**Statement of Work**

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1. **Overview/Executive Summary:**

Lead Pharmaceuticals (LP) is a pharmaceutical company that develops biologic drug products. To sell their products, they are required to be compliant with both the Food and Drug Administration (FDA) and the European Medical Agency (EMA), and as such they are held to stringent procedural standards for manufacturing their products. Many of the steps within their processing (i.e. sampling, pH adjustment, inoculations, vessel cleanings) must occur within certain time frames to remain compliant. Non-compliancy leads to deviations, and in severe cases, discarding of the drug product which costs the company large amounts of money. It is important that processing materials be always available and easily obtainable to avoid situations where processing is affected due to lack of materials.

* 1. Executive Summary

A Warehouse Management System (WMS) database will be developed in LP’s primary plant #111 to track all materials within the facility, this will increase processing efficiency, accuracy, and ultimately compliance. The database will provide accurate data about material quantities and storage locations. It will allow traceability of total material cost to use for cost analysis of each procedure and provides information on expiration dates, another important detail for upholding compliance. Material numbers and associated barcodes will be assigned to each material, if new materials are acquired a unique material number will be generated and added into the database. If materials are no longer used, material numbers will be deleted from the database. This SOW will provide the additional outline of the objectives, timeline, scope, goals and deliverables, benefits, technology to be used, and an SQL usage and style guide for the proposed WMS database.

2. **Purpose and Objectives**:

2.1 Objectives of your database project

The WMS will be used to increase efficiency of material movement by tracking all materials throughout plant #111. This encompasses materials as they are received from vendors through when they are used in processing. The database will interact with a server that accepts data about material numbers and barcode information. It will track addition of materials by warehouse staff as deliveries are received as well as material consumptions as they are used by technicians. It will house material’s current locations, which is updated by qualified staff as materials are moved. Objectives include accurate storage of large amounts of data such as material quantities, storage locations, and transaction history (addition and consumption of materials) to ensure accurate representation of material availability. This makes sure material stocks do not dip below a specified threshold. WMS will also assist with tracking overall cost of production. It will store material information securely, only certain personal can access information on material cost and submit material requests to vendors, and certain hazardous materials can only be handled by appropriately trained staff. Once the database is implemented it is recommended that additional organizational methods such as 5S be implemented to improve efficiency of material stocking and requests, this is not within the scope of this project.

1. Project Timeline

It is important to stick to the scheduled timeline of the database to costs of development do not exceed what was originally expected:

* SOW submission on 09/13/2022.
* Developed **Requirements Definition Document and Entity Relationship Diagram (ERD) to provide business rules and design outline of the database by 09/27/2022.**
* Create physical database objects that implement the logical objects, using SQL Data Definition Language (DDL) by 10/11/2022.
* Complete definition of database schema by entering data into tables and perform query testing by 11/01/2022.

1. Project Scope

The purpose of this database project it to provide the expectations and business rules, and a visual outline represented by an ERD. It will provide SQL scripts using DDL, along with queries to ensure successful object creation. It will create a SQL script using DML along with database testing to check for functionality. The database is to be implemented at this specific plant (#111). This material database may work in conjunction with other third-party systems, the setup and construction of those relationships will not be within the scope of this project. Other plants within the company are outside the scope of this project. A data recovery strategy and general software maintenance for the WMS once the database is implemented is outside the scope of this project but should be considered within the design. Implementation of security measures between the users and the database is also outside of the scope of this project.

* + - 1. Work within the scope of the project
* The creation of initial business rules and outline of the WMS.
* Developed SQL scripts using DDL and DML.
* Final implementation of WMS at plant #111.
  + - 1. Work outside the scope of the project
* Setup and integration of relationships between the WMS and other third-party systems (ie MES, Sharepoint).
* Extending management of materials to other plants within the company, this WMS will be kept solely in house.
* Data recovery strategy and software maintenance strategies are not within the scope of this project but should be considered.
* Addition of security measures for the client-server access is recommended but not included within this project.

1. **Database Goals, Expectations, and Deliverables**

Database goals and expectations include accurate tracking of materials within the warehouse, as they are ordered and received from vendors until they are used within processing. Specifically, it will track materials received from vendors, receival of materials to the warehouse, movement of materials to requested rooms, and then consumption of material for processing. Deliverables include this SOW, a developed requirements definition document, an ERD diagram, SQL DDL and DML scripts, and the database.

1. **Database Benefits**

The WMS will ultimately provide more efficient tracking and control of materials within plant #111. Within the pharmaceutical industry special procedures (SOPs, PBRs) are followed step-by-step to ensure products are compliant, when materials are out of stock or not in their proper locations this can slow or halt processing and ultimately cost the plant money. Implementation of the WMS will help to avoid these instances by accurately tracking location and quantities of materials throughout the entire plant, and by ensuring minimum quantities of materials are continuously available. Additionally, the WMS provides a centralized location for analyzing total cost of materials and is a valuable resource for cost analysis by the financial department. The warehouse management system also aids in tracking material expiration dates, this is critical in pharmaceuticals as using expired materials can result in a deviation and may lead to product non-compliance.

