Generative AI-Powered JSA Auto-Generation System

JSA ; Job Safety Analysis

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JSA Overview

JSA (Job Safety Analysis)

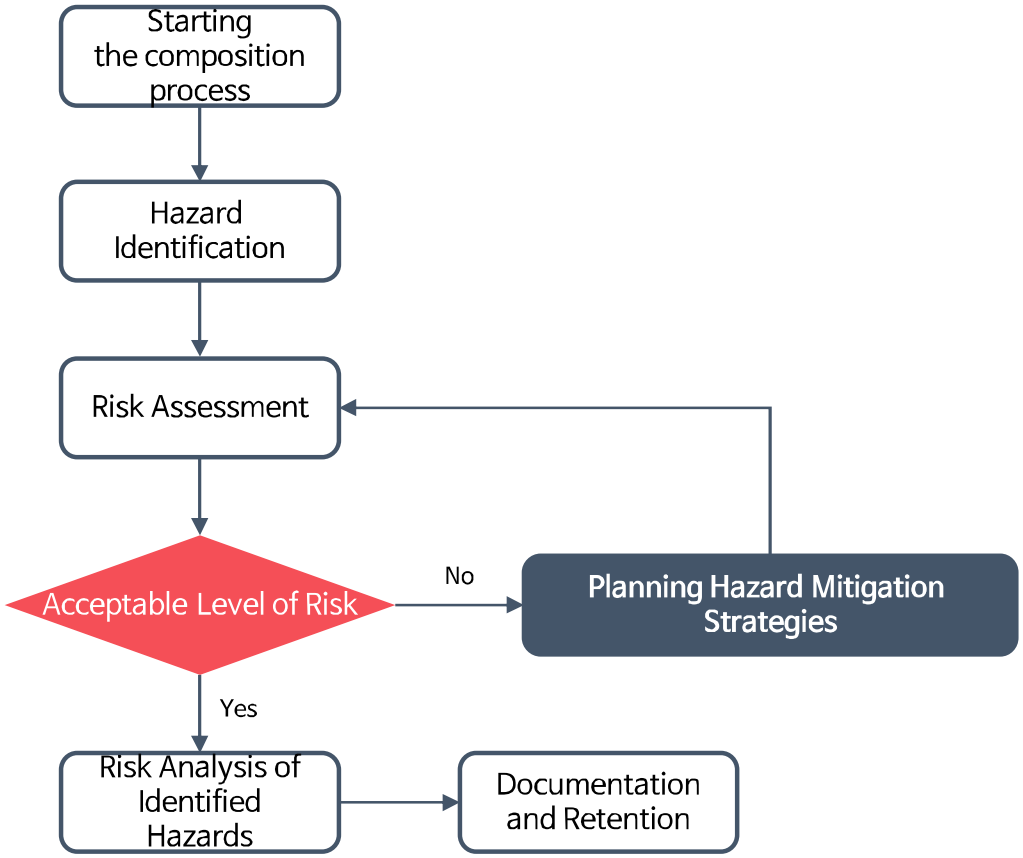
- A structured process to proactively identify job-related hazards
- Define preventive actions to protect workers and reduce accident risks.

JHA (Job Hazard Analysis)

- A process similar to Job Safety Analysis (JSA),but with a stronger focus on identifying and evaluating potential risk factors during routine job activities
- Planning control measures to mitigate those risks

- For consistency, both JSA (Job Safety Analysis) and JHA (Job Hazard Analysis) are referred to as JSA throughout this document.

