OCTOBER 24, 2019

LOUISIANA PROFESSIONAL ENGINEERING AND LAND SURVEYING BOARD (LAPELS)

SOFTWARE DEVELOPMENT STANDARDS

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Executive Summary

This document represents a basis for the overall design, implementation, development, deployment, and documentation to which all work performed on current applications and systems as well as future systems deployed at LAPELS must adhere. Included within this basis are the general and specific requirements as defined by LAPELS. These requirements cover the internal and external systems which LAPELS depends on for day-to-day operations. The increasing complex external systems are becoming more important for proper LAPELS operation.

In addition, the method of integration which connects the applications and systems together and creates a seamless LAPELS-wide application are included within the document. Finally, the structure and storage of all data within LAPELS databases are described.

These standards have been developed with the cost of implementation in mind and there is no risk to LAPELS in employing these suggested standards. A greater risk to LAPELS's operations exists if developers do not follow or correctly employ these minimum standards as more applications are developed.

The complexity and critical nature of LAPELS's automated systems in relation to the operations and function of LAPELS necessitate that these standards be implemented and followed closely. LAPELS's overall IT plan for a completely integrated system is currently in progress. The plan depends on the standards being implemented and followed, and adherence to the standards will be being monitored.

LAPELS Software Development Standards Goal

The primary goal of this document is to establish common standards that all present and future automated systems at LAPELS will obey. These standards will provide LAPELS maximum flexibility, increase the flow of information between databases, systems, and applications, reduce errors, maximize speed, decrease the need for special interfaces, and lower the cost of maintenance.

These standards cannot be circumvented in any state of an application's or system's lifecycle. Only by all systems embracing these standards will the overall goals of LAPELS be achieved.

The objective during implementation of these standards is to ensure and verify proper integration and consistency across the automated system or systems being developed or maintained. Correct integration within LAPELS databases and current automated systems is crucial for the operation of LAPELS. The process and scheme of implementation must be consistent with other databases and systems as to minimize the future development and maintenance costs to LAPELS. Finally, only by consistent implementation can LAPELS be secure in relying on the systems for dependable operation, and in the accuracy of the information being stored and processed.

Acceptable Tools and Technologies by Category

The following tools and technologies are acceptable for the development of new LAPELS software systems:

Operating Systems:

- Microsoft Windows Server 2016/2019
- Microsoft Windows (10 Update 1803 and greater)

Database Engines:

- SQL Server 2019

User Interface:

- Internal users – IE 11 or greater
- External users – Chrome and other modern browsers supporting HTML5 and CSS3

Programming Languages, Tools and Technologies:

- .NET Framework 4.7+
- Visual Studio 2019
- C#.NET 6
- Java Script
- JQuery
- MVC5
- ASP.Net Razor Syntax
- Entity Framework 6
- Axure RP Pro
- Active Reports 11
- ReSharper
- Closed XML
- ItextSharp
- LinqPad
- JSON
- HTML 5
- CSS 3

- Windows Workflow Foundation 4.5+
- WCF/SOAP

Database Design Tools:

- SQL Server 2019
- Microsoft Visio 2019

Administrative Tools and Technologies:

- Azure DevOps Server (formerly Team Foundation Server)
- Microsoft Project Server 2019
- Red Gate SQL Toolbelt
- Red Gate SQL Source Control
- OneNote 2016
- Microsoft Office Professional 2019

Documentation Technologies:

- Adobe Photoshop CC
- Adobe Acrobat Pro XI or higher
- Microsoft Office Professional Plus 2019

All development and maintenance work will be completed on LAPELS systems using only LAPELS-approved software.

For all maintenance performed, the original development environment and/or application initially used can be utilized.

Project Management

LAPELS has chosen Microsoft Project as its primary automation tool to assist in managing all IT projects. In addition to the reports that can be generated by Microsoft Project, LAPELS has mandated that the following additional documents be produced.

- Requirements Document
- Design / Definition / Specifications Document
- Project Plan and Work Breakdown Structure
- Screen and system functional mockups
- Execution Schedule
- Scope Document
- Weekly Status Reports
- Issue Descriptions
- Change Requests / Issue Description
- Sign Off Sheets
- Test Plan
- Test Plan Results

Requirements Document, Scope Document, Design / Definition Specifications Document, overall Project Plan, Work Breakdown Structure, and Execution Schedule are all due before programming on a project begins. These documents should at a minimum determine the functionality, operational capability, and features of the system, define the whole organizational structure of the system, explain any critical dates in the timeline of the project, illustrate any possible problems, and define the critical path for project completion.

A Gantt chart is an appropriate method for displaying timelines and the critical path for a project.