1. **Hardware and Software**
   1. Object Hardware/Software

Server side-technologies are accessed by the client through UMGCs Virtual Desktop Access (VDA), they are run on an Intel(R) Xeon(R) Platinum 8370C CPU @ 2.80GHz processor that is a 64-bit operating system, x64-based processor. It is run on Windows 11 Pro version 21H2.

Client-side technologies will be accessed using Microsoft Edge Version 105.0.1343.33 (Official Build) 64-bit, run on Windows 10 Home version 21H2.

* 1. Diagramming Tool Identified

ER-Assistant version 2.10 running on Windows 11 Pro will be the diagramming tool, and crow’s feet notation will be used.

* 1. Database

Oracle SQL Developer version 19.3.0.0 run through UMGC’s VDA on Windows 11 Pro will be used to develop the database.

* 1. Office Productivity Tools

Microsoft Office run on Windows 10 Home version 21H2.

* 1. Access Method Identified

Clients will use using Microsoft Edge Version 105.0.1343.33 (Official Build) 64-bit, run on Windows 10 Home version 21H2 to access the WMS in the server. This should be a secure connection due to the nature of the data contained within the WMS, only trained employees within the plant should be able to access the WMS. To increase security measures, it is recommended that a Secure Sockets Layer (SSL) be implemented to protect the connections between the client and the server (Microsoft, 2021). This would be done by a third party and is outside the scope of this project.

1. SQL Usage and Style Guide

It is important to use the SQL Usage and Style Guide throughout the development of this project, it beneficial for maintaining consistency throughout the database and will aid team members working on the databases development.

*The following Naming Conventions and SQL Statement Structure and Readability style guides were adapted from Ben Brumm and can be retrieved from* [*https://www.databasestar.com/sql-best-practices/*](https://www.databasestar.com/sql-best-practices/)

* 1. Naming Conventions
* Avoid using spaces I object names
* Avoid using quotations within object names
* Avoid square brackets around object names
* Use underscores instead of camel case
* Avoid prefixes for object names
* Avoid reserved words for object names (i.e User, Order, Upper, etc.)
* Use singular names rather than plural names
* Don’t name columns the same as the table
* Name joining tables based on what they represent.
* Specify names of constraints instead of the default
* Consider using prefixes on constraint names
  1. SQL Statement Structure for Readability and Script Format
* Use meaningful table aliases as your query grows
* Use AS for column aliases
* Use consistent case for keywords
* Keywords should start a new line
* Columns in SELECT clause should be in their own lines.
* Commas for columns should go at the end of a line
* Add a space before and after =
* Treat tables in joins as siblings and don’t indent them
* Put multiple join conditions on separate lines
* Indent subqueries
* Finish each statement with a semicolon

*The following Comment Usage style guide was adapted from Rob Parker and can be retrieved from https://about.gitlab.com/handbook/business-technology/data-team/platform/sql-style-guide/*

* 1. Comment Usage
* When making single line comments in a model use the – syntax
* When making multi-line comments in a model use the /\*\*/ syntax
* Respect the character line limit when making comments.
* Utilize the dbt model documentation when it is available
* Calculations made in SQL should have a brief description of what’s going on if available.
* Instead of leaving TODO comments, create new issues for improvement.
  1. DDL/DML

Physical database objects: tables, columns, keys, and indexes will all be developed once the ERD and design model are approved, this will be done using SQL Data Definition Language (DDL). All objects within the database will have drop statements. DDL Create statements will be used for all tables and associated objects, for example creating tables for the warehouse, the warehouse team, the manufacturing employees, the material restocking request transaction, and consumption of the materials to the product. Once the tables are created, the indexes can be added to necessary columns to speed up queries. DDL will then be used to add additional objects such as sequences, views, and triggers which will facilitate data entries and triggers.

Once the database schema is well defined, data can be entered into the tables using data manipulation language (DML) to create SQL insert statements. This will populate each table with sample data, for example the warehouse table might have a statement to insert the material\_ID, quantity, and storage\_room into the table. SQL select statements will then be used to query the tables.

References

Brumm, B. (2022, January 30). *SQL Best Practices and Style Guide*. Database Star. https://www.databasestar.com/sql-best-practices/

Microsoft. (2021, January 24). *Enable SSL for all customers - internet information services*. Enable SSL for all customers - Internet Information Services | Microsoft Docs. https://docs.microsoft.com/en-us/troubleshoot/developer/webapps/iis/www-administration-management/enable-ssl-all-customers#:~:text=To%20enable%20SSL%20server%20certificate%20verification%2C%20and%20to,Web%20site%20to%20which%20you%20to%20bind%20SSL.

Parker, R. (n.d.). *SQL Style Guide*. GitLab. https://about.gitlab.com/handbook/business-technology/data-team/platform/sql-style-guide/