JSA Procedure



JSA Job Elements Example

Reinforced Concrete Work at OO0 Shipping Dock

No	Job Steps	Risk Factors	Work-related chemical materials	Current Control Measures	Current Risk Level		
Job Preparation 1		Safety Accidents Caused by not checking Personal Health conditions	No	Check Health Conditions, Safety Education	1	1	L(1)
Job Preparation 2		Safety Accidents Caused by Inadequate Pre-Job Preparation	No	Wear Personal Protective, safety Shoes & Halmet	1	2	L(2)
Securing the Work Area and Access Routes		Movement and work performed without a secured passageway	No	Secure the work zone and access routes before starting any operation. Clearly mark and restrict unauthorized access to the designated work area.	1	2	L(2)
Partial Removal of the Existing Worktable		Fire hazard due to sparks from grinding operations	No	Measure the concentration of flammable gases before starting work Install spark-resistant fire blankets to prevent spark dispersion Remove or isolate flammable and combustible materials from the area Place fire extinguishers and other firefighting equipment nearby	1	2	L(2)
Drilling into Concrete Using a Hammer Drill		Airborne dust generated during drilling may cause respiratory illness.	No	Wear a dust mask (respirator) Wear safety goggles	1	2	L(2)

Importance of JSA

Technical Effects

Workplace Accident Prevention

- Identifies and evaluates potential hazards in advance to prevent accidents
- Ensure worker safety—emphasizing prevention over post-incident response.

Positive Societal Effects

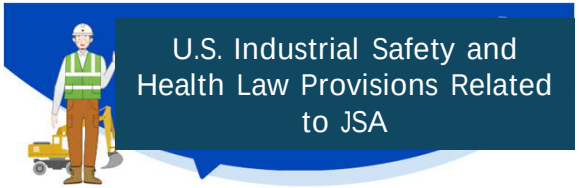
Establishing a Strong Safety Culture

- Enhancing safety awareness and management capabilities across all organizational members, while fostering a sustainable culture of industrial safety.

Economical Effects

Clarification of Legal Responsibility

- Legal protection for employers and avoidance of costly plant closures through compliance with strengthened safety regulations..
- Conduct risk assessments and Display mandatory safety signage



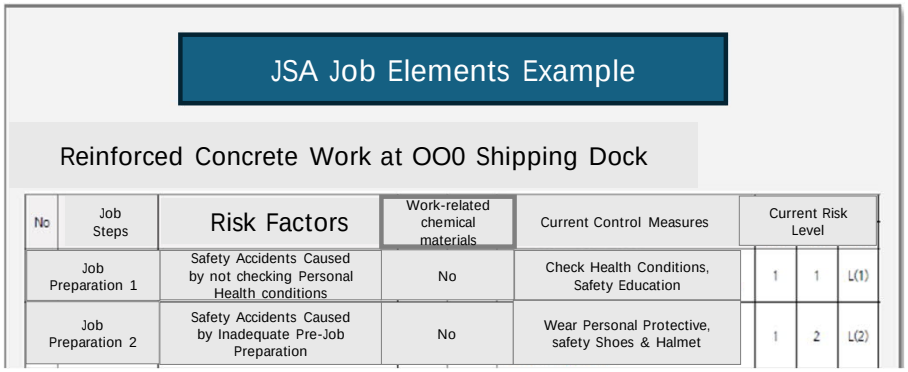
U.S. Industrial Safety and Health Law Provisions Related to JSA

OSHA Act of 1970
Establishes the employer's responsibility to provide a workplace free from recognized hazards.Section 5(a)(1), known as the "General Duty Clause," requires employers to proactively assess and mitigate job-related risks.

JSA plays a central role in fulfilling OSHA's legal requirements for hazard identification, employee training, and preventive action planning. While not always mandatory by name, JSA is widely recognized and referenced in OSHA's safety guidelines as an effective tool for ensuring regulatory compliance and preventing workplace accidents.

Necessity of AI-Based JSA Auto-Generation

AS-IS : Manual JSA Preparation



① High time consumption and workload during JSA creation→ Often leads to meaningless, formal documentation.

