Digitalized Full Lifecycle Management System for Chemicals Based on a No-Code Platform

Case Providing Department: Laboratory and Technical Management Office

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1. Background

As a laboratory technician in the LTMO unit of the IME School at XJTLU, daily responsibilities include coordinating the procurement, inventory management, and distribution of chemicals for teaching and research activities across the school. Prior to the implementation of this case, chemical management largely relied on manual compliance and individual self-discipline, resulting in several pain points that negatively affected management efficiency and safety control.

1) Blind spots in regulated chemical management and lack of effective traceability and monitoring mechanisms. The school involves the use of various regulated chemicals. Under the previous management model, there was no unified channel for querying regulatory lists. Before submitting procurement requests, laboratory technicians had to consult multiple up-to-date regulatory lists or policies, often relying on email communication with the HSAO. This process was time-consuming and

prone to omissions or misjudgments, posing potential safety risks. Applicants—particularly students and Principal Investigators (PIs)—found it difficult to quickly identify chemical attributes and regulatory status, increasing the risk of incorrect procurement or non-compliant usage and placing significant pressure on safety management.

2) Data lag between paper-based and online inventory records. Chemical inventory data relied heavily on paper-based ledgers. Disposal of general hazardous chemicals depended largely on users' self-reporting, and all inbound and outbound inventory updates required manual input, resulting in frequent data delays. Faculty members and students were unable to query real-time inventory status, often leading to duplicate purchases and resource waste, or discovering insufficient stock when chemicals were urgently needed, thereby affecting teaching and research progress. In addition, laboratory technicians were required to conduct regular manual stocktaking, which was time-consuming and labor-intensive.

3) Cumbersome procurement and distribution processes with no unified workflow channel. Chemical procurement requests were submitted through non-standardized channels. In some cases, students from research groups directly contacted suppliers via WeChat to place orders, creating compliance risks. Records for regulated chemical usage were

scattered among different responsible personnel, resulting in information silos. The lack of accumulated historical procurement data made it difficult to provide effective reference support for future purchasing decisions.

To address these challenges in full lifecycle chemical management, it became an urgent need to develop a digital management system covering “query – inventory – procurement” based on a no-code platform, in order to improve both management efficiency and safety control.

2. Solutions

Based on the no-code platform, a parent folder titled “Chemical Procurement Process” was constructed. Through a modular design consisting of three subfolders, the system enables digitalization, standardization, and visualization of chemical management across the entire lifecycle. The key functional designs and process optimization approaches are as follows:

1) **Subfolder and Form Design**

The system includes a total of five forms under three subfolders, two workflow forms, and three data dashboards.

a. Subfolder 1: Regulated Chemical Catalogue Query

- Function:

Built-in dynamic database containing the latest regulated chemical catalogues.

- Process Optimization:

Faculty and students can independently query whether a target chemical falls under regulatory control before submitting procurement or usage requests, thereby reducing safety risks at the source.

b. Subfolder 2: Chemical Inventory and Distribution

Step 1. Chemical Warehouse Inventory List: Serves as the master database for all warehouse chemicals, recording real-time information including chemical name, CAS number, specification, control category, inventory quantity, and storage location.

Figure 44 Menu module

Step 2. Chemical Inbound Registration: After procurement and delivery, chemicals are registered through an inbound form, with data automatically updated to the IME Chemical Inventory Dashboard.

Step 3. Chemical Outbound Registration: Planned integration with the

usage application workflow (currently under development). Upon outbound processing, inventory is automatically deducted, and records of user, project, quantity, and time are generated to enable precise traceability.

IME Chemical Inventory Dashboard

Visualizes hazardous chemical inventory data in the warehouse, presenting total inventory, category distribution, and available stock through statistical tables, enabling intuitive and efficient management.

CAS Number	化学品名 Chemical Name	化学品英文名 Chemical Name	规格-总量 Specification-Quantities	规格-单位（容积/质量） Specification-Unit (Volume/Mass)	管控类别 Control Type	状态 Status	在库库存 In-Stock Qty	可用库存 Avail. Qty
10043-52-4	无水氯化钙	calciumdichloride	500	g	非管制	已回收/报废	0	0
7697-37-2	硝酸	nitricacid	500	mL	管制-双锁	使用中	400	0
		Nitric acid	500	mL	管制-双锁	未使用	1000	1000
7647-01-0	氢氯酸	hydrogenchloride	500	mL	管制-非双锁	已回收/报废	0	0
67-63-0	异丙醇	propan-2-ol	4	L	非管制	已回收/报废	0	0
107-21-1	1,2-乙二醇	Ethyleneglycol	25	L	非管制	使用中	12	0
						未使用	50	50
10026-11-6	氯化锆(IV)	Zirconium tetrachloride	100	g	非管制	已回收/报废	0	0
67-64-1	丙酮	acetone	4	L	管制-非双锁	已回收/报废	0	0
nocas-	Opteon™ XL20 (R-	Opteon™ XL20	10.5	kg	非管制	未使用	31.5	31.5

1 / 1

Figure 24 IME Chemical Inventory Dashboard

IME Regulated Chemical Usage Application Form

Implements an automated, multi-level approval workflow (e.g., Student → Supervisor → CC to Laboratory Technician → Process Completion). After submission, the system automatically sends email notifications. Approvers can review and process requests anytime and anywhere, with full traceability, significantly improving efficiency and standardization.

