WHITEPAPER

By Dr. Hossein Azodi, Managing Consultant | FIDAS Excellence
& Deepak Andayil, Junior Consultant | LIMS Excellence

LIMS Master Data
Sentiment Analysis, Verification Q&A Pipeline and Migration Agent

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Executive Summary

Life sciences organizations depend on accurate master data for compliance, efficiency, and faster product delivery. So far much of this data is fragmented across PDFs, scanned documents, spreadsheets, JSON, or XMLs. These unstructured data introduce various risks, slows down digital transformation, and challenges data-driven initiatives.

Our AI-powered solution which is based on FrontWell Solutions years of expertise in LIMS[1], ERP[2] and MES[3] systems is curated for Life Sciences. This solution transforms unstructured content into clean, standardized, and governed master data. It covers extraction, cleansing, governance, and migration to target systems. In addition, the sentiment analysis as well as verification Q&A pipelines help particularly pharmaceutical organizations handle thousands of processes simultaneously with above 99.999% accuracy (roughly equals to 100x less errors), 10x faster go-live and 3x implementations acceleration

1. Introduction

In regulated environments, data integrity and accessibility are critical, yet much information remains in unstructured or semi structured files, such as Word, Excel, PDFs (also handwritten texts), XMLs, or (scanned) images.

Example of these documents is Standard Operating Procedures (SOP). SOPs are typically stored only on a shared drive with various versions. These versions are also maintained by filenames, e.g. "DOXYCYCLIN_300083654965_v004.pdf" indicating the 4th version of the product. Apart from integrity between document filename and its content, operators may use outdated versions, QAs must struggle to trace approvals, and MES systems are unable to consume instructions which causes inefficiency, compliance risk and delays in the product release process.

In summary, (semi-)unstructured data poses serious regulatory and operational risks (Fig. 1)

- Batch delays and deviations: Duplicate or inconsistent specifications (e.g., material codes, methods) create release delays.
- Audit and inspection findings: Lack of traceability across instructions, certificates, and systems leads to regulatory non-compliance.
- Manual re-entry errors: Transferring data from paper or PDFs into ERP/LIMS increases human error.

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[1] Laboratory Information Management System
[2] Enterprise Resource Planning
[3] Manufacturing Execution System

- Regulatory expectations: Agencies like FDA and EMA expect data integrity (ALCOA principles and its variations ALCOA+ or ALCOA++), GDPR compliance, and end-to-end traceability.

Figure 1: Risks of unstructured or semi-unstructured data in regulated environments.

2. The Solution: Structured Data Through Intelligent Migration

Our approach combines AI-driven extraction pipelines with governance-by-design principles to transform data locked in documents into trusted master data records.

Three-Layer Intelligent Pipeline:

1) OCR & Regex Parsing: Identifies standardized fields such as IDs, revision numbers, and expiry dates, especially when information is grouped together and follows a clear format. For example, a line like "Material number: 8746587" in a test instruction can be reliably captured by this module.
2) AI Semantic Understanding: Uses multimodal AI – fully compliant with regulatory standards – to interpret loosely structured text, multilingual content, and contextual information in SOPs or technical documentation. It can process both text and images with equal precision.
3) Q&A Pipelines: Enables query-based extraction, answering questions such as "Who approved this SOP?" or "What is the cleaning interval?".

The solution also supports handwriting recognition, converting printed, cursive, or mixed handwriting from scanned notes, operational checklists, or legacy archives into digital records. Beyond extraction, it performs data cleansing, normalization, deduplication, and schema mapping into enterprise systems such as SAP or LIMS - delivered as a true end-to-end migration service.

Every migration includes QA validation and rollback capabilities to ensure business continuity. Compliance requirements such as GDPR, role-based access, and audit trails are built in. The solution is platform-agnostic, with no vendor lock-in.

3. Low Risk, Faster and Safer Delivery by FIDAS

End-to-End Migration Partnership
With FrontWell Intelligence Data AI Solutions (FIDAS), clients benefit from a true one-stop partner. We handle the complete journey from unstructured documents to validated master data - including extraction, cleansing, schema mapping, migration, and QA validation. Customers gain a single accountable partner who owns the outcome, not just a piece of the process.

Deep LIMS, MES & ERP Expertise
With decades of combined experience in LIMS, MES, and ERP projects, FrontWell Solutions understands the unique workflows and regulatory requirements of the pharma and life sciences sector. This expertise allows us to deliver migrations and integrations significantly faster than general IT providers - reducing project risk, avoiding unnecessary trial-and-error, and ensuring compliance from day one.

Pharma-Specific AI Pipelines
Our domain knowledge eliminates the lengthy workshops and discovery phases, typical of generic providers. Because we already understand the structure of batch records, SOPs/instructions, certificates, and CoAs, we can configure AI pipelines and rule engines rapidly, while high accuracy and 100% compliance are guaranteed.

Our Company

FrontWell Solutions is an expert in the digital transformation of the pharmaceutical manufacturing process. Our team of experts is engaged in providing digital solutions to 12 of the 20 leading pharmaceutical, biotechnology, chemical, and medical device companies and suppliers spanning Europe, the United States, and Asia.

Our expertise lies in delivering specialized consulting services, primarily centered around Manufacturing Execution Systems (MES), Laboratory Information Management Systems (LIMS), seamlessly integrating these Level 3 systems with Enterprise Resource Planning (ERP) platforms and driving Manufacturing Intelligence initiatives such as Overall Equipment Effectiveness (OEE) reporting.

Moreover, we have partnered with prominent digital solutions platforms in the market, showcasing our proficiency in leveraging cutting-edge technology.

We can support you with our well trained LabVantage experts (Business Analysts and Solution Engineers) as well as our Validation Excellence Team with long term experience in the field.

Get in Touch with us

Thinking about taking your next steps towards the digitalization journey? Our experts are ready to support you! Contact us under ReachUs@frontwell-solutions.com or via +49 (6101) 595 89 85.