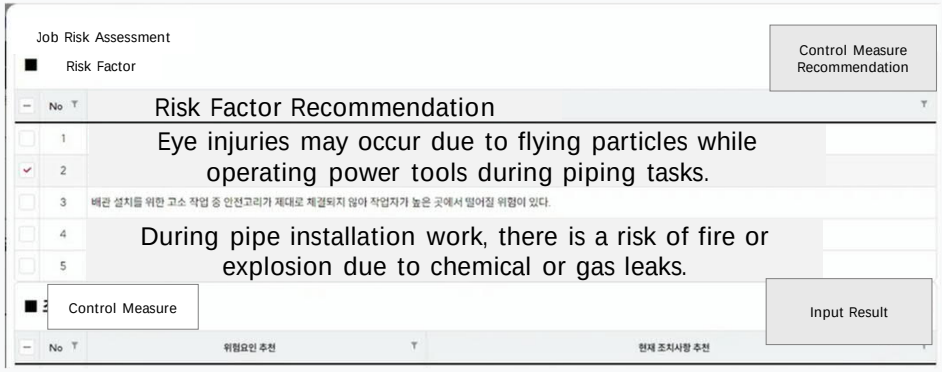
② Inconsistent quality across writers and contractors→ Decreases standardization and reliability.

③ Risk of referencing irrelevant or outdated JSA templates→ May overlook job-specific hazards.

④ Variability in descriptive input fields→ e.g., task steps, hazard types, current control measures.

⑤ Need to improve the overall quality and management of safety-related content→ Systematic enhancement of safety documentation practices is essential.

TO-BE : Utilization of Automated JSA Generation



① Provides step-by-step guidance based on similar past cases→ Context-aware recommendations for each JSA field

② Applies industry-specific terminology and vocabulary→ Improves accuracy and relevance across sectors

③ Expands generation capabilities for hazard and control action fields→ Covers a broader range of job conditions and scenarios

④ Utilizes factory-specialized LLM models rather than generic LLMs→ Trained on real-world manufacturing and process control data

⑤ Leverages stored data to generate reference content and contextual summaries→ Enables efficient and consistent JSA generation using internal knowledge bases

* LLM (Large Language Model) is an AI model trained on vast amounts of text data, capable of understanding and generating human-like natural language. It enables advanced tasks such as question answering, document summarization, and content generation through deep contextual understanding.

Objectives of AI-Based Automatic JSA Generation

“ Facilitating higher-level hazard analysis to proactively ”

prevent major industrial accidents.

An AI-powered recommendation engine that combines past JSA cases with domain-specific knowledge

- Searches similar JSA documents based on the task information entered by the user –
- Automatically suggests relevant hazard types, risk factors, and control measures for each step of the job

The system also helps users identify potential hazards or legal compliance issues they may overlook, ultimately reducing JSA preparation time and improving documentation quality.

References

AI-Driven Job Safety Analysis for Construction, 2024.03~2025.02

SK chemicals

AI-Driven Job Safety Analysis for Construction and Experimental Work 2025.04~2025.07

