Materials Acceptance and Certification (MAC) System

State of Florida

Agency for State Technology

&

Department of Transportation

Category: Improving State Operations

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Executive Summary

Florida's Materials Acceptance and Certification (MAC) system is a mission critical enterprise IT system supporting the Florida Department of Transportation's (FDOT) $10-15 billion annual construction program. The MAC is an innovative approach replacing and expanding the previous Laboratory Information Management System (LIMS).

The MAC contains functionality to ensure the quality of materials and workmanship through materials sampling, testing, and acceptance processing and serves as a model to other states and local governments. The system is recognized by the Federal Highway Administration (FHWA) as the most capable and powerful project quality assurance and acceptance certification tool of those it inspects.

The groundbreaking feature that contributes to this success is the integration of materials information with other department data such as pay item information in the Project Estimating/Letting & Award Systems (PES/LAS), Construction Contracts and Estimates from the Department's Construction Contract Administration System (SiteManager), Local Agency Program (LAP) Contracts and Work Program.

The MAC enables the State Materials Office to manage specifications using the "MAC Spec" module in which the business users apply changes directly to the "MAC Spec" module and approve changes in a timely manner without intervention from a development team. This forward-thinking approach reduces costs and decreases delays during the sampling and testing of FDOTs construction projects. These specifications are then enforced by MAC across all districts, which means the specifications are no longer the interpretation of the sampler or testing technician.

The benefits of the MAC are realized by FDOT, industry partners, the traveling public, as well as federal, city, county, and municipal agencies; and the value is gained while ensuring adherence to rigorous federal and state specifications for maintaining and certifying road and bridge materials.

Concept

The Code of Federal Regulations, specifically 23 CFR 637 Sub Sections 201-207, requires that State Highway Agencies (SHA) develop and execute an approved construction project quality assurance and acceptance certification program to be eligible to receive federal transportation funding. This multi-faceted, detailed and rigorous quality assurance program must be approved by the FHWA, implemented and continuously managed by the SHA to remain eligible for that funding.

The technology risk for the previous system (LIMS) was a major concern, the Department was at risk of losing the capability in 2015 as it was no longer supported and the State Data Center could not guarantee the servers could be recovered if the system failed. The timeframe to acquire and implement a new technical solution would have been approximately 3-5 years. In the absence of LIMS, many of the Department's current processes would have been impossible, and it would be unable to guarantee the quality of materials and workmanship of its construction

projects without impacting schedules. Any impact to the Department's delivery of the $15 billion Work Program has potential economic repercussions.

The business goals of the MAC project provided the required functionality and capabilities to ensure acceptable materials and products are used in transportation construction projects. The Federal Highway Administration (FHWA) mandates rigorous verification processes and procedures divided into functional areas found within the MAC application:

1. Qualified Technicians – only technicians specifically trained and qualified in sampling and testing of a given material are permitted to sample and test that material; the FDOT must conduct and manage a rigorous Construction Qualification and Training program (CTQP) to ensure technicians performing acceptance sampling and testing are qualified.
2. Qualified Laboratories – only laboratories specifically qualified to test a given material are permitted to test that material; the FDOT must conduct and manage a rigorous Laboratory Qualification program to ensure laboratories performing acceptance testing are qualified.
3. Independent Assurance (IA) Program – the FDOT must conduct and manage a rigorous inspection program to ensure technicians conduct their sampling and testing correctly. The FDOT employs a system based approach that reviews technicians qualified under the CTQP are consistently following sampling and testing test methods.
4. Job Guide Schedule (JGS) – all projects must be given a specific material sampling and testing job guide schedule, which identifies the testing requirements for all materials used on a construction project. The JGS will include: test types required to ensure acceptable quality, frequency those tests must be conducted, and test results required to ensure material quality;
5. Project Certification – FDOT is required to certify – in writing – that all contract requirements have been met for all federally funded projects but also issues the certification for all contracts regardless of the funding source;
6. Approved Materials – aggregates, cement, hot mix asphalt, and structural concrete are examples of materials that must be approved for use on Department projects.

The MAC also supports the following Departmental objectives:

1. The ability to effectively and efficiently create, analyze and report on vast amounts of data to ensure the materials used on projects are in compliance with federal requirements;
2. Seamless access with minimal restrictions for a vast number of simultaneous internal and external users;
3. Automated checks and balances to ensure entered data meet quality and integrity requirements.

Commercial off the shelf (COTS) products were evaluated before the Department determined to create the application around FDOT business processes. Analysis of these COTS products were not robust enough or were too restrictive for the users and would require costly customization. The cost of customization and future customizations (for example, to address product updates) were found to be more expensive than developing an application based on the exact FDOT business processes. With Material management being a core function of the Department it was too risky not to develop a custom system to directly support this mission critical function.

