DEEP-INNOVATORS

RAPID
(RISK ANALYSIS &
PROACTIVE INTELLIGENCE
FOR DECISION-MAKING)

SUMMARY

- INTRODUCTION
- PROGRESS OVERVIEW
- MODEL STRUCTURE
- RESULTS ANALYSIS
- CONCLUSION AND NEXT STEPS

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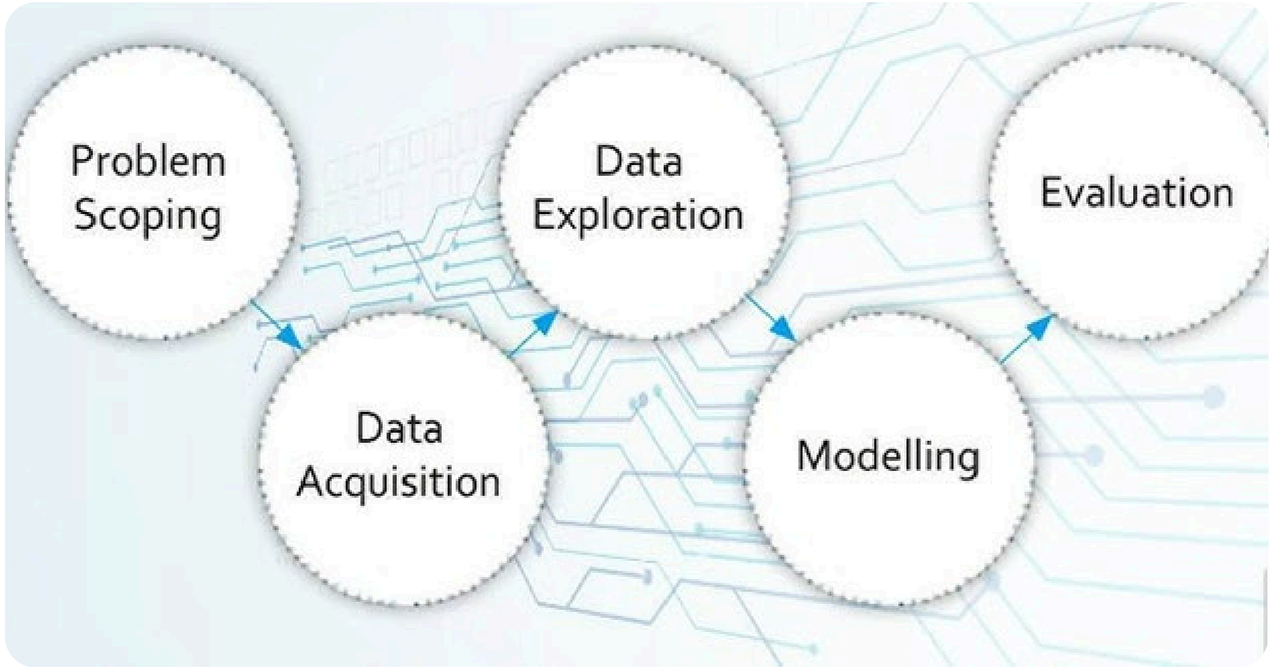
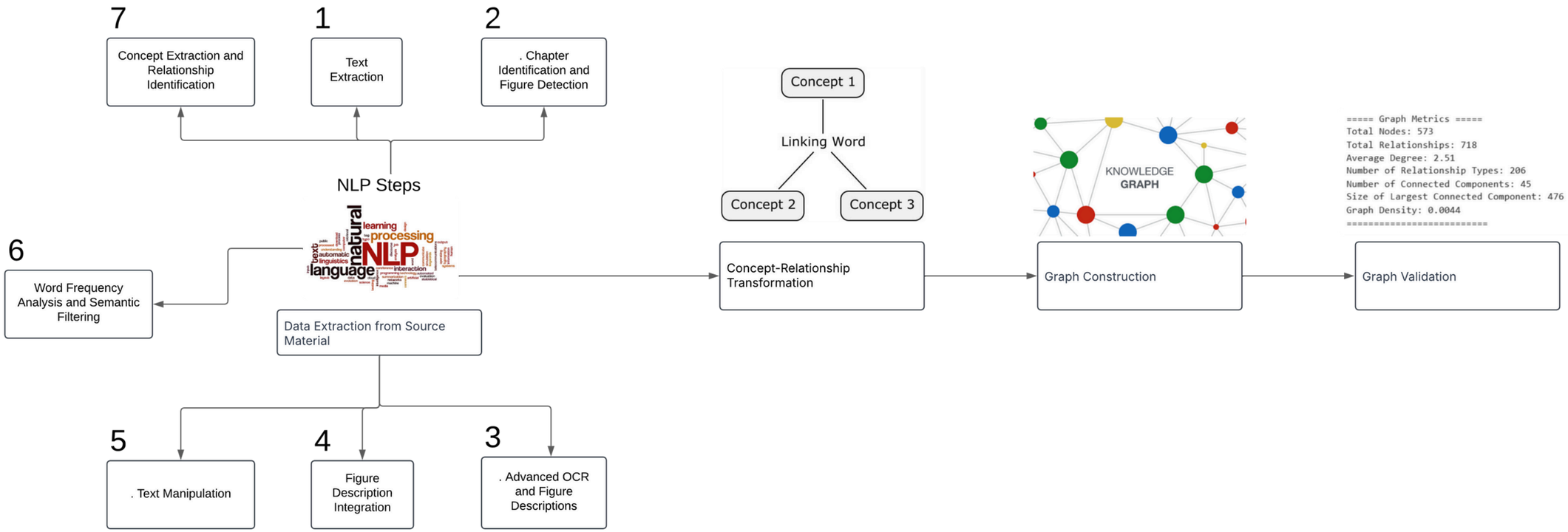
INTRODUCTION