Completed weekly status reports including timesheets, change requests / issue description sheets, sign-off sheets, and test plan results are to be given to both IT and the respective division's IT coordinator for project tracking and stored in the central LAPELS OneNote repository.

At minimum, the Scope Document must include, but is not limited to the following sections:

- Objectives of the project
- Scope of the project
    - In Scope items that will be developed
    - Out of Scope items discovered in interviews of staff that is beyond the original statement of work and should not be considered as items in the project – these items shall be signed off prior to development
- Deliverables that will be produced
- Assumptions of the contractor in development of the Scope Document
- Risks associated with the project

For the Software Development Lifecycle, LAPELS uses a hybrid approach for tracking of the overall project and the execution of the actual work. LAPELS uses a phased waterfall approach combined with Project Management Institutes (PMI) process groups for the overall management of the project. Agile methodologies are utilized within the phases for project execution and actual work performed, especially during software development. Since Agile is a collection of numerous practices and methodologies combined with an assortment of tools that are dependent on the goals, circumstances, scope and complexity of the project, we use the Disciplined Agile Delivery (DAD) framework. DAD builds on the many practices espoused by advocates of agile software development, including Scrum, Agile Modeling, Lean software development, Extreme Programing, Kanban and others. We have used this combined approach with great success in numerous past projects.

Project Deliverables

All software development and maintenance projects at LAPELS have a:

a. Software component
b. Documentation component

These two components should be delivered in a form consistent with LAPELS standards in accordance with LAPELS Acceptable Tools and Technologies by Category section of this standard.

Software Deliverables

LAPELS requires the following software deliverables:

- Interface and system proof of concept
- Final code and system settings published within LAPELS internal systems
- Documented procedures for publishing the developed application and/or system to the development, staging and production servers. Additionally, any settings or client side configuration required for the application/system to function properly
- Documentation on the software developed including: high level function and functionality

The functional interface mockups and system proof of concept are due before primary development. Interfaces and business rules can be constructed using any of LAPELS approved tools and technologies. Demonstration, review, acceptance and signoff by key stakeholders and LAPELS IT is required prior to primary development proceeding.

The final code base, databases, all system settings and documentation, are due at the final system sign-off.

Documentation Deliverables

LAPELS requires that all documentation be a consistent, organized collection of documents that describe the global structure, purpose, operation, maintenance and data requirements for a program. All documentation for LAPELS systems will include:

- User Documentation / User Manual
- Program Source Code and Technical Documentation

All documentation should be submitted in LAPELS-approved electronic format, Adobe PDF.

Documentation deliverables are due when the software deliverable is completed or according to the contract between LAPELS and the contractor.

User Documentation/ User Manual

User Documentation – User manual is to be written from a user perspective. The purpose of the document is to empower the user to be self-sufficient.

How To – Includes any of the following that apply to the project. All documentation is to be written in "User Manual" format. Include screen capture images for easy understanding.

- Security Maintenance
- Application Maintenance
- Application Usage
- Expirations – Any expirations which will affect the system (i.e. rollover of data, temporary permissions, and site and/or application certificates)

User help documentation must be integrated within the respective system.

Technical Documentation

All technical documentation should to be written from a design and support perspective. The reader of the documents should be assumed to fully understand the technology and grasp the problem for which the system provides a solution. The only instance when technology should be explained is when the technology is being utilized in a non-standard method, or in a technique that has not been exploited previously by LAPELS. Industry standards are to be followed and referenced at all times.

Standard technical documentation to be produced for all projects:

- System Design Overview
- Operational Environment
- Object Reference
- Database Models
- Entity Relationship Diagrams
- Database Normalization
- Stored Procedure Reference
- Table Reference / Data Dictionary
- External System API Implementation
- Security References
- All System Source Code – Locations within LAPELS servers
- Stored Procedure Source Code
- SQL Script
- Report Descriptions
- Deployment Instructions

The following is a synopsis for each document:

System Design Overview:

- Overview: Provide an overview of the system developed.
- Program Specifications: Describe the specifications developed in the planning phase of the project.
- Functions: Specify the system / subsystem functions.

- System/Subsystem Logic: Describe the logic flow of the entire system/subsystem in the form of a flowchart / diagram.
    - Each workflow process needs a corresponding flowchart.

Operational Environment:

- Operations: Describe the operating characteristics of the user and computer centers or sites where the software will be installed.
- Equipment: Identify the equipment and software required for the operation of the software to be developed.
- Support Software: Describe any if needed.
- API (Application Programming Interface): Describe all APIs used by the system
- Custom DLLs – Describe DLLs used by the system, which are not industry standard and required for normal operation. Custom developed DLLs shall also include the source code.
- Interfaces: Describe and define all interfaces to the system. These include interfaces with other LAPELS databases and application systems, external databases and systems to LAPELS, and specific user interface requirements.