There are many sample life cycle products available, but few based on road and bridge construction sampling and testing. Most sample life cycle products do not have the ability to track the other programs that make up the FDOT's Quality Assurance Procedure for Construction, such as qualified personnel and qualified laboratories.

Because most of the application users (industry partners) are not FDOT employees, it was essential to the project success that the user pool be represented in requirements collection, design, programming and system testing to ensure the application did not unduly burden partners and stakeholders. Most application development includes a small number of key users, but this approach was not sufficient for the robust MAC requirements.

The functional application team included members of Materials employees, both Central Office and District Offices, Construction, and key industry users from contractors, producers and laboratories. Also, for the wider audience not participating in the development and testing, the project development team provided updates to all stakeholders at every major industry meeting during the project life. The users continue to provide feedback during the initial implementation and changes have been made to the application based on stakeholder feedback. The focus is to ensure that the application correctly documents the contract requirements without requiring any undue constraints on the users.

This program is used to guarantee that the materials and workmanship incorporated into all federally funded projects comply with the contractual and quality requirements of each project's approved plans and specifications.

The FDOT Materials Offices provided the bulk of the user education. The project time line and planning allowed the proper time for the full implementation and training to the nearly 2,000 users. This was necessary to provide end users with basic training before they were expected to use the application and specialized training continues.

The Department was aware that the implementation period could result in many changes to the system based on user input. Thus, MAC was designed with flexibility such that many of the changes suggested by the end user pool did not require programming. Since implementation, the Department has received numerous positive comments from our stakeholders and partners. The comments address the system in general in that it is a very good product and the Department's ability to respond in a timely manner when adjustments need to be made. For example, when Construction personnel initiate a contract Change Order revising material method of acceptance, the contract's requirements in MAC can be updated from the standard requirements to the project specific requirements. This feature has received a great deal of positive feedback.

Significance

The investment in Florida's transportation infrastructure continues to grow and is an integral part of the state's economic recovery. Increased funding has resulted in increased construction capacity. The Department has leveraged technology to support this increased capacity and the

benefits are both tangible and intangible and will be realized by FDOT, FHWA, the traveling public, cities, counties, and municipal agencies as well as industry.
The technology and the automation of manual processes has significantly improved the Department's ability to manage the quality assurance program; and continue to provide opportunity to partner with industry for materials sampling and testing. As shown in Figure 1 below the MAC has four (4) major segments that work together to ensure the Department's MAC system continues to meet FDOT Management and Industry expectations.

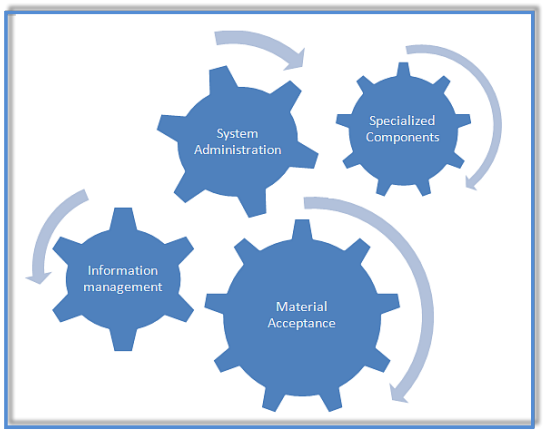

Figure 1 - Major Segments of MAC

Materials Acceptance

The Materials Acceptance segment of MAC has incorporated data input, processing and reporting necessary for the life cycle of all materials sampled and tested. This segment included methods for data input ranging from customized online screens to various upload tools to address the lack of Internet connectivity for some industry partners. The segment has also provide a means to continue to process the over 150,000 various material samples collected each year while addressing the specific laboratory processing requirements. A formal workflow for tracking and documenting the Final and Monthly Materials Certification processes was provided. Materials Acceptance process has incorporate requirements of the Independent Assurance (IA), Lab Qualification and QC programs.

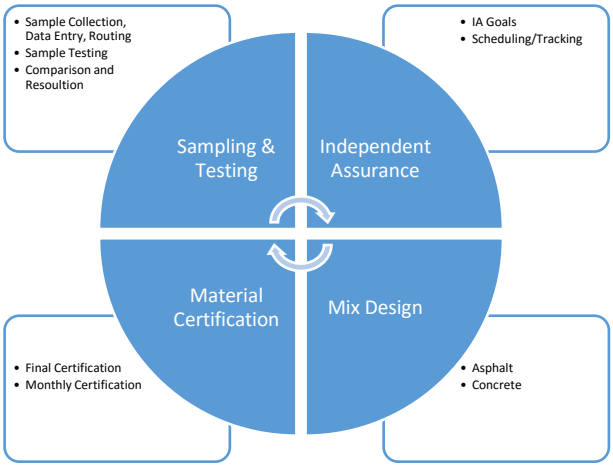

Figure 2 - Material Certification

Information Management

In support of the Materials Acceptance all producers, terminals, facilities, laboratories and technicians must be qualified to do business with the FDOT. The Information Management segment of MAC ensures the materials, providers, and personnel are qualified to participate during Materials Acceptance. This segment also address the Reporting needs of the system.