SK bioscience SK gas SK innovation SK hynix

Construction Safety AI-JSA Project 2024.05 ~ 2025.09

SK telecom kt 5G LG U+ posco

System Implementation

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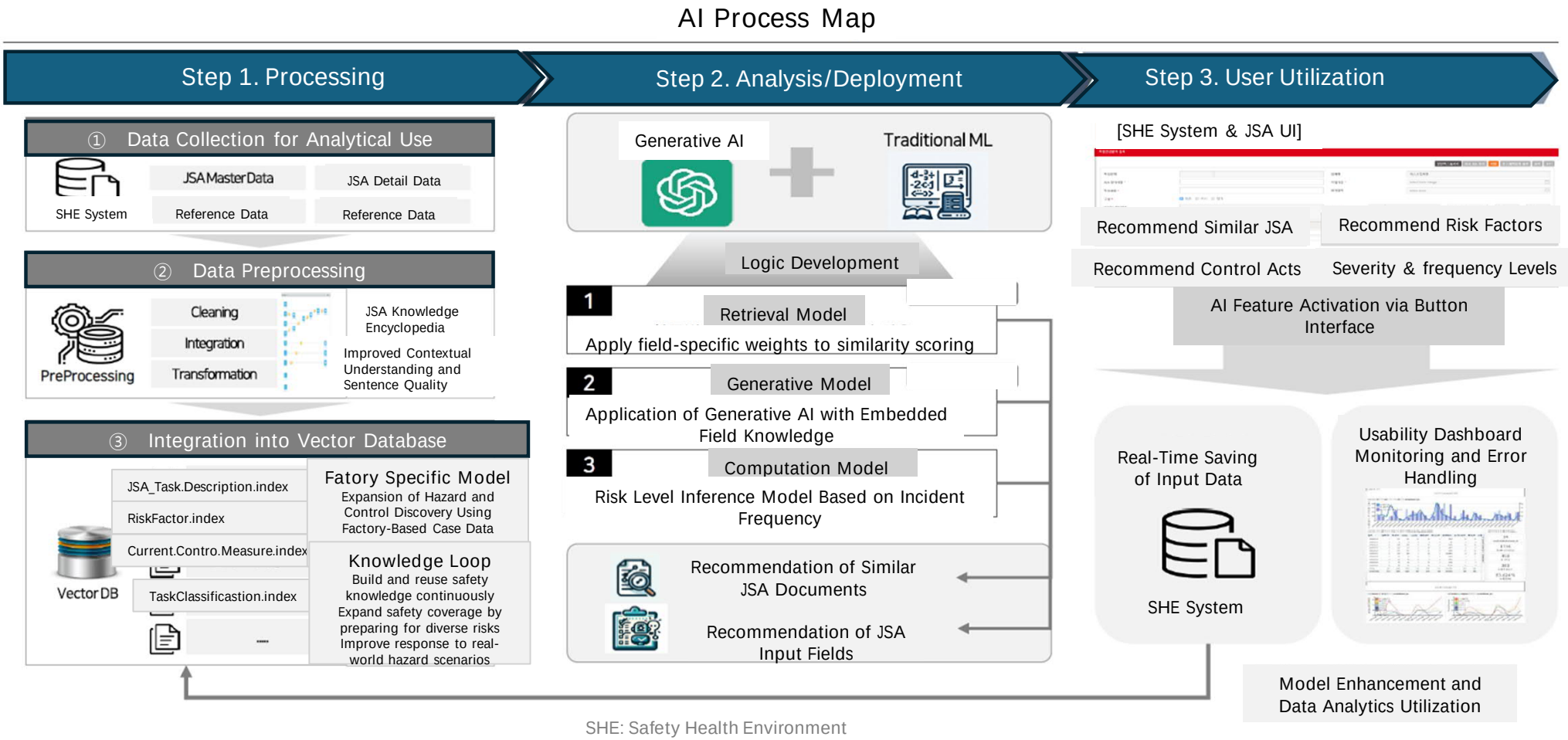
- AI-Based JSA Auto-Generation: Process, Architecture
  - Implementation Stages

