

Generative AI-Powered JSA Auto-Generation System

JSA ; Job Safety Analysis

2025-05-00

UDMTEK Co., Ltd.

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Overview

1

- JSA overview, procedure, and importance
- 2) Need and Objective of AI-Based Automatic JSA Generation

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.



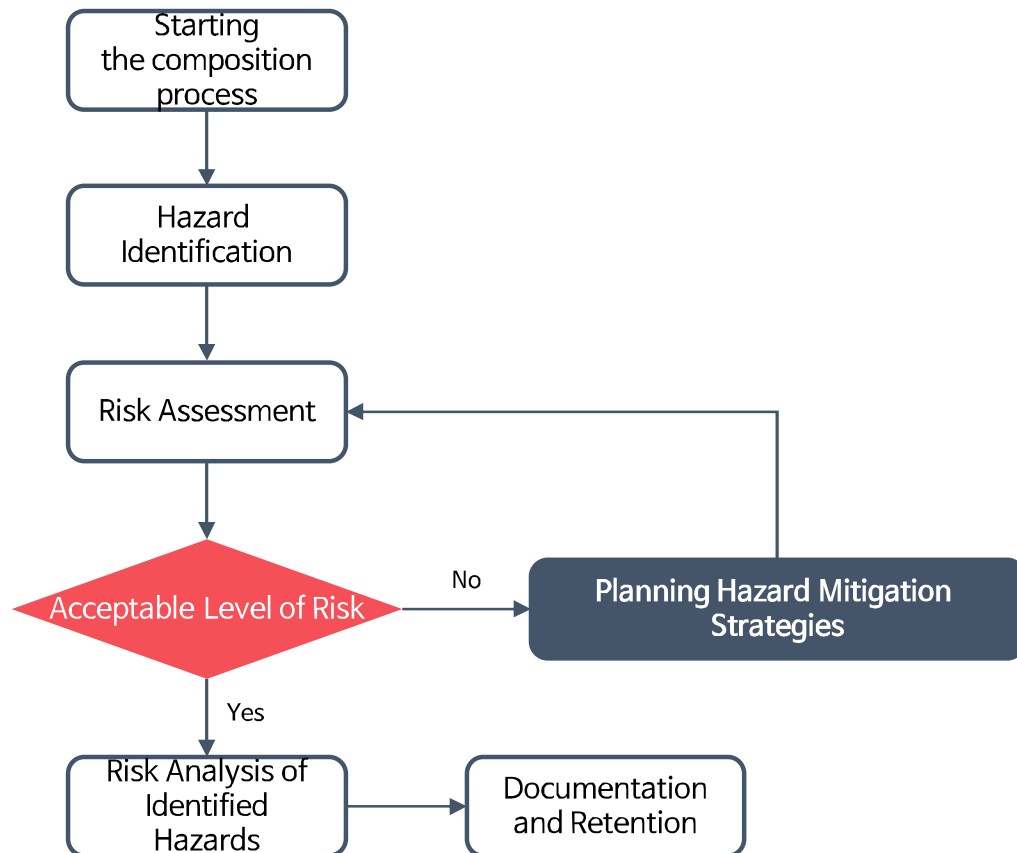
JHA (Job Hazard Analysis)

- 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 & Helmet	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	1	2	L(2)		
				Install spark-resistant fire blankets to prevent spark dispersion	1	2	L(2)		
				Remove or isolate flammable and combustible materials from the area	1	2	L(2)		
Drilling into Concrete Using a Hammer Drill		Airborne dust generated during drilling may cause respiratory illness.	No	Place fire extinguishers and other firefighting equipment nearby	1	2	L(2)		
				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

JSA Job Elements Example						
Reinforced Concrete Work at 000 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	L(1)
Job Preparation 2		Safety Accidents Caused by Inadequate Pre-Job Preparation	No	Wear Personal Protective, safety Shoes & Helmet	1	L(2)

