

Modular Research Engine (MRE) – Database Design Report

Course: ICCS225 – Database Foundations

Term Project: November 2025

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GitHub Repo: <https://github.com/Pakin-m/mre-db>

Render PostgreSQL Database URL:

`postgresql://mre_db_mm7j_user:P9m07PC8vGJI0Ha0cpzBHSAGo19NmIKs@dpg-d4ntp92li9vc738d1vt0-a.singapore-postgres.render.com/mre_db_mm7j`

Render DB User: `mre_professor`

Render DB Password: `professor123`

1. Project Scope

Chosen small business: ****Independent research consultants / small business strategists****.

Platform goal: provide a “Modular Research Engine” that organizes sources, concepts, notes, and insights.

Pain points solved:

- Scattered research files
- Hard to track insights
- No structured knowledge base
- Difficult to reuse past work

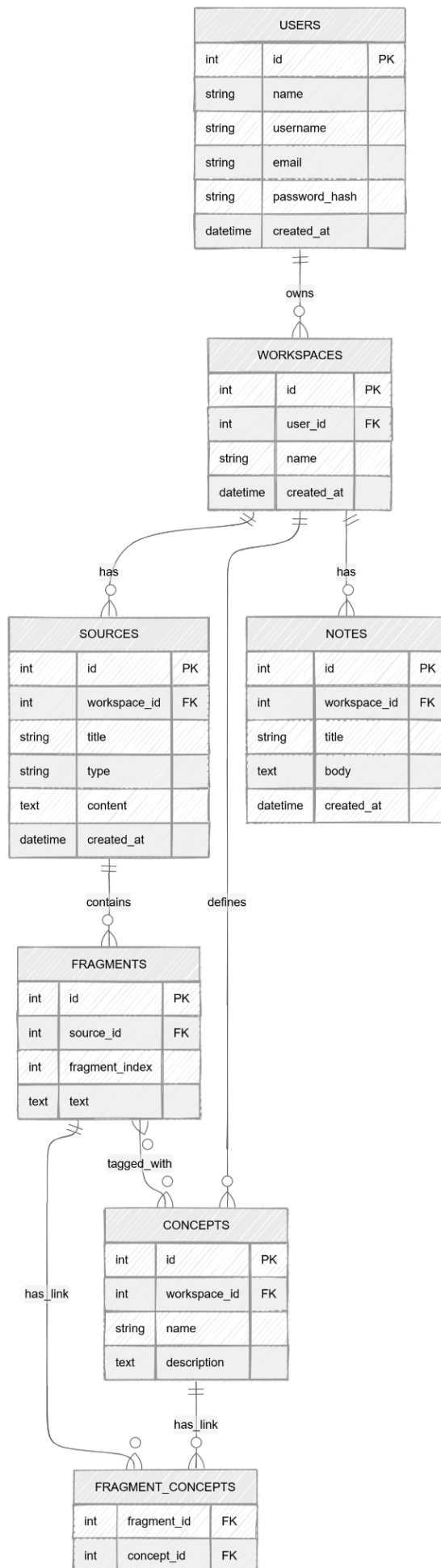
Monetization: subscription-based (199–399 THB/mo).

2. Key Features

Core features:

- 1) Workspace system
- 2) Sources + fragments (research ingestion)
- 3) Concepts tagging
- 4) Notes system
- 5) Search & insights
- 6) Inbox (recent items)
- 7) Workspace overview

3. ER Diagram



The database is normalized to 3rd Normal Form (3NF).

Each entity (users, workspaces, sources, fragments, concepts, notes) stores only atomic attributes, and all non-key attributes depend solely on the primary key.

Many-to-many relationships (e.g., fragments ↔ concepts) are resolved using a junction table (fragment_concepts).

No duplicate or derived data is stored, ensuring minimal redundancy and consistent updates.

4. Security

The database uses a least-privilege design.

A dedicated role (`mre_app`) is created with *restricted permissions*, and the actual application user (`mre_app_user`) inherits only the minimal privileges required (SELECT + limited INSERT).