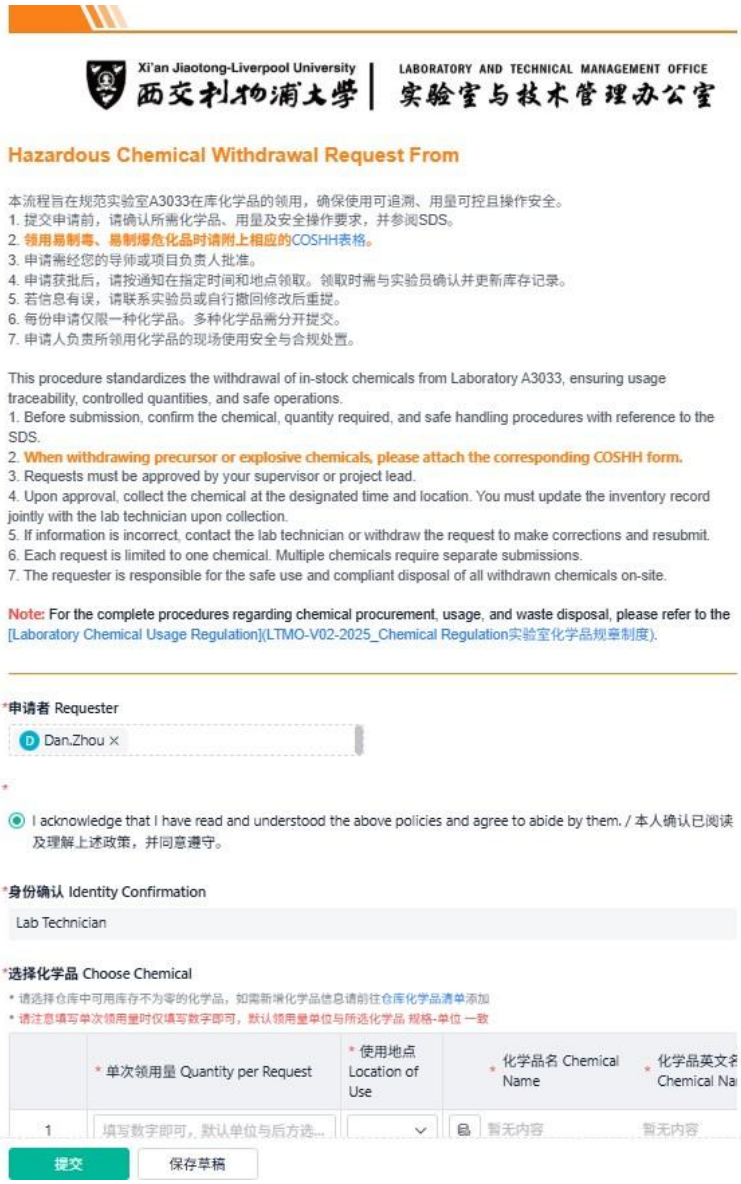

Figure 25 IME Regulated Chemical Usage Application Form

c. Subfolder 3: Chemical Procurement Application

Chemical Procurement Application: Digitizes and standardizes the procurement application process. Key information such as application purpose, regulatory status (with direct links to Subfolder 1 dashboards), and available inventory balance (with links to Subfolder 2 dashboards) is clearly presented to support informed approval decisions.

List of Previously Procured Regulated Chemicals at XJTLU： Serves as a shared knowledge base, providing historical procurement data to support procurement applications and avoid repeated safety and feasibility assessments.