Object Reference:

- Overview: Identify and describe all program and data objects developed.
- Sub Programs: Describe any separate subprograms required for system functionality.

Database Models:

- Overview: Describe the database design and goals and database models developed for system.

Entity Relationship Diagrams:

- Overview: Include all relationship diagrams for system. Due upon request and prior to system deployment for new or substantially updated systems which are being maintained.

Database Normalization:

- Overview: Describe normalization implementation and how it relates to the LAPELS databases.

Stored Procedure Reference:

- Stored Procedures: Define and describe all stored procedures developed for system that are located on LAPELS database.
- Special Dependencies: Define and describe any special or extraordinary stored procedure dependencies.
- Views: Describe and define all database views.

Table Reference / Data Dictionary:

- Table Schemas
- Schemas and Table Definitions: Describe all table layouts with types, length and size where appropriate.
- Database Diagrams: Include all diagrams with identifying primary and foreign keys with all indexes.
- Data Dictionary: Include all fields by field name with description of information to be stored in data fields.

External System API Implementation:

- Describe system usage of APIs external to LAPELS systems.

Security References:

- Model: Define the security model utilized for the system. Describe all algorithms for security verification and encryption.
- Database: Include all table, stored procedure, and view permissions by active directory (AD) users and groups.
- User: Include all specific update, view, and create permissions by active directory (AD) users and groups.

All System Source Code:

- Source Code: Include all source code of the system divided by module. The source code will be stored within LAPELS TFS server.

Stored Procedure Source Code:

- Stored Procedure Source: Include all transact SQL source code for all procedures, divided by procedure.

SQL Script:

- Provide SQL scripts for all SQL objects.

Report Descriptions:

- Overview: Describe each report. Include reporting requirements, all input parameters and sample output.

Deployment Instructions:

- Overview: Detail technician level instructions for installing the developed system.
- Dependencies: Describe all required support software by operating system, operating system version, support software, support software version, and required software location on server and client computers.

Application Look and Feel Guidelines

All applications and systems developed for LAPELS should conform as closely as possible to the Windows design metaphor. In addition to conforming to the Windows design metaphor, applications need to conform to the look, feel and function of LAPELS applications and colors. LAPELS has chosen Microsoft products as LAPELS's standard for base installations on all LAPELS workstations. Designing programs and systems to closely conform to the Microsoft standard will minimize the training costs and reduce the time required for users to become familiar with a new application or system. All deviations or extensions from this standard must be approved by the IT division.

Network and Server Standards

All new servers set up for development which may require input from the Internet must be secured via HTTPS. It is the responsibility of the developer requiring a new server to consult with LAPELS IT. LAPELS IT staff will work in concert with the developers to load and configure any servers required for software development or maintenance.

Applications shall not be developed and tested on a production server.

All new servers set up to house web applications accessible externally must be on the DMZ. There will be no exceptions. It is the responsibility of the developers who are setting up the servers along with LAPELS IT to see that this standard is enforced.

All new servers, regardless of whether or not they are used for development, testing or production must be added to LAPELS backup solution. There will be no exceptions.

All code on development / testing and production servers shall be placed on a drive other than the system drive. In other words, SOURCE CODE OR SITE DIRECTORIES SHALL NOT be placed on the system drive.

Development, Test, and Production Environments

In order to create the most robust environment for systems development and production, the areas of development and production have been logically and physically separated into the following regions:

- Development
- Testing/Staging
- Production

Only in the **system development environment** are databases and program code objects created and modified, and actual system or program coding

occurs. The development environment is characterized by the unique ability of the developer to make dynamic changes to their system development area without prior authorization or coordination, and does not affect testing or the production environment.

During and after development, all system code developed or updated is controlled and cataloged through Microsoft Azure DevOps Server. The location and management of the Microsoft Azure DevOps Server will be controlled by LAPELS IT. All code developed will be checked in daily to the TFS server once the code is deemed stable by the developer.

The **application testing environment** shall be an exact replica of the production system on which the system is designed to function. This environment allows the developed code to be tested against final production schemas before being moved into production. The primary difference between the development environment and the staging/testing environment is the ability for the developer to make on-the-fly changes to the underlying database. The staging databases are not to be changed without prior coordination. The staging/testing environment is to be used for all system and program testing by the developers, LAPELS IT staff, and LAPELS users. Testing by developers, LAPELS IT staff, and LAPELS users will be coordinated to ensure testing is consistent.