- 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

Job Risk Assessment		Control Measure Recommendation
<div> <input checked="" type="checkbox"/> Risk Factor </div>		
<div> <div> <div>No</div> <div>Y</div> </div> <div>Risk Factor Recommendation</div> </div>		
<input type="checkbox"/> 1		
<input checked="" type="checkbox"/> 2	Eye injuries may occur due to flying particles while operating power tools during piping tasks.	
<input type="checkbox"/> 3	배관 설치용 위한 고소 작업 중 안전고리가 제대로 체결되지 않아 작업자가 높은 곳에서 떨어질 위험이 있다.	
<input type="checkbox"/> 4	During pipe installation work, there is a risk of fire or explosion due to chemical or gas leaks.	
<input type="checkbox"/> 5		
<div> <div> <div>No</div> <div>Y</div> </div> <div>Control Measure</div> </div>		
		Input Result
위험요인 추천		현재 조치사항 추천

- 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



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



Construction Safety AI-JSA Project
2024.05 ~ 2025.09



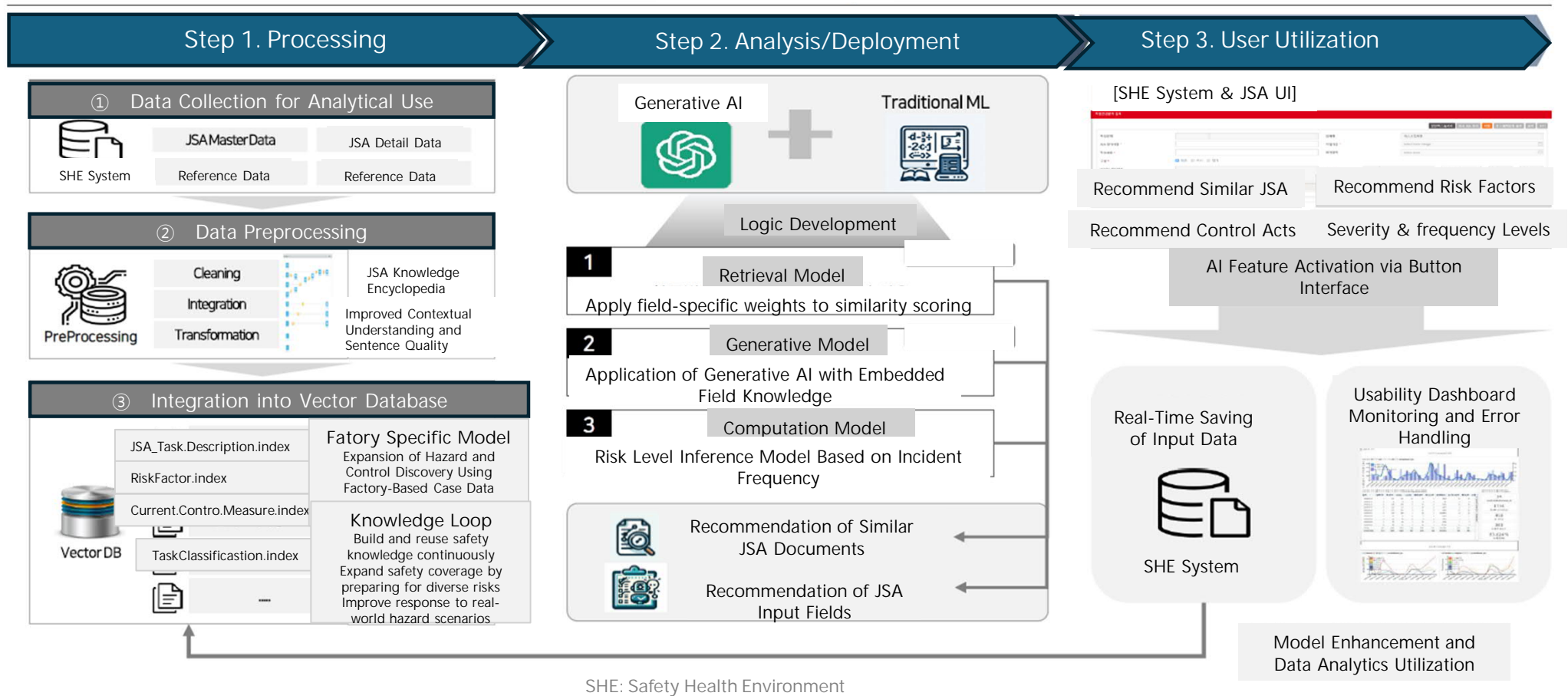
System Implementation

2

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

AI-Based JSA Auto-Generation Process

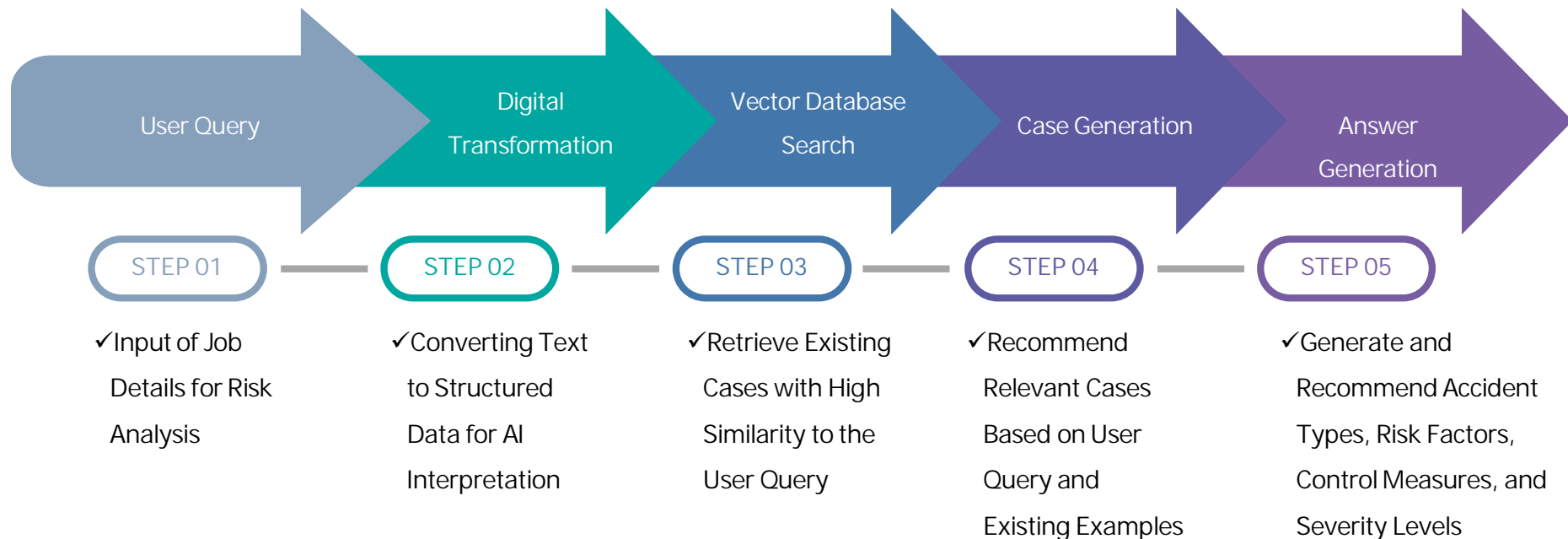
AI Process Map



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 –



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)

작업위험성평가 상세

작업내용: 보일러 교체 작업, 평가기간: 2023. 11. 17, 평가종류: 정기점검, 평가대상: LNG 발전 / 안전, 평가자: 김민준, 평가일자: 2023-11-14, 평가장소: 35A, 평가부서: 안전과