Passwords are stored as `password_hash` (never plaintext), and all data access is routed through PL/pgSQL functions to prevent SQL injection.

Foreign-key constraints enforce referential integrity across all tables, ensuring that users cannot access or create orphaned data in other workspaces.

5. Performance & Efficiency

The database is optimized for high-read workloads common for large data search tools.

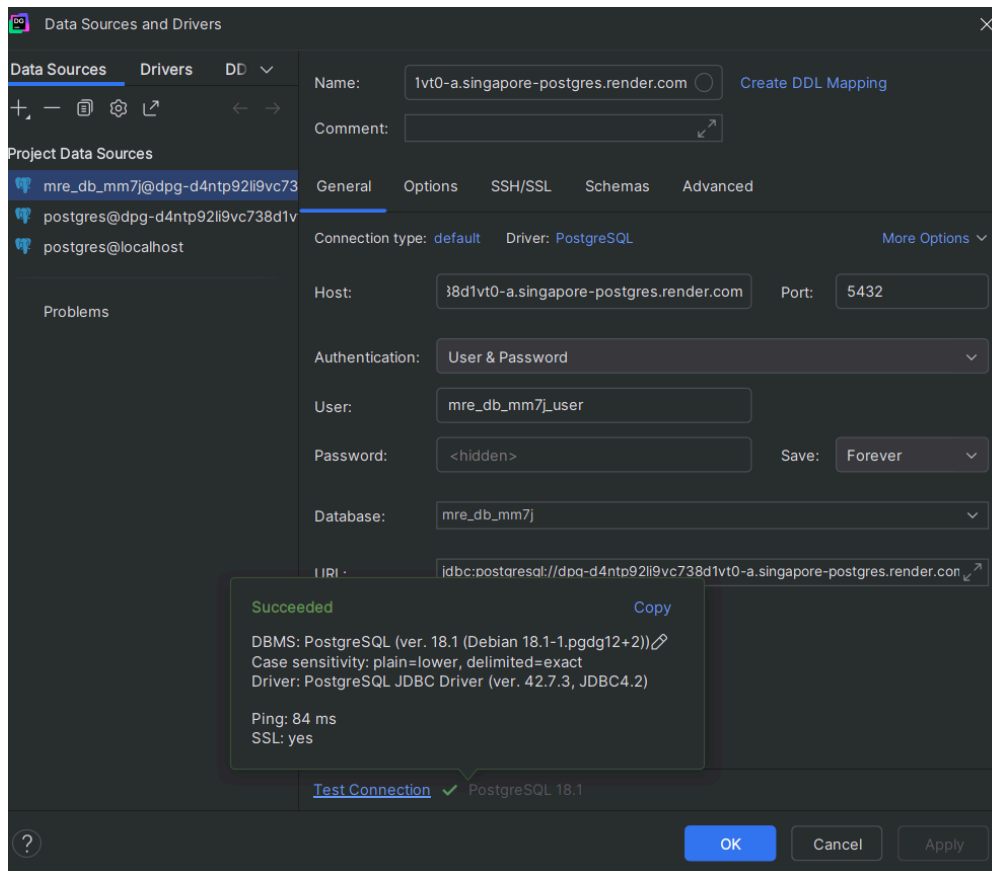
Indexes are created on frequently accessed fields (`workspace_id`, `source_id`, `concept_id`, and the `fragment_concepts` junction table) to ensure fast lookups under heavy queries.

PL/pgSQL functions provide pre-filtered, workspace-scoped query paths, reducing unnecessary full-table scans.

Table design avoids redundancy and ensures that large text fields (e.g., source content) are stored once, with fragments referencing them by ID.

6. PL/pgSQL Functions

Connect to the database on render:



Call: `SELECT * FROM mre.fn_workspace_overview(1);`

Output Result 4

	workspace_id	workspace_name	owner_user_id	owner_username	sources_count	fragments_count
1	1	Indie Strategy Lab	1	kalam_iwa	3	12

This allows conveniently getting all information about the selected workspace.

MREInboxSearchConceptNotesGuest

Select a workspace

Welcome, Guest.