PROGRESS OVERVIEW

GNN


7
Concept Extraction and Relationship Identification
1
Text Extraction
2
. Chapter Identification and Figure Detection
NLP Steps
6
Word Frequency Analysis and Semantic Filtering
Data Extraction from Source Material
5
. Text Manipulation
4
Figure Description Integration
3
. Advanced OCR and Figure Descriptions
Concept 1
Linking Word
Concept 2
Concept 3
Concept-Relationship Transformation
KNOWLEDGE GRAPH
Graph Construction
===== Graph Metrics =====
Total Nodes: 573
Total Relationships: 718
Average Degree: 2.51
Number of Relationship Types: 206
Number of Connected Components: 45
Size of Largest Connected Component: 476
Graph Density: 0.0044
==========
Graph Validation

GNN

OUTPUT VALIDATION

```
===== Graph Metrics =====
Total Nodes: 573
Total Relationships: 718
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Number of Relationship Types: 206
Number of Connected Components: 45
Size of Largest Connected Component: 476
Graph Density: 0.0044
==========================
```
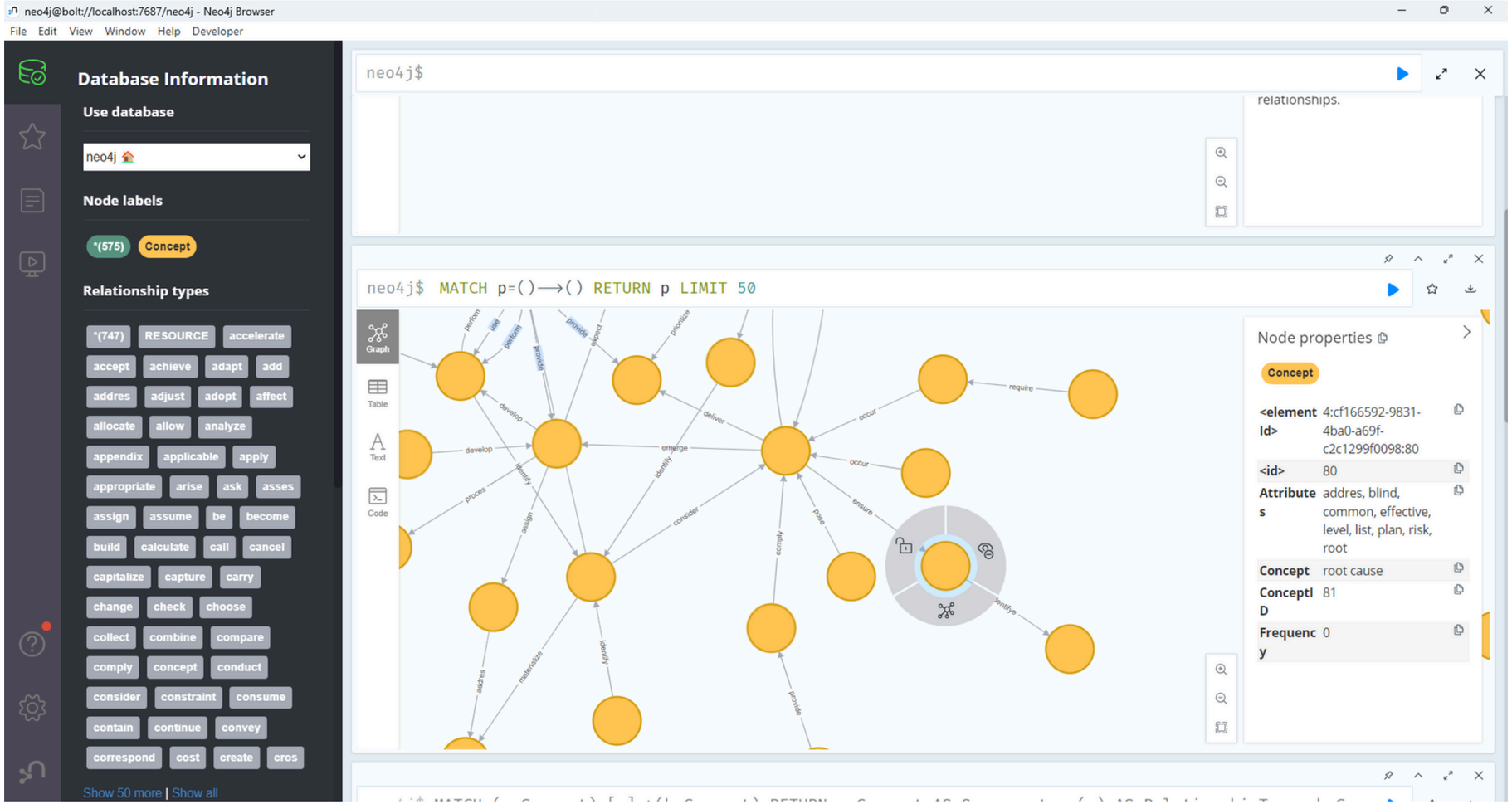
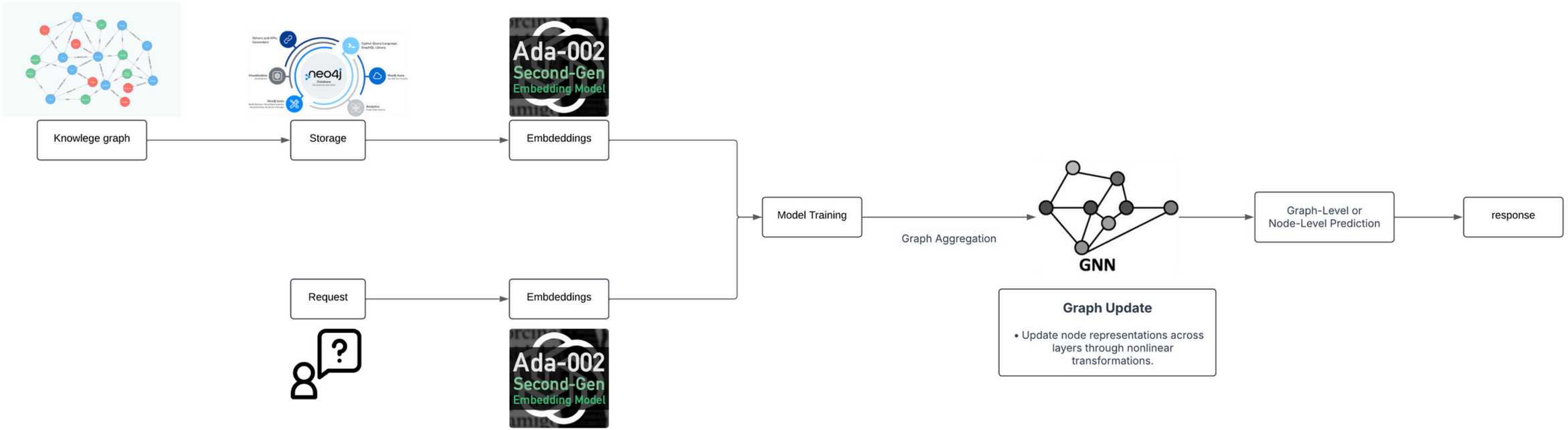

```
         Source Node                                      Relationship  \
0           textbook                                Associated Resource
1  practice standard                           organizes and categorizes
2  practice standard                                             include
3  practice standard  defines the structure and presentation approac...
4          principle                                  Fundamental Basis
5          principle  Validation of Principles in Risk Management Fr...
6          principle                     Incorporate Principles of Value
7          principle                                     Implementation
8             proces                                         elucidates
9             proces                                              apply

    Target Node                          Source Enhanced Attributes  \
0        course              Publisher Language Subjects Page Count
1       section  version history revision control process audit...
2   information  version history revision control process audit...
3  style format  version history revision control process audit...
4        proces  Critical Components Detailing the key elements...
5          defi  Critical Components Detailing the key elements...
6         value  Critical Components Detailing the key elements...
7           use  Critical Components Detailing the key elements...
8        addres  Compliance Framework Development A structured ...
9         asset  Compliance Framework Development A structured ...

                        Target Enhanced Attributes
0  Syllabus Prerequisites Course Format Assignmen...
1  strategic objectives clearly delineated analyt...
2  Trustworthiness Explores the reliability accur...
3  Formatting guidelines Clear instructions on fo...
4  Compliance Framework Development A structured ...
5  Definition A clear and concise description of ...
6  Value Enhancement Factors Strategic stakeholde...
7  RealWorld Application Examples A diverse colle...
8  Address Actionable Steps Clearly defined quant...
9  Maintenance Procedures Detailed maintenance sc...
Cleaned data has been saved successfully.
```

