapter (data mining, statistics and graphs) the Authority can use LASTADA's facilities to compare samples from the finished road or building and compare them with samples taken from the plant, the delivery or from the road/building during construction!

With these tools at hand, the Public Works Authority can

- **Quickly find the reasons for construction failures**
- **Evaluate the effectiveness of the imposed contracting standards**
- **Look for correlations of design criteria and performance to adopt to special climatic conditions**
- **Perform benchmarking of contractors on the basis of one or many projects**
- **Perform proficiency testing trials for independent laboratories**

Conclusion

An integrated quality management system offers the Public Works Authority a powerful IT solution to define own materials testing standard and to centrally monitor the quality of all public construction projects. The system integrates efficient division of task; standardised, convenient and easy data transfer and the possibility to evaluate all relevant quality data in any aspect.

Remark: Quality, efficiency and speed in the underlying laboratory processes are strongly enhanced by an integrated laboratory system (see chapter 5). The above construction process control regime is fully supported by LASTRADA.



4 Development of Improved Material Designs

This chapter describes how to develop improved material designs with an integrated quality management system. The key to this goal is the possibility to empirically determine the **performance of mix designs under specific circumstances** and base the development of new mix designs on those findings.

Empirical Evaluation of Mix Designs

Using an integrated quality management system like LASTRADA, the Public Works Authority can easily gain an overview of test results and compliance for a specific mix design across construction projects.

For asphalt roads, for instance, the Authority can evaluate the test results of asphalt cores per mix design according to project attributes, like road type (traffic level), exposure to heat or other special requirements. It is therefore possible to implement **best practice rules for the mix designs which have proven themselves in practice.**

Furthermore, if material producers submit their mix recipes via interface to the Authority, it is possible to link the test results of asphalt cores to the actual mix recipe (and its alterations). In another step, if the asphalt delivery ticket includes plant settings, this information could also be linked to the asphalt core.

All this information will help to determine the cause of failures - whether they are rooted in the production process, construction process or in the mix recipe itself.

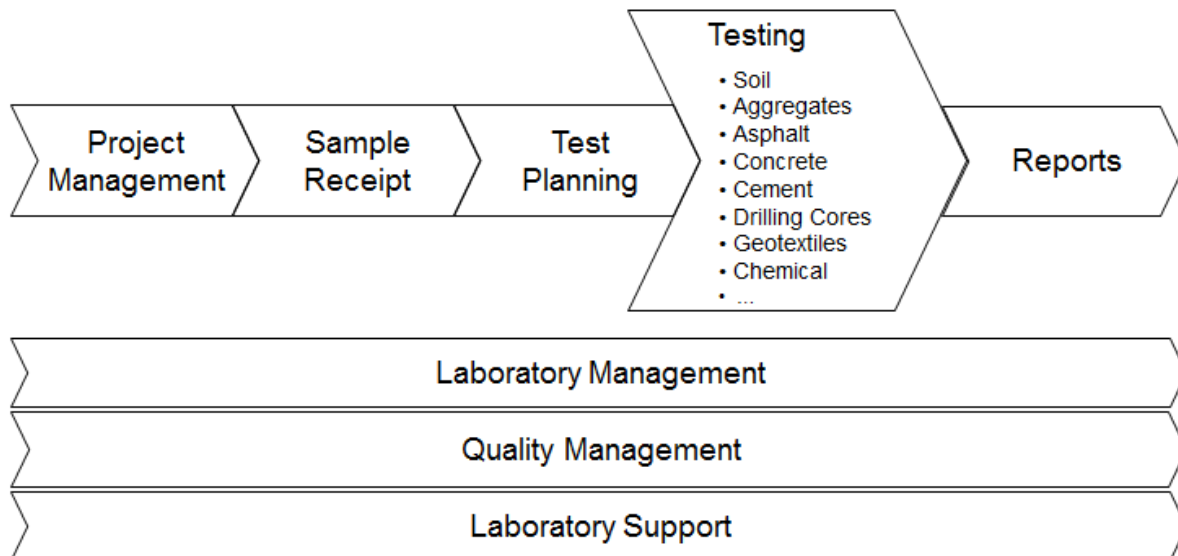
Conclusion

An integrated quality management system offers a powerful solution to compare quality data from roads and buildings with test results obtained during the production and the construction processes. The findings of this comparison will enable the Authority to evaluate the performance of mix designs at an unrivalled level of detail. In combination with its power to influence the procurement process and the nation-wide rules for material specifications, it will be able to achieve a higher overall-level of material performance.

Remark: LASTRADA provides powerful tools to conduct the above empirical evaluations. It also offers tools to quickly develop mix designs which are highly reliable and consistent.

5 Integrated Laboratory System

This chapter describes the aspects of an integrated laboratory system within an integrated quality management system. Ideally, all laboratory operations are integrated into one single application. LASTRADA, for instance, covers laboratory and quality management, materials testing and supports all laboratory tasks from project management to reporting and from sample receiving to disposal:



Ensure and Improve the Quality of Operations

The laboratory system facilitates a standardisation of laboratory processes. An efficient division of tasks is structured by user rights. The data entry dialogues follow test-specific requirements, support plausibility checks and thereby prevent errors. Norms and target values apply automatically. Report templates assure consistent document quality. Additionally, laboratory processes are fully traceable: Samples are traceable through automated sample register. Work traceability is enforced by user rights and defined quality procedures. Monitoring of all projects and work in progress is fast and comfortable.

Optimise Laboratory Operations

Laboratories with an integrated system handle more projects and more samples. Planning laboratory work is quick and easy. The throughput time will be shorter through sophisticated testing dialogues, one time data entry, interfaces to testing equipment, automatic plausibility checks, digital clearance, digital signature, and digital data exchange. Complex tests are supported by work lists. Also, the laboratory system can be interfaced with other existing IT systems.

Furthermore, the integrated system reduces the effort to comply with ISO 9001 and ISO 17025. Finally, a professional software provider secures a continuous and up-to-date support.

Conclusion

LASTRADA as an integrated laboratory system improves the overall quality, efficiency and speed of the laboratory operations.