Create new workspace

Your workspaces

- nice ID: 7
- jojok ID: 6
- New Research Sandbox ID: 5
- Indie Strategy Lab ID: 1
- Personal Learning Vault ID: 2

Call: `SELECT * FROM mre.fn_inbox_recent_sources(1, 5);`

Output Result 5

	source_id	title	type	created_at	fragment_count
1	3	Customer interviews - Gen Z in Bangkok	transcript	2025-12-03 10:31:01.494715 +00:00	4
2	2	DTC skincare competitors - summary	memo	2025-12-03 10:31:01.494715 +00:00	4
3	1	SEA e-commerce market report 2025	report	2025-12-03 10:31:01.494715 +00:00	4

Call:

```
SELECT * FROM mre.fn_create_source_with_fragments(
    1, 'new source',
    'text',
    'This is a test source');
```

and ran `SELECT * FROM mre.fn_inbox_recent_sources(1, 5);`

	source_id	title	type	created_at	fragment
1	11	new source	text	2025-12-03 18:59:40.800522 +00:00	
2	3	Customer interviews - Gen Z in Bangkok	transcript	2025-12-03 10:31:01.494715 +00:00	
3	2	DTC skincare competitors - summary	memo	2025-12-03 10:31:01.494715 +00:00	
4	1	SEA e-commerce market report 2025	report	2025-12-03 10:31:01.494715 +00:00	

MRE

InboxSearchConceptNotes

Guest

Inbox

Quick capture for raw sources: reports, transcripts, memos.

Title

e.g. SEA e-commerce market report 2025

Type

note

Content (optional)

Paste or write a short summary of the source...

Add to inbox

Recent sources

Workspace #1

- Test source from curl
note2025-11-30

Hello from curl

- test source
test2025-11-29

This is a test.

- Test source from function
note2025-11-29

First fragment text. Second fragment text. Third fragment text.

- Customer interviews – Gen Z in Bangkok
transcript2025-11-26

Interview notes with Gen Z online shoppers about habits and pain points.

- DTC skincare competitors – summary
memo2025-11-26

Summary of major DTC skincare brands, positioning, and pricing.

Call: `SELECT * FROM mre.fn_get_source_with_fragments(1);`

	source_title		source_created_at		fragment_text
1	SEA e-commerce market report 2025	report	2025-12-03 10:31:01.494715 +00:00	1	SEA e-commerce GMV grew 18% YoY in 2024, led by Indonesia and
2	SEA e-commerce market report 2025	report	2025-12-03 10:31:01.494715 +00:00	2	Thailand's online fashion segment shows strongest growth among
3	SEA e-commerce market report 2025	report	2025-12-03 10:31:01.494715 +00:00	3	Top customer segments include price-sensitive students and young
4	SEA e-commerce market report 2025	report	2025-12-03 10:31:01.494715 +00:00	4	Conversion rate improves significantly when offering free shipping

Call: `SELECT * FROM mre.fn_search_fragments_text('1', 'tiktok');`

fragment_id	fragment_text	source_id	source_title	snippet	source_created_at
9	1	3	Customer interviews – Gen Z in Bangkok	Gen Z shoppers often discover new brands via TikTok creators	2025-12-26
7	3	2	DTC skincare competitors – summary	Most competitors rely heavily on Instagram and TikTok as marketing channels	2025-11-26

MRE

InboxSearchConceptNotes

Guest

Search

Find fragments across your workspace by keywords in their text.

tiktok

Search

Results

Workspace #1

- Customer interviews – Gen Z in Bangkok
Fragment #12025-11-26

Gen Z shoppers often discover new brands via TikTok creators, not ads.

- DTC skincare competitors – summary
Fragment #32025-11-26

Most competitors rely heavily on Instagram and TikTok as marketing channels.

Quickly look up fragments.

Call: `SELECT * FROM mre.fn_list_fragment_concepts(1);`

	concept_id		name		description
1	1	customer_segments			Key groups of customers based on behavior or demographics.