GNN

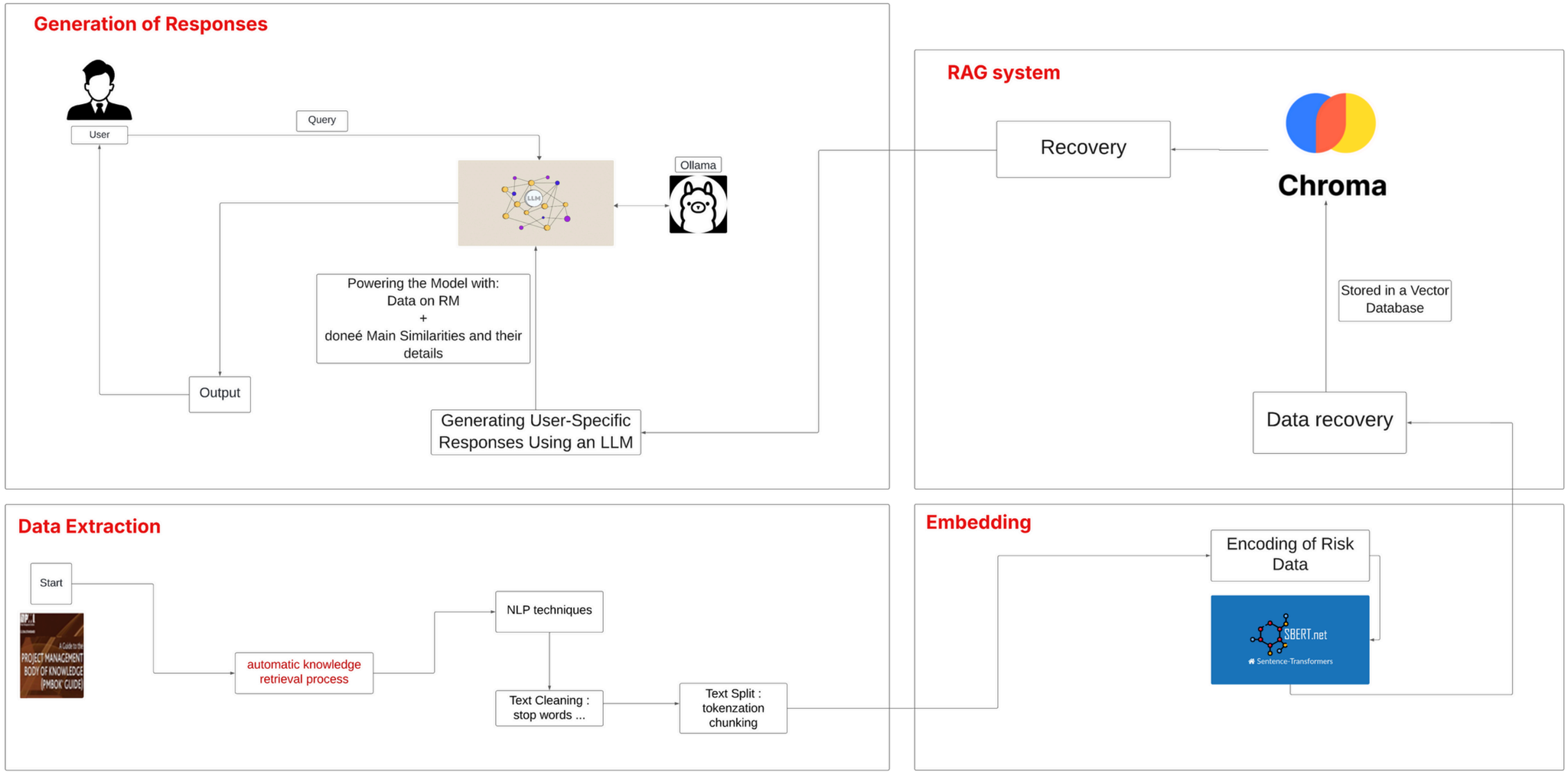
KNOWLEDGE GRAPH CONSTRUCTION



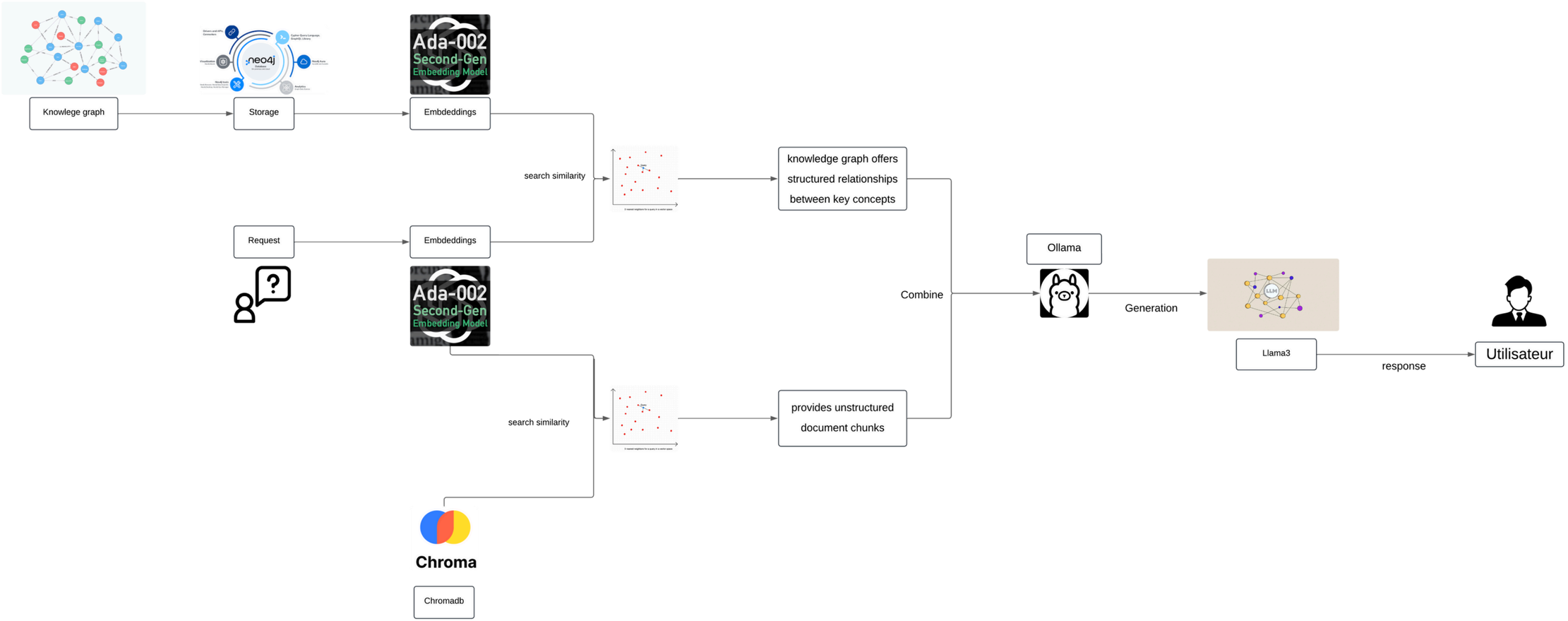
GNN


Knowlege graph
Storage
Embdeddings
Request
Embdeddings
Model Training
Graph Aggregation
GNN
Graph Update
• Update node representations across layers through nonlinear transformations.
Graph-Level or Node-Level Prediction
response

RAG


Generation of Responses
User
Query
Ollama
Powering the Model with:
Data on RM
+
doneé Main Similarities and their details
Output
Generating User-Specific Responses Using an LLM
RAG system
Recovery
Chroma
Stored in a Vector Database
Data recovery
Data Extraction
Start
PROJECT MANAGEMENT BODY OF KNOWLEDGE (PMBOK GUIDE)
automatic knowledge retrieval process
NLP techniques
Text Cleaning : stop words ...
Text Split : tokenzation chunking
Embedding
Encoding of Risk Data
SBERT.net
Sentence-Transformers

GRAPHRAG


Knowlege graph
Storage
Embdeddings
Ada-002
Second-Gen
Embedding Model
search similarity
knowledge graph offers structured relationships between key concepts
Request
Embdeddings
Ada-002
Second-Gen
Embedding Model
search similarity
provides unstructured document chunks
Combine
Ollama
Generation
Llama3
response
Utilisateur
Chroma
Chromadb

MODEL STRUCTURE

GNN MODEL

RETRIEVAL-AUGMENTED GENERATION
RAG

GRAPHRAG

GNN MODEL

GNN Model Layer Breakdown :

- **Layer 1 - GCNConv(1433 → 128):**
  - **Purpose:** This step simplifies the input and extracts meaningful information from each node to start building node representations.

- **Layer 2 - GCNConv(128 → 64):**
  - **Purpose:** Further compresses the features from 128 to 64 dimensions, while allowing nodes to gather information from neighboring nodes. This enables the model to learn relationships between connected nodes.

- **Layer 3 - GCNConv(64 → 32):**
  - **Purpose:** Reduces the node features to 32 dimensions, which helps in capturing longer-range relationships in the graph without making the model too large or complex.

- **Layer 4 (Output Layer) - GCNConv(32 → 7):**
  - **Purpose:** The final layer maps the 32-dimensional features to the 7 output classes required for the task (e.g., node classification). This is where the model predicts the class or label of each node.