AI-Based JSA Auto-Generation Process

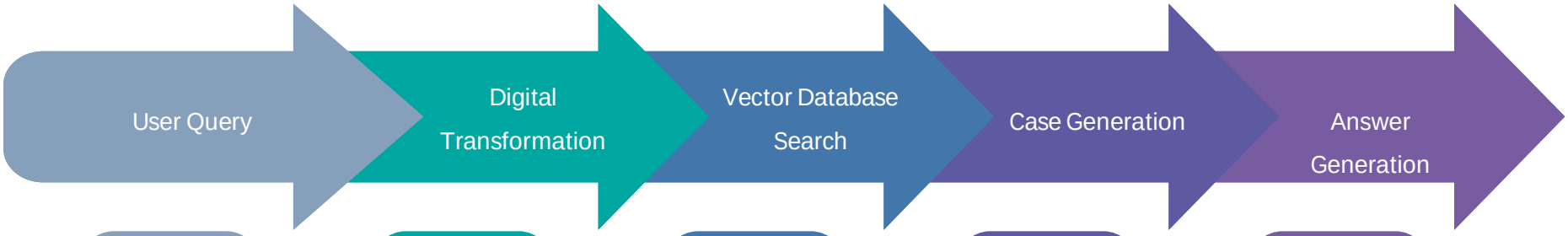


SHE: Safety Health Environment

Operating Principle of AI-Based JSA Auto-Generation

AI-Based JSA Auto-Generation Powered by LLMs

– Full Workflow Automation from User Query to Final Output –



STEP 01

✓Input of Job Details for Risk Analysis

STEP 02

✓Converting Text to Structured Data for AI Interpretation

STEP 03

✓Retrieve Existing Cases with High Similarity to the User Query

STEP 04

✓Recommend Relevant Cases Based on User Query and Existing Examples

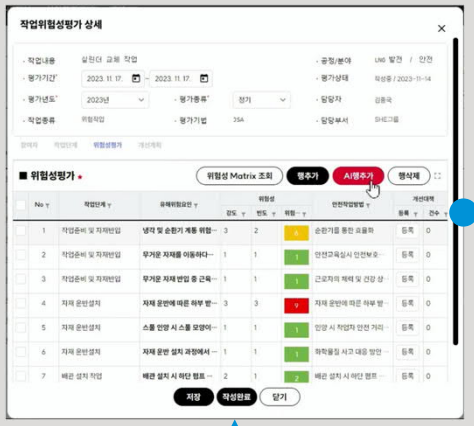
STEP 05

✓Generate and Recommend Accident Types, Risk Factors, Control Measures, and Severity Levels

Vector DB stores unstructured data (e.g., text, image, audio) in vector form for semantic similarity search using embeddings.

System Architecture

Legacy System (Existing SHE)



Job Information Input
(JSA Title and Description)

JSA DB

REST API

New Generative AI System

AI Server (Ex. : Dataiku)

- Retrieval Engine
- Generative Engine
- ML Engine
- API Recommendation of Similar JSA Documents & Contents

Data Store (Ex.: AWS)