Test add fragment 1 to concept 2

```
SELECT * FROM mre.fn_add_concept_to_fragment(1,2);
```

```
SELECT * FROM mre.fn_list_fragment_concepts(1);
```

Output

fn_add_concept_to_fragment

fn_add_concept_to_fragment

1 • true

	concept_id	name	description
1	2	conversion_rate	Percentage of visitors who complete the desired action.
2	1	customer_segments	Key groups of customers based on behavior or demographics.

```
SELECT * FROM mre.fn_remove_concept_from_fragment(1,2);
```

fn_remove_concept_from_fragment

1 1

MRE

Inbox

Search

Concept

Notes

Guest

Concepts

New concept

average_order_value

Average revenue per order in e-commerce.

conversion_rate

Percentage of visitors who complete the desired action.

customer_segments

Key groups of customers based on behavior or demographics.

Deep work

Notes about focused work sessions.

marketing_channel

Where traffic and awareness come from (TikTok, IG, etc.).

marketing_channel(edited)

Where traffic and awareness come from (TikTok, IG, etc.).

retention

How well we keep existing customers over time.

Concept detail

Workspace #1

2 evidence fragments

Nameaverage_order_value

Average revenue per order in e-commerce.

Description

Save concept

Evidence fragments

DTC skincare competitors – summary

Fragment #1

Brand A positions itself as premium clean beauty with higher price points.

DTC skincare competitors – summary

Fragment #4

Average order value is highest when bundles include serums and moisturizers.

Call:

```
SELECT * FROM mre.fn_list_notes(1);
```

	note_id	title	created_at	preview
1	4	Marketing channel priorities	2025-12-03 10:31:02.168922 +00:00	Double down on TikTok creators and IG reels. Test YouTube sh
2	3	Skincare positioning ideas	2025-12-03 10:31:02.168922 +00:00	Consider mid-premium positioning with strong community and e
3	2	E-commerce growth summary	2025-12-03 10:31:02.168922 +00:00	SEA GMV grew 18% YoY. Thailand fashion segment is outperform
4	1	Gen Z fashion insights	2025-12-03 10:31:02.168922 +00:00	Key takeaways: high TikTok influence, sensitivity to shippin

Call:

```
SELECT * FROM mre.fn_get_note(1);
```

	note_id	workspa...	workspace_name	own...	own...	title	body
1	1	1	Indie Strategy Lab	1	kalam_iwa	Gen Z fashion insights	Key takeaways: high TikTok influence, sen

Test add note:

```
SELECT * FROM mre.fn_create_note(1,'new note', 'Test note');
```

```
SELECT * FROM mre.fn_list_notes(1);
```

	note_id ▾	title ▾	created_at ▾	preview ▾
1	11	new note	2025-12-03 20:25:07.905990 +00:00	Test note
2	4	Marketing channel priorities	2025-12-03 10:31:02.168922 +00:00	Double down on TikTok creators and IG reels. Test YouTube sh
3	3	Skincare positioning ideas	2025-12-03 10:31:02.168922 +00:00	Consider mid-premium positioning with strong community and e
4	2	E-commerce growth summary	2025-12-03 10:31:02.168922 +00:00	SEA GMV grew 18% YoY. Thailand fashion segment is outperform
5	1	Gen Z fashion insights	2025-12-03 10:31:02.168922 +00:00	Key takeaways: high TikTok influence, sensitivity to shippin

MRE

InboxSearchConceptNotes

Guest ▾

Notes

New note

Test note from curl

2025-12-01

Hello note body

Test note title

2025-11-30

Test note body from function.

Marketing channel priorities

2025-11-27

Double down on TikTok creators and IG reels.
Test YouTube shorts later.

Skincare positioning ideas

2025-11-27

Consider mid-premium positioning with strong community and educational content.

E-commerce growth summary

2025-11-27

SEA GMV grew 18% YoY. Thailand fashion segment is outperforming overall market.

Gen Z fashion insights

2025-11-27

Key takeaways: high TikTok influence, sensitivity to shipping fees, and strong p...

Edit note

Workspace #1

Title

Marketing channel priorities

Double down on TikTok creators and IG reels.
Test YouTube shorts later.

Body (Use @[Concept name] to mention concepts)

Save note