- **Log-Softmax Activation:**
  - **Purpose:** Converts the model outputs into probability distributions, ensuring the results are suited for classification tasks (more stable for computing loss).

```
GNN(
  (conv1): GCNConv(1433, 128)
  (conv2): GCNConv(128, 64)
  (conv3): GCNConv(64, 32)
  (conv4): GCNConv(32, 7)
)
```

GNN MODEL

```
GNN(
  (conv1): GCNConv(1433, 128)
  (conv2): GCNConv(128, 64)
  (conv3): GCNConv(64, 32)
  (conv4): GCNConv(32, 7)
)
```

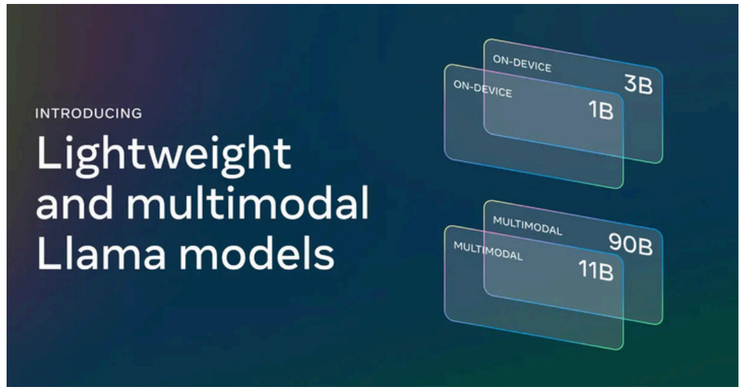
Layer	Input Shape	Output Shape	Param #
GCN Layer 1 (1433 → 128)		(Batch size, 128)	183392
GCN Layer 2 (128 → 64)		(Batch size, 64)	8256
GCN Layer 3 (64 → 32)		(Batch size, 32)	2080
GCN Layer 4 (32 → 7)		(Batch size, 7)	231

RETRIEVAL-AUGMENTED GENERATION RAG

Conceptual Overview:

- **Retrieval-Augmented Generation (RAG) combines two key components:**
  - **Retriever:** Finds relevant information from a knowledge base using methods like Dense Passage Retrieval (DPR) or BM25. It outputs the top-N relevant documents based on a user's query.
  - **Generator:** Utilizes a Large Language Model (LLM), such as LLaMA or GPT, to generate natural language responses using both the query and the retrieved documents as input.
- The retriever's output is used as context for the **LLM**, allowing **RAG** to combine external knowledge with natural language generation for accurate, contextually rich responses.

Ollama



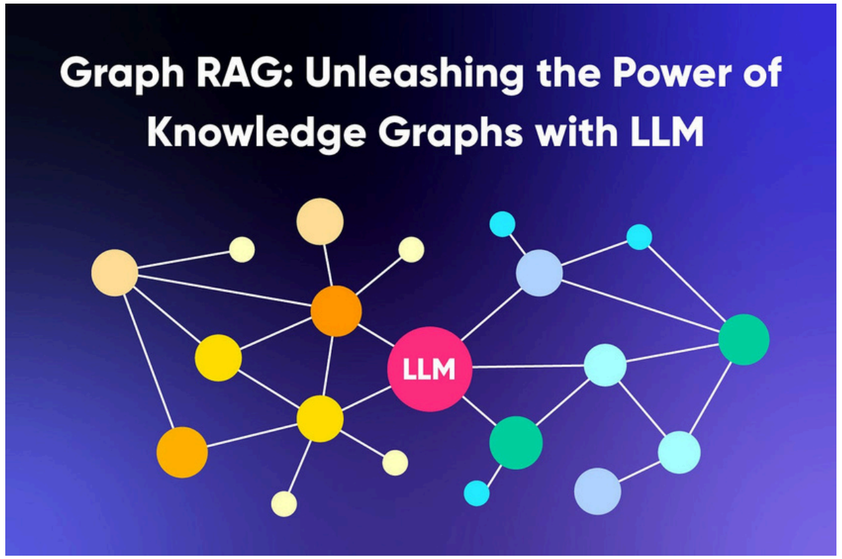
Chroma

GRAPHRAG

Graph-RAG combines graph-based learning with retrieval-augmented generation to generate more precise and context-aware responses. It leverages both graph relationships between entities and external knowledge from retrieved documents.

Key Components:

1. **Graph Retriever:** Uses Graph Neural Networks (GNNs) to traverse a Knowledge Graph, fetching the most contextually relevant nodes and subgraphs based on the query.
2. **Document Retriever:** Retrieves relevant documents using traditional methods like BM25 or DPR to find text-based information.
3. **Graph-Enhanced Generator:** Combines the graph data and retrieved documents, passing them to an LLM (e.g., LLaMA, GPT) to generate a coherent, contextually rich response using both structured (graph) and unstructured (text) data.