Integrated Vector DB

A B C … Z

Common Data

- Integrated Data Vector DB
- Standard Data Vector DB

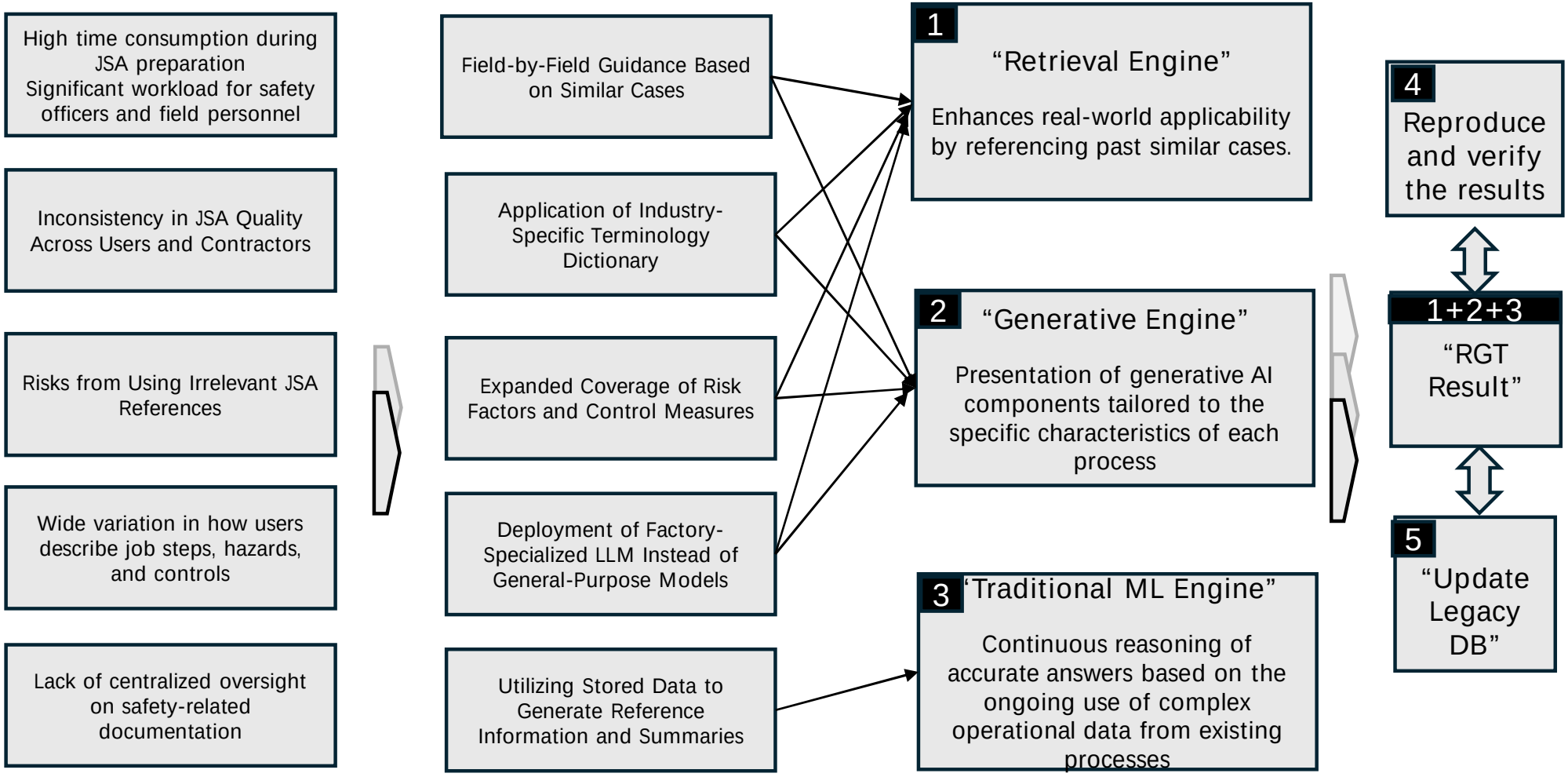
Site Specific Data

- Standard Pattern Vector DB
- Flyer Vector DB