A SQL job is scheduled and routinely executed to keep the data in the test environment consistent with the production environment. Certain database objects require LAPELS DBA to manually sync the different environments. All database object syncing will be coordinated with all required parties and executed solely by LAPELS IT.

The **production environments** are logically separated within LAPELS network. This allows for maximum flexibility and security with LAPELS data. The production environment is designed for maximum uptime and the fastest possible response time. As a result, no on-the-fly changes are allowed within the production environment. All changes to either the databases or system programs have to be scheduled with LAPELS IT staff.

Unhandled exceptions that cannot be corrected immediately should be trapped and the captured information sent to a log file for evaluation. During the testing and debugging phase of development, errors do not have to be trapped on the development and test servers, but these errors are unacceptable in the production environment so the developer should use their own procedures to correct these errors in the development environment. A procedure of adding a "continue" or a "cancel" routine and/or button on the interface is not acceptable.

Methods and Procedures to Move New Systems and Updates into the Production Environment

Once a newly developed system or existing system update has been thoroughly tested by the developer and LAPELS staff, LAPELS staff has approved the system update, and the system signed off, only then can the system be published to the production environment for operations.

LAPELS staff, working in conjunction with the entity responsible for completing the project, will determine the best method for transitioning a new system or updated system into LAPELS production environment.

Permissions Structure

All system, application, and database permissions are handled by the Windows Server active directory (AD), and roles defined within the database server.

All users within LAPELS are divided into functional areas or groups. Windows Server has the groups defined within its active directory (AD). Users are defined by which group they belong to. The group itself determines which permissions or abilities the group has. All database roles are a subset of the group as defined within the active directory (AD). Together the group's permissions and database roles describe all actions a user can perform on LAPELS network. LAPELS's Active directory (AD) will control the internally developed application.

No other method or technique of managing users or user's permissions is allowed. New accounts will be created and appropriately named for the purpose its being used. Individual user accounts SHALL NEVER be used as a service account for a system or server. Service accounts will be named for an intended system or function, and will not be used in any other unrelated system or function.

External Browser Compatibility Requirements

In order to for LAPELS to meet its mission of regulating the state engineer/surveyor licensing industry, all work produced must be available to the widest possible audience. Therefore, any application which will be used by the general public or industry must be compatible with the greatest range of potential Internet browsers. In order to accomplish this goal, when external-facing systems or applications are being built, updated or maintained, they must be 100% compatible the current and prior 2 versions of Chrome. Additionally, the system or application should be as close to 100% compatible with the following browsers:

- Internet Explorer 11 or higher
- Firefox (last two versions from current)
- Safari (last two versions from current)
- Edge (last two versions from current)

Additionally, all system and application screens will be built to be web responsive, and mobile compliant, in their overall design to ensure maximum usability with differing screen sizes. The screen resolution guidelines will be will be set by LAPELS on a project-by-project basis.

All code will be verified on the current version of Chrome as part of the testing process to ensure 100% compatibility, web responsive and mobile compliant design. Testing results will be submitted to LAPELS for verification.

Naming Conventions and Data Standards

All tables, stored procedures, database views, code modules, programs, and reports should comply with LAPELS's naming conventions.

LAPELS's current naming convention for tables, stored procedures, database views, and reports has the application name followed by an underscore preceding the name of the object. This standard is consistent across all systems.

All code or reference tables have an underscore and the characters code following the table name.

Periodically, LAPELS updates and extends naming convention guidelines. Only the most current naming convention guidelines are to be utilized.

Database fields cannot be an empty string or spaces. Nulls must be used in the fields. Date fields must contain either a date or a null.

Miscellaneous Standards

Delivery of documentation and source code from a developer to LAPELS will be completed using the LAPELS Sign Off sheet. The time and location for a smooth turnover shall be agreed on by all parties and signed off.

LAPELS standard session is 20 minutes for both internal and external users. Session timeout exceptions need to be evaluated by LAPELS staff and all the developers onsite in order to set the optimal timeout. Not all session timeouts are the same.

All programmers and technicians working at LAPELS must share and discuss their problems and solutions as well as their progress regarding the applications they are developing. In order to affect this exchange of ideas, weekly meetings will be held which must include the developers and project managers from every developing entity at LAPELS.

Logins and security: All contractor accounts will be disabled by IT immediately upon completion of a contract when a contractor's services are no longer needed.

- IT Technical staff in charge of Active directory (AD) will disable the Active directory (AD) accounts.

- The IT staff or Contract / DBA will disable all database and/or server accounts.