RESULTS ANALYSIS

GNN

The Graph Neural Network (GNN) processes the query within the structured data (the Knowledge Graph) and retrieves answers based on node relationships and graph structure.

- **Results:** The answers were accurate for the known entities in the graph but lacked broader contextual information from external sources.

- **Limitation:** The GNN, while powerful with structured data, was restricted to the information explicitly present within the graph and missed out on external knowledge or any deep, natural language fluency.

GNN Result

Question: budget allocation processes

Relevant Concept: part project budget

Response:

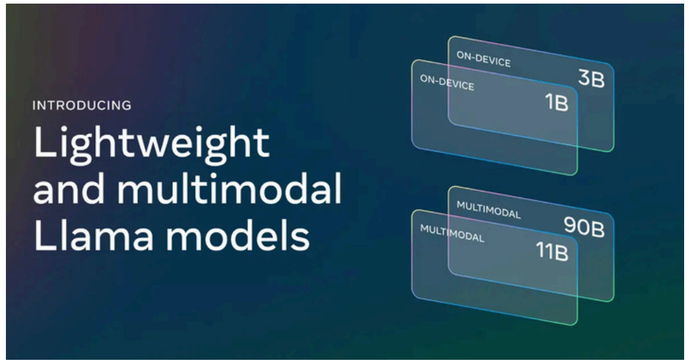
- **Budget Allocation:** Details on how the budget components are allocated, such as the criteria used, decision-making process, and any allocation methodologies employed.
- **Budget Monitoring:** Processes and tools used to track and evaluate the actual spending against the allocated budget components to ensure financial controls and project success.
- **Budget Reporting:** Mechanisms for communicating budget status, variances, and financial performance to stakeholders, including frequency, format, and key metrics presented.

RETRIEVAL-AUGMENTED GENERATION RAG

RAG (Retrieval-Augmented Generation) used a traditional retriever paired with a language model (LLM) to fetch relevant documents and generate a more contextually fluent response.

- **Results:** The RAG model was able to provide relevant pieces of information but sometimes lacked depth in understanding relationships between specific entities within the structured data (like the Knowledge Graph).

- **Limitation:** While the retrieved document-based information was extensive, the model couldn’t fully utilize structured relationships between entities that are key for certain types of queries.

