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SPECIALTY : DATA AND WEB TECHNOLOGIES ENGINEER

Theme :

Quality Control Mangement System For Cement Factory Based On Odoo

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Abstract

This thesis presents the design and implementation of **LTM (Laboratoire Traitement des Matières)**, a Laboratory Information Management System (LIMS) developed for the quality control laboratory of the Ain El Kebira Cement Factory in Sétif, Algeria. The objective of the proposed system is to improve laboratory operations by providing an integrated, automated, and traceable solution for managing quality control activities throughout the cement production process.

The study began with an analysis of the cement manufacturing process and an evaluation of the existing laboratory management system. The analysis revealed several limitations, including weak sample traceability, limited integration with production activities, lack of automated anomaly detection, and inefficient management of laboratory data.

To overcome these limitations, a new version of the LTM system was developed as a custom module within the Odoo 11 ERP platform. The system follows the Model–View–Controller (MVC) architecture and consists of several modules dedicated to sample management, laboratory analysis, quality monitoring, equipment calibration, production batch management, and certificate generation.

The implemented solution provides automatic parameter loading, real-time validation against quality specifications, automated anomaly detection and alert generation, equipment calibration tracking, and reporting functionalities. Validation scenarios confirmed the successful implementation of the main functional requirements, including sample processing, specification compliance verification, batch approval workflows, and REST API integration.

The developed LTM system improves data reliability, enhances sample traceability, reduces manual intervention, and supports continuous quality control throughout the cement production process.

Keywords : LTM, LIMS, Quality Control, Cement Industry, Odoo, ERP, Laboratory Management, Traceability.

Résumé

Ce mémoire présente la conception et le développement de **LTM (Laboratoire Traitement des Matières)**, un système de gestion de laboratoire (LIMS) destiné au laboratoire de contrôle qualité de la cimenterie d'Aïn El Kebira, située à Sétif, en Algérie. L'objectif principal de cette solution est d'améliorer les opérations de laboratoire en proposant un système intégré, automatisé et assurant une traçabilité complète des activités de contrôle qualité tout au long du processus de fabrication du ciment.

L'étude a débuté par une analyse du processus de production du ciment ainsi qu'une évaluation du système de gestion de laboratoire existant. Cette analyse a mis en évidence plusieurs insuffisances, notamment une faible traçabilité des échantillons, une intégration limitée avec les activités de production, l'absence de détection automatique des anomalies et une gestion inefficace des données de laboratoire.

Afin de répondre à ces besoins, une nouvelle version du système LTM a été développée sous forme d'un module personnalisé intégré à la plateforme ERP Odoo 11. Le système repose sur l'architecture Modèle–Vue–Contrôleur (MVC) et comprend plusieurs modules dédiés à la gestion des échantillons, aux analyses de laboratoire, au suivi de la qualité, à la gestion des équipements, à l'étalonnage, à la gestion des lots de production et à la génération de certificats.

La solution développée offre le chargement automatique des paramètres, la validation en temps réel selon les normes de qualité, la détection automatique des anomalies avec génération d'alertes, le suivi des opérations d'étalonnage ainsi que des fonctionnalités de reporting. Les scénarios de validation ont confirmé la mise en œuvre réussie des principales exigences fonctionnelles, notamment la gestion des échantillons, la vérification de conformité aux spécifications, les procédures d'approbation des lots et l'intégration via une API REST.

Le système LTM développé améliore la fiabilité des données, renforce la traçabilité des échantillons, réduit les interventions manuelles et contribue à un contrôle qualité continu tout au long du processus de production du ciment.

Mots-clés : LTM, LIMS, Contrôle Qualité, Industrie Cimentière, Odoo, ERP, Gestion de Laboratoire, Traçabilité.

الملخص

يقدم هذا العمل تصميم وتنفيذ نظام **(LTM) مختبر معالجة المواد**، وهو نظام معلوماتي لإدارة المختبرات (LIMS) تم تطويره لفائدة مخبر مراقبة الجودة بمصنع عين الكبيرة للإسمنت بولاية سطيف، الجزائر. يهدف النظام المقترح إلى تحسين عمليات المختبر من خلال توفير حل متكامل وآلي يضمن إدارة فعالة وقابلة للتتبع لجميع أنشطة مراقبة الجودة خلال مختلف مراحل إنتاج الإسمنت.

بدأت الدراسة بتحليل عملية تصنيع الإسمنت وتقييم نظام إدارة المختبرات المعمول به سابقاً، حيث أظهرت نتائج التحليل وجود عدة نقائص، من بينها ضعف تتبع العينات، ومحدودية التكامل مع أنشطة الإنتاج، وغياب آليات الكشف التلقائي عن الحالات غير المطابقة، بالإضافة إلى ضعف كفاءة إدارة البيانات المخبرية.

ولمعالجة هذه المشكلات، تم تطوير نسخة جديدة من نظام LTM في شكل وحدة مخصصة ضمن منصة Odoo 11 الخاصة بتخطيط موارد المؤسسة .(ERP) يعتمد النظام على معمارية النموذج–العرض–المتحكم(MVC) ، ويتكون من عدة وحدات وظيفية تشمل إدارة العينات، والتحاليل المخبرية، ومراقبة الجودة، وإدارة المعدات، وتتبع عمليات المعايرة، وإدارة دفعات الإنتاج، وإصدار شهادات المطابقة.

يوفر النظام آليات التحميل التلقائي للمعلمات، والتحقق الفوري من النتائج وفق المواصفات القياسية، والكشف الآلي عن الحالات غير المطابقة مع إنشاء التنبيهات، وتتبع عمليات معايرة الأجهزة، بالإضافة إلى إمكانيات إعداد التقارير. وقد أكدت سيناريوهات الاختبار والتحقق نجاح النظام في تحقيق المتطلبات الوظيفية الأساسية، بما في ذلك إدارة العينات، والتحقق من مطابقة النتائج للمواصفات، وسير عمل اعتماد دفعات الإنتاج، والتكامل عبر واجهات برمجة التطبيقات.REST API

يساهم نظام LTM المطور في تحسين موثوقية البيانات، وتعزيز إمكانية تتبع العينات، وتقليل التدخل اليدوي، ودعم مراقبة الجودة بشكل مستمر خلال مختلف مراحل إنتاج الإسمنت.

الكلمات المفتاحية : LTM ، LIMS، مراقبة الجودة، صناعة الإسمنت، Odoo، ERP، إدارة المختبرات، التتبع.