위험성평가

위험성 Matrix 조회, 평가하기, 시정요구, 평가완료

No	작업단계	유해위험요소	위험성	잔존위험성	잔존위험성	잔존위험성	잔존위험성
1	작업준비 및 작업인입	냉각 및 순환기 작동 위험	3	2	순환기를 통한 유출 위험	중	0
2	작업준비 및 작업인입	무거운 자재를 이동하다	1	1	안전장착을 통한 안전 확보	중	0
3	작업준비 및 작업인입	무거운 자재를 운반하다	1	1	안전장착을 통한 안전 확보	중	0
4	작업준비 및 작업인입	작업 중 안전사고 발생	3	3	작업 중 안전사고 발생	중	0
5	작업준비 및 작업인입	작업 중 안전사고 발생	1	1	작업 중 안전사고 발생	중	0
6	작업준비 및 작업인입	작업 중 안전사고 발생	1	1	작업 중 안전사고 발생	중	0
7	작업준비 및 작업인입	작업 중 안전사고 발생	2	1	작업 중 안전사고 발생	중	0

저장, 삭제, 평가완료

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



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

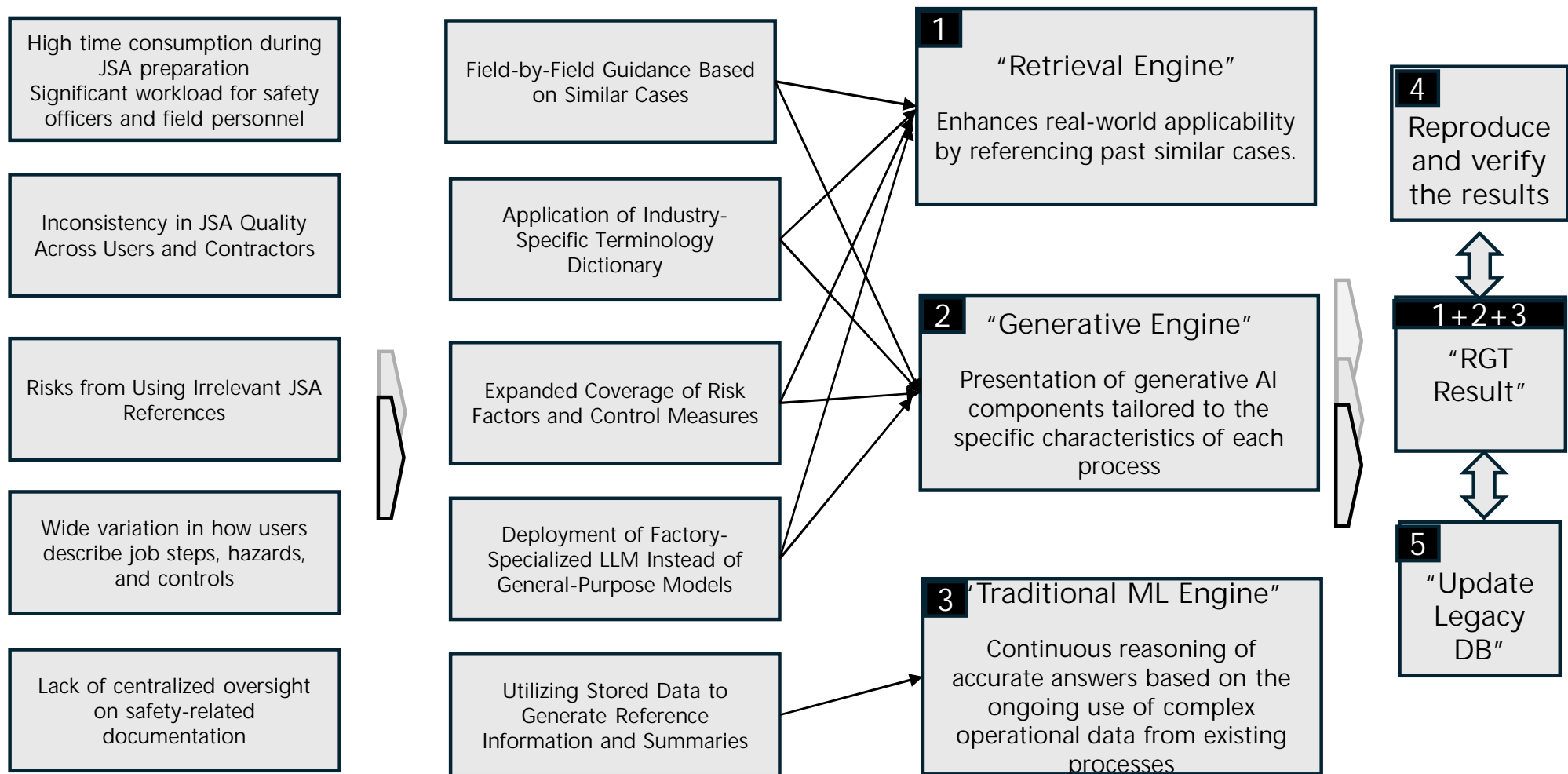


Flyer
Vector DB

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

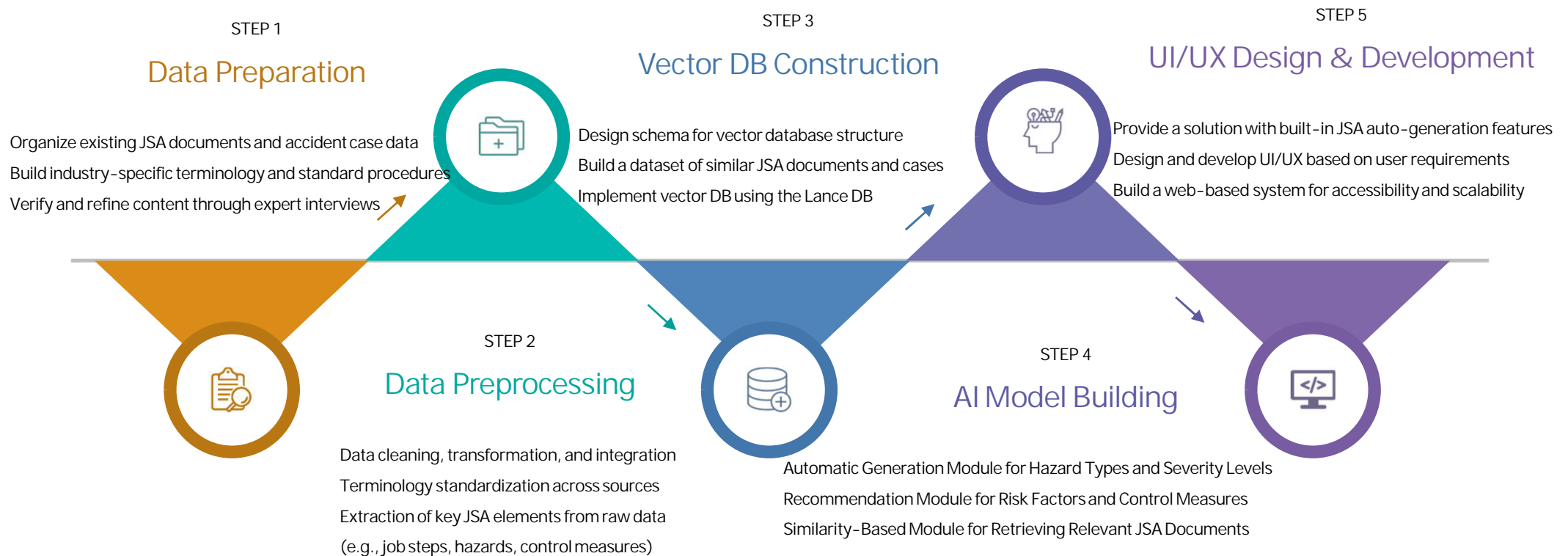
Integrated Data Pipeline: Legacy & Operational DB

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

Detailed Job Risk Assessment

Job Description: Cylinder Replacement Work
Assessment Period: November 17, 2023
Assessment Year: 2023
Job Type: High-Risk Task