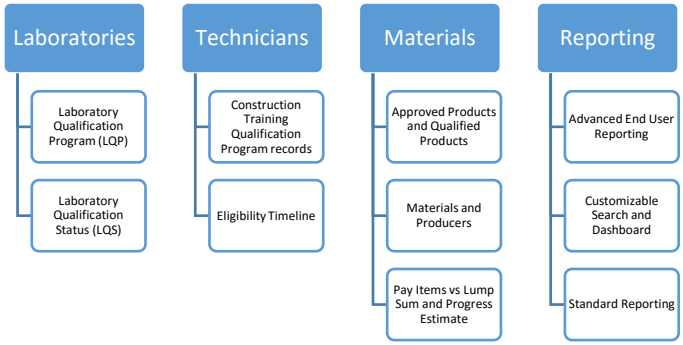

Figure 3 - Information Management

System Administration

As with any automated system a certain level of System Administration is required for general housekeeping and routine data management. This segment of the MAC focuses on the System Administrator responsibilities which range from system support to data management of predefined areas of the system. The Administrators have automated screens to manage user access to the system as well as online access to manage predefined data elements. A primary focus with System Administration was the development of a user friendly "Test Designer" that provides the capability to define questions and calculation based on American Society for Testing and Materials International (ASTM), American Association of State Highway and Transportation Officials (AASHTO), and Florida Test Methods. System Administrators are able to create or modify test without the intervention of a development team, this is a cost and time savings to the Department. These features allow MAC to be very flexible while still maintaining a statewide standard. The project specific entries can be created and maintained by the System Administrators and rarely require programming updates.

Specialized Components

The following are identified as specialized areas with the State Materials Office. Of these areas the MAC was able to incorporate the Quality Control Program, Defective Materials, Issue Tracking and Data Conversion as part of the MAC development project. The Earthwork Record System (ERC) is currently a manual process and is considered a potential enhancement project that will be able to integrate into the MAC architecture. Consideration for the Earthwork Records Systems was considered during the design of MAC and the architecture and design of the MAC will allow for integration of this project.

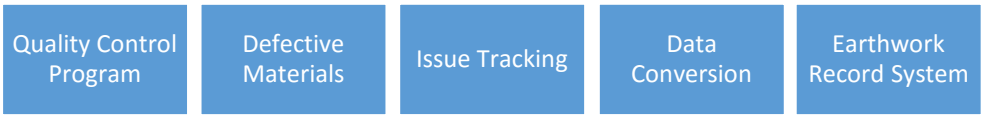

Figure 4 - Data Conversion (AKA Data Transfer Project)

Impact

The notable MAC system benefits include but not limited to better quality, assurance the materials and workmanship contracted are what is received, and avoidance of project delays. Impacts to construction industry/economy are a direct correlation of the realization of the value provided by this system. The implemented MAC system has raised the bar and provided the Department a tool to monitor quality and ensures the Transportation Project(s) are delivering/meeting the necessary logistic requirements.

Florida has a higher level of privatized sampling and testing than any other state, with approximately 85% of the annual 150,000 samples processed each year performed by industry partners external to the Department. Because contractor sampling and testing data is part of the project acceptance determination, construction contracts require industry partners to provide and be readily able to submit this data. Given the trend toward more private sector jobs, it was even more critical that this process be supported by automation that allows external contractors to efficiently transmit sample and test data to the department.

The system goes far beyond routine sample logging and test result tracking. Without the robust application, the materials data and information required from a program of the magnitude of Florida's extensive work program would not be feasible or manageable from either FDOT's or the construction industry's perspective.

The MAC has provided FDOT the continued ability to meet federal requirements to be eligible to receive federal funding. Benefits will continue to be assessed by compliance with federal laws and mandates, as well as compliance with current Department specifications.

Beyond just collecting material acceptance requirements, the system is designed to track and monitor materials from the raw product to the final delivery & placement for the State of Florida use. MAC's interconnectivity gives the department a unique opportunity to manage the materials acceptance program and make decisions based on quantitative and qualitative data. By monitoring long term trends, we are better able to identify and reduce requirements while ensuring that the Department's materials program continues to deliver the highest quality. FDOT is recognized nationally as a leader for our ability to deliver a 10+ billion dollar work program while still having some of the best roads and bridges in the nation. We do not sacrifice quality by focusing on trying to keep our contracts delivered on time and on budget. MAC is part of the reason we are able to do this.