Rapid-access storage for unstructured, short-form documents used in real-time operations (e.g., memos, field notices, PDFs).

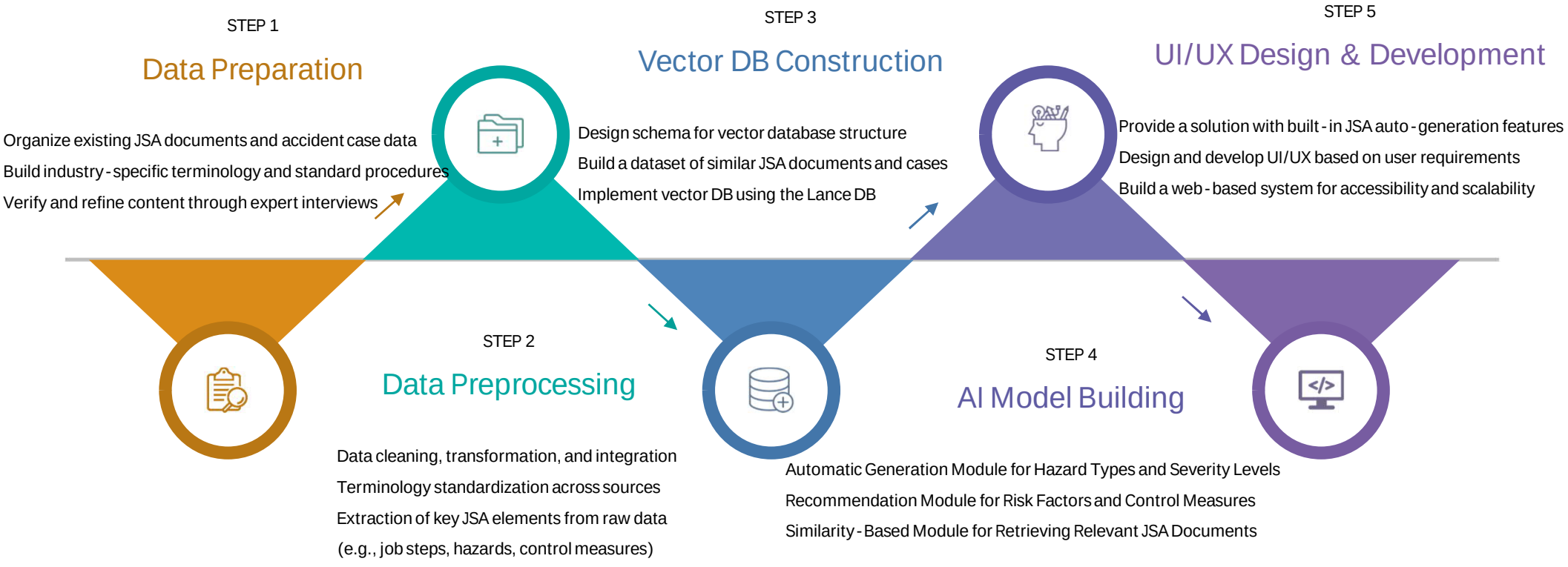
Integrated Data Pipeline: Legacy & Operational DB