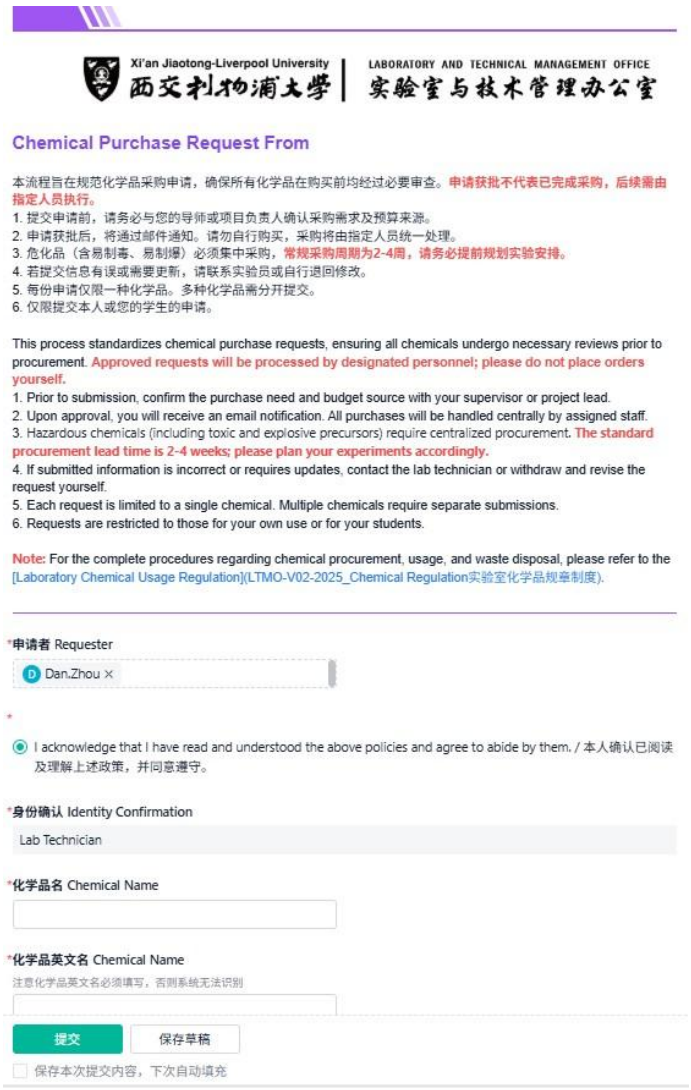

Figure 26 Chemical Procurement Application

2) Digital Reconstruction of Approval Workflows

Previously fragmented procurement communications via WeChat or email were unified into a single online workflow. Approval rules were configured on the no-code platform to automatically match approval nodes based on chemical type (regulated or non-regulated) and applicant identity. During the approval process, approvers can directly

access supporting information such as inventory data, regulatory requirements, and historical procurement records, reducing communication costs and enabling one-time submission with efficient approval.

3) **Data Accumulation and Traceability Optimization**

All operational data—including query logs, inbound and outbound records, procurement applications, and approval records—are automatically stored on the platform. Multi-dimensional traceability and retrieval are supported based on chemical name, CAS number, and usage time, fully meeting the requirements of safety inspections and compliance audits.

3. Outcomes and Benefits

After thorough testing, all forms were rolled out for use by faculty and students in both the IME School and the CHIP School. The implementation is expected to significantly enhance chemical management efficiency, safety control, and overall management value, with the following outcomes:

(1) Significantly improved query efficiency

Faculty and students can retrieve regulated chemical information

through the catalogue forms and dashboards, substantially reducing document search time.

(2) Standardized management of regulated chemicals

Laboratory technicians can distribute chemicals based on usage application records, fostering standardized application and usage habits among students.

(3) Improved procurement approval efficiency

Procurement workflows are standardized and unified, eliminating the time-consuming and inefficient email-based communication used previously.

(4) Enhanced safety and compliance

Full-process, end-to-end traceability is achieved for all chemicals—from application, procurement, inbound storage, usage, return, to disposal—effectively reducing compliance risks to near zero.

4. Replicability and Promotion Value

This solution demonstrates strong replicability and promotion potential and is applicable to all departments and scenarios involving chemical management across the university. Its value is reflected in the following

aspects:

(1) Cross-departmental adaptability

Developed on a no-code platform without requiring professional programming skills, the solution can be rapidly adapted by different departments (e.g., science, pharmacy, and other disciplines with varying chemical usage characteristics) through simple form modifications and workflow adjustments.

(2) Scenario expansion potential

The core logic of the solution can be extended from chemical management to other laboratory asset management scenarios, such as laboratory equipment procurement. By reusing the core architecture of "catalogue query – inventory management – workflow approval – data traceability," management systems for other materials can be rapidly established, enabling comprehensive digital transformation of laboratory management.

(3) Feasibility of large-scale promotion

All core functionalities are built using standard components of the no-code platform, allowing rapid cloning and deployment without code modification. The solution has already been successfully implemented and matured in both the IME School and the CHIP School.

5. Next Steps

To further enhance the intelligence level and coverage of the solution, several exploratory initiatives are planned:

(1) Intelligent function upgrades

Explore the feasibility of automatic recognition and entry of chemical labels through image capture to replace manual input; develop an arrival notification module that triggers email alerts upon chemical delivery and, once usage applications are approved, automatically notifies both laboratory technicians and applicants to complete distribution.

(2) Enhanced query functionality

Integrate online databases of Material Safety Data Sheets (MSDS) and emergency handling guidelines. Mandatory reading during the usage application process will be enforced to strengthen safety education and awareness.