· 공정/분야 LNG 발전 / 안전
· 평가상태 작성중 / 2023-11-14
· 담당자 김종국
· 담당부서 SHE그룹

참여자 작업단계 위험성평가 개선계획

Risk Assessment

Retrieval Risk Matrix

행추가 AI행추가 행삭제

No	작업단계	유해위험요인	위험성			안전작업방법	개선대책	
			강도	빈도	위험		등록	건수
1	작업준비 및 자재반입	냉각 및 순환기 계통 위험...	3	2	6	순환기를 통한 효율화	등록	0
2	작업준비 및 자재반입	무거운 자재를 이동하다...	1	1	1	안전교육 실시 안전보호...	등록	0
3	작업준비 및 자재반입	무거운 자재 바이 조그...	1	1	1	근로자의 체력 및 건강 상...	등록	0
4	자재 운반설치		3		9	자재 운반에 따른 하부 받...	등록	0
5	자재 운반설치	스폴 인양 시 스폴 모양이...	1	1	1	인양 시 작업자 안전 거리...	등록	0
6	자재 운반설치	자재 운반 설치 과정에서 ...	1	1	1	화학물질 사고 대응 방안 ...	등록	0
7	배관 설치 작업	배관 설치 시 하단 펌프 ...	2	1	2	배관 설치 시 하단 펌프 ...	등록	0

저장 작성완료 닫기

- 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

Detailed Job Risk Assessment

JSA No. WRE2023111406001 · 작업명 실린더 교체 작업

· 작업단계 선택

AI추천

Risk Factors

대반입 004

조치사항 추천

No 1

자재 운반설치 UNW2023112217003

위험요인 추천

Control Measures

결과입력

- 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

작업위험성평가 상세

JSA No. WRE2023111406001 · 작업명 실린더 교체 작업

· 작업단계 배관 설치 작업

AI추천

위험요인

조치사항 추천

No	위험요인 추천
1	배관 설치 작업 중 전동공구 사용 시 비산물에 맞아 인구 손상이 발생할 위험이 있다.
2	배관 설치 작업 중 볼팅 작업 시 손가락이 끼여 부상을 입을 수 있다.
3	배관 설치를 위한 고소 작업 중 안전고리가 제대로 체결되지 않아 작업자가 높은 곳에서 떨어질 위험이 있다.
4	배관 설치를 위한 그라인더 작업 시 무리한 자세로 인한 근골격계 상해가 발생할 수 있다.
5	배관 설치 작업 시 화학 물질이나 가스 누출로 인한 화재 또는 폭발 사고가 발생할 위험이 있다.

- 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

Detailed Job Risk Assessment

Risk Factors

Q 조치사항 추천

No	위험요인 추천
1	배관 설치 작업 중 전동공구 사용 시 비산물에 맞아 인구 손상이 발생할 위험이 있다.
2	배관 설치 작업 중 불링 작업 시 손가락이 끼여 부상을 입을 수 있다.
3	배관 설치를 위한 고소 작업 중 안전고리가 제대로 체결되지 않아 작업자가 높은 곳에서 떨어질 위험이 있다.
4	배관 설치를 위한 그라인더 작업 시 무리한 자세로 인한 근골격계 상해가 발생할 수 있다.
5	배관 설치 작업 시 화학 물질이나 가스 누출로 인한 화재 또는 폭발 사고가 발생할 위험이 있다.

- 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

Control Measures

Q 결과입력

No	위험요인 추천	현재 조치사항 추천
1	배관 설치 작업 중 불링 작업 시 손가락이 끼여 부상을 입을 수 있다.	개인 보호 장비 착용
2		불링 작업 전 작업 구역 내 위험 요소 제거
3		작업자 교육 및 불링 작업 절차 숙지

· 유해위험요인* 배관 설치 작업 중 불링 작업 시 손가락이 끼여 부상을 입을 수 있다.

· 안전작업방법* 개인 보호 장비 착용
불링 작업 전 작업 구역 내 위험 요소 제거

· 현재 위험성* 강도 1 빈도 1 위험도 1

- 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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