System Diagram generative AI (RGT)

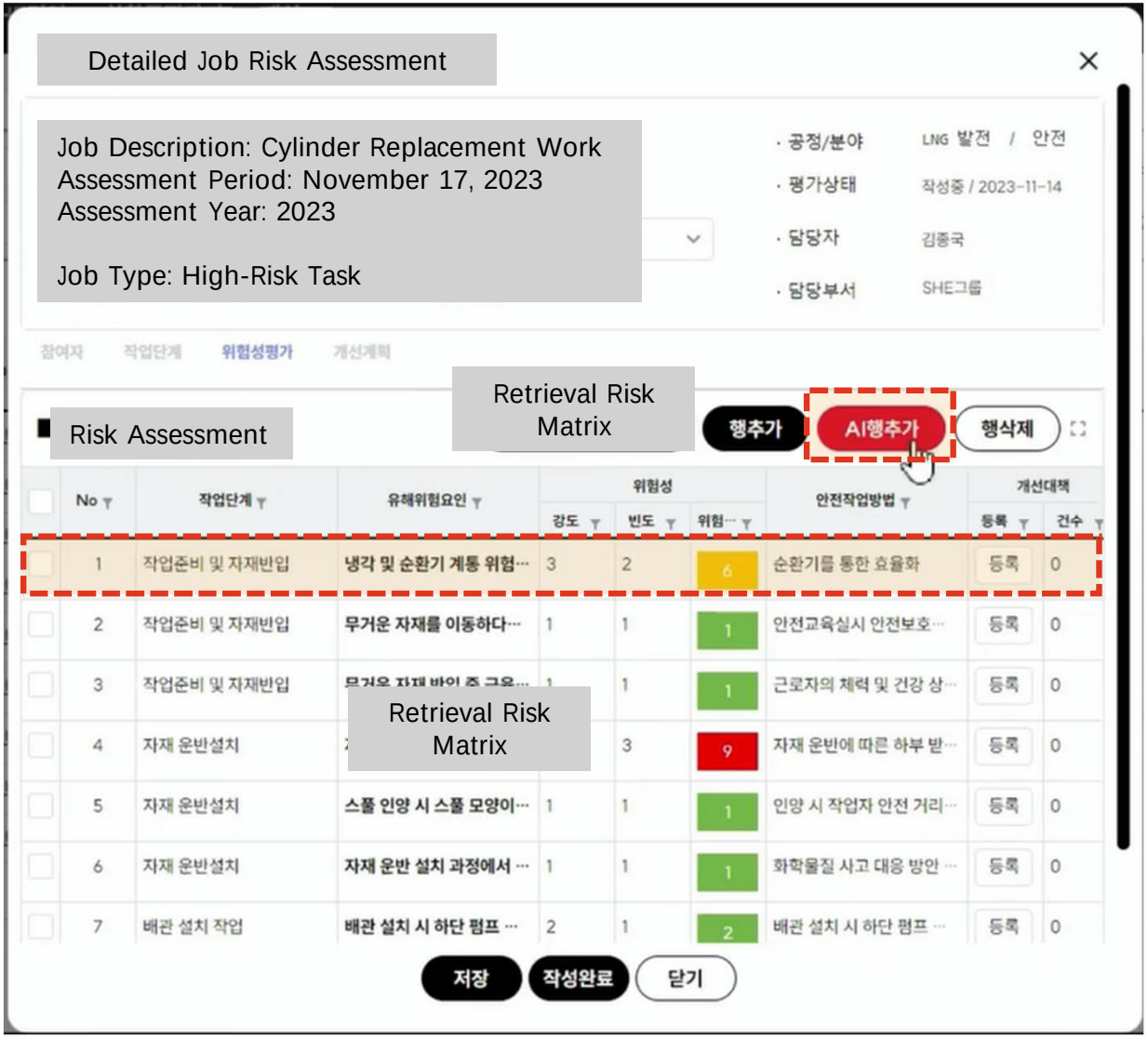


1. User Input (Natural Language Question)
2. Embedding (Convert to Vector), Retrieval (Search for Relevant Context in DB)
3. Generation (LLM produces the answer using context)

Implementation Stages



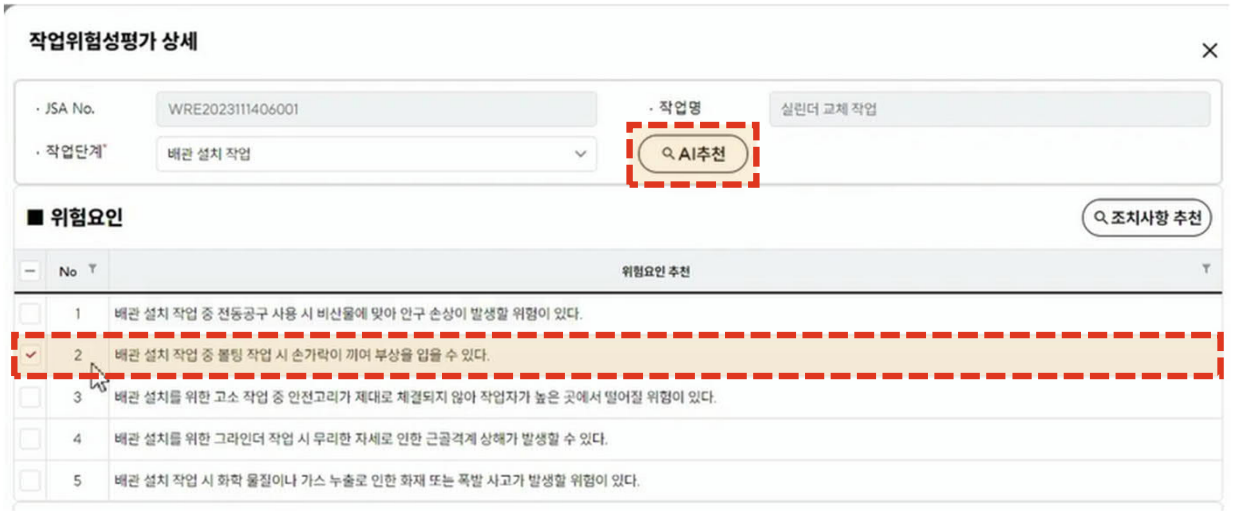
Phase ① Expansion of Risk Assessment Items



- Click “Add AI Row” to create new risk assessment items
- Edit existing risk assessment items as needed
- Submit for admin approval, Once approved, items become available for use in JSA generation

Phase ② Entering Hazard Types and Risk Factors

- Enter basic information:
  - JSA ID (Management Number)
  - Job Title
  - Hazard Type
- Select specific job steps from predefined task templates
  - Choose only the steps relevant to the current JSA



- Click “AI Recommend” to automatically suggest risk factors for each job step
- Review the suggested list and select the most appropriate risk factors

Phase ③ Entering Control Measures and Severity Levels

- After selecting a risk factor, click “Recommend Control Measures”
- The system automatically suggests appropriate control actions
- Choose the most suitable control measure from the recommended list

- Click “Enter Result” to save selected risk factors and control measures
- Severity level is automatically generated based on saved inputs
- Once all fields are completed, save and submit for approval

Thank You.

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