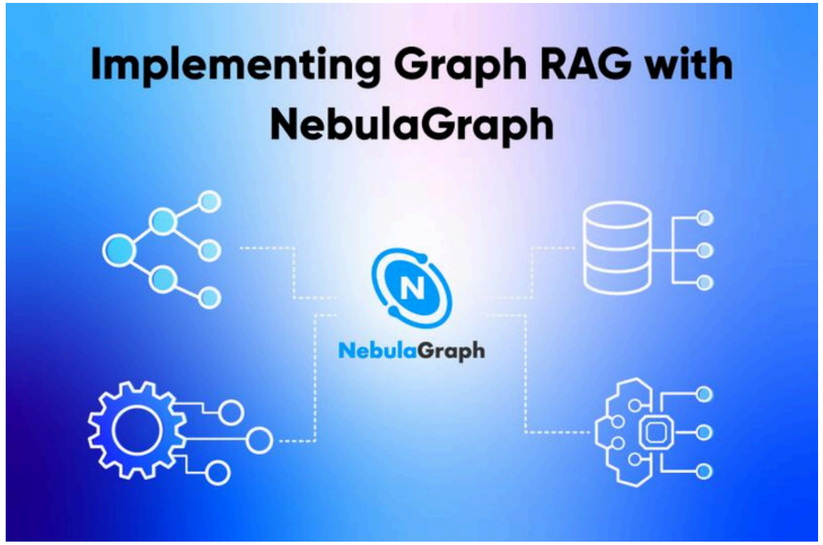


RETRIEVAL-AUGMENTED GENERATION RAG

```
Enter your query:  How does risk management integrate into the overall project scope?

Llama Model's Answer:
According to the context, risk management integrates into the overall project scope by:

1. Being an integral part of the overall project management plan.
2. Being integrated with project management to ensure that potential risks are identified and addressed throughout the project lifecycle.
3. Involving ongoing monitoring and assessment of risk as well as continuous improvement of process and procedure.
4. Being included in the project budget and risk management plan, which describes part of the project budget and evaluates, allocates, and manages risk.
5. Having a normal frequency of repeat throughout the project, with exceptions being made for exceptional conditions that require corresponding actions
to initiate.

In essence, risk management is an integral component of the overall project scope, involving ongoing monitoring, assessment, and improvement to ensure t
he achievement of success criteria and stakeholder agreement on acceptable levels of result.

Context used for the answer:
 likely to take an active role in the risk management process which can lead to a more effective and efficient approach integrate with Project Managemen
t risk management should be integrate with project management to ensure that potential risk be identify and address throughout the project lifecycle thi
s integration enable organization to proactively manage risk reduce the likelihood of surprise or unforeseen consequence by integrate risk management in
to the project planning phase organization can develop mitigation strategy and contingency plan early in the process risk management success the goal of
risk management be to achieve success which mean minimize potential loss and maximize opportunity a successful risk management strategy should involve o
ngoing monitoring and assessment of risk as well as continuous improvement of process and procedure Scale risk Effort to Project the risk effort require
should be scale to the project s size complexity and scope this ensure

holder become clear change although Project Risk Management process form integral part overall project management plan budget term resource cost time sp
ecifi risk management activity establish order well track control necessary defend correspond expenditure throughout project cost treating risk include
appropriately project budget risk management plan describe part project budget evaluate allocate manage risk management plan defi monitoring method ensu
re corresponding expenditure track appropriately well condition approve budget risk management modifi ed way project management process progressive elab
oration risk management activity need repeat throughout project risk management plan defi normal frequency repeat process well specifi exceptional condi
tion corresponding action initiate correspond risk management activity integrate project management plan two category success criterion risk management
success project general success Project Risk Management Project Management Institute Practice Standard Project Risk Management Project Related Criteria
assess success Project Risk Management stakeholder must agree acceptable level result

 emerge or modification to exist risk mitigation plan management Plan this plan outline the overall approach to manage risk within the project it set th
e stage for the risk management process and define the scope role and responsibility of team member risk response Monitoring this section involve monito
r the effectiveness of implement risk response plan and track the status of risk mitigation status review regular review be conduct to assess the curren
t state of risk and ensure that plan response be on track these review help identify area where adjustment may be necessary audit periodic audits be per
form to verify that risk management process be be follow correctly and to identify any gap or opportunity for improvement additional Major Trigger this
section highlight the importance of have trigger in place to alert stakeholder when a significant event occur these trigger can prompt additional risk i
dentification analysis and response planning

Retrieved From (metadata):
{'chapter': 'Chapitre_1_introduction', 'index': 20}
{'chapter': 'Chapitre_4_plan_risk_management', 'index': 53}
{'chapter': 'Chapitre_9_monitor_and_control_risks', 'index': 307}
```

GRAPHRAG

Graph-RAG combined both **GNN-based retrieval** (structured data) and **RAG's unstructured document retrieval**. The processed knowledge from the graph, paired with external textual data, enabled the Large Language Model (LLM) to generate answers with both contextual depth and relationship accuracy.



- **Results:** The answer was the most detailed and contextually accurate. By using both structured knowledge from the Knowledge Graph and unstructured knowledge from document retrieval, Graph-RAG provided the most meaningful and nuanced response compared to GNN and RAG alone.

- **Strength:** This combination allowed the model to produce the best results by leveraging a richer understanding of the query context that neither GNN nor RAG could achieve on their own.

GRAPHRAG

Enter your query: How does risk management integrate into the overall project scope?

Llama Model's Answer:
Based on the provided context, risk management integrates into the overall project scope in the following way:

1. During the planning phase, risk management is integrated with project management to identify potential risks early on. This enables organizations to develop mitigation strategies and contingency plans, thereby reducing the likelihood of surprises or unforeseen consequences.
2. The risk management plan describes part of the project budget, which outlines the overall approach to managing risk within the project. This sets the stage for the risk management process and defines the scope, role, and responsibility of team members.
3. Risk response monitoring involves tracking the effectiveness of implemented risk responses and the status of risk mitigation plans. Regular reviews a re conducted to assess the current state of risk and ensure that the plan remains on track.
4. The project scope includes risk management contingencies and potential impact assessments, which ensures that risks are considered when defining the project deliverables, boundaries, exclusions, and success criteria.

In summary, risk management is an integral part of the overall project scope, as it helps organizations proactively manage risks, develop mitigation str ategies, and track the effectiveness of implemented responses.

========== How the Knowledge Graph Helped ==========
The knowledge graph provided additional context by identifying 3 relevant nodes.
Here are the nodes and their attributes used to help form the answer:
--- Knowledge Graph Nodes and Relations Included ---
Node: project, Attributes: Strategic Project Goals Clearly articulated objectives that support the overall vision and mission of the public organization aligning with key performance indicators and longterm sustainability targets. Detailed Project Scope An exhaustive outline specifying all project delive rables boundaries exclusions and success criteria incorporating risk management contingencies and potential impact assessments. Resource Allocation Stra tegy A comprehensive plan for the optimal distribution of financial human and technological resources ensuring alignment with organizational priorities and capacity constraints.

Relates to context refl via "carry"

Relates to response via "The process by which a project initiates and influences a response often in the context of organizational management and operat ional effectiveness."

CONCLUSION

THANK YOU
FOR YOUR ATTENTION