Data Model & Calculation Logic

This document explains how raw search analytics events are transformed into meaningful metrics. It covers event sequences, timing calculations, and business rules with clear examples.

Table of Contents

1. Event Types & Sequence

Initialization Events

Events fired when the search interface loads (before any user search):

Event	Description	When Fired
`SEARCH_USER_LOGGED_IN_SUCCESS`	User authenticated	User successfully authenticated in goto/echo
`SEARCH_USER_DETAILS_FETCHED`	User profile loaded	User details fetched from User Profile after authentication
`SEARCH_USER_DETAILS_FETCHED_FROM_CACHE`	User profile from cache	User details fetched from local storage after authentication
`SEARCH_USER_PHOTO_FETCHED`	Profile picture loaded	User profile pic retrieved from User Profile
`SEARCH_DATA_FETCH_STARTED`	Suggestions request sent	Request to fetch suggestions and trending searches sent to backend
`SEARCH_DATA_FETCH_COMPLETED`	Suggestions loaded	Suggestions and trending searches retrieved from backend

Search Flow Events

Core events in the search execution flow (stored in the `name` column):

Event	Description	When Fired
`SEARCH_TRIGGERED`	User initiates search	User clicks search button OR presses Enter key
`SEARCH_STARTED`	Request sent to backend	Search request submitted to search service
`SEARCH_COMPLETED`	Results returned	Search results returned to user
`SEARCH_RESULT_COUNT`	Results displayed	Search completed and result count returned to user
`SEARCH_FAILED`	Search error	Any error occurred during search

Click Events

Events fired when users interact with search results:

Event	Description	When Fired
`SEARCH_TAB_CLICK`	Tab clicked	Any tab (All, News, GOTO) is clicked
`SEARCH_RESULT_CLICK`	Result clicked	Any item from search results is clicked
`SEARCH_ALL_TAB_PAGE_CLICK`	All tab pagination	User on ALL tab clicks page in pagination
`SEARCH_NEWS_TAB_PAGE_CLICK`	News tab pagination	User on NEWS tab clicks page in pagination
`SEARCH_GOTO_TAB_PAGE_CLICK`	GoTo tab pagination	User on GOTO tab clicks page in pagination
`SEARCH_PEOPLE_*`	People result clicked	User clicks a People tab result
`SEARCH_TRENDING_CLICKED`	Trending item clicked	User clicks a trending search item
`SEARCH_FILTER_CLICK`	Filter clicked	Date OR Relevance filter clicked on results page

Full Event Sequence

```
[Initialization – happens once per session]
    |
    v
```

```
SEARCH_USER_LOGGED_IN_SUCCESS
    |
    v
SEARCH_USER_DETAILS_FETCHED (or SEARCH_USER_DETAILS_FETCHED_FROM_CACHE)
    |
    v
SEARCH_USER_PHOTO_FETCHED
    |
    v
SEARCH_DATA_FETCH_STARTED
    |
    v
SEARCH_DATA_FETCH_COMPLETED
    |
    v
[User ready to search]
    |
    v
SEARCH_TRIGGERED  <-- User presses Enter or clicks search (10:30:15.123)
    |
    v
SEARCH_STARTED    <-- Request sent to backend (10:30:15.150)
    |
    v
SEARCH_COMPLETED  <-- Results returned (10:30:15.400)
    |
    v
SEARCH_RESULT_COUNT  <-- Results displayed to user (10:30:15.567)
    |
    v
[User interacts with results - independent events]
    |
    +-- SEARCH_TAB_CLICK / SEARCH_RESULT_CLICK
    +-- SEARCH_ALL_TAB_PAGE_CLICK / SEARCH_NEWS_TAB_PAGE_CLICK / SEARCH_GOTO_TAB_PAGE_CLICK
    +-- SEARCH_TRENDING_CLICKED
    +-- SEARCH_FILTER_CLICK
```

Typical Search Sequence (Simplified)

```
User types "project budget" and presses Enter
    |
    v
[SEARCH_TRIGGERED]    <-- timestamp: 10:30:15.123
    |
    v
[SEARCH_STARTED]      <-- timestamp: 10:30:15.150  (27ms later)
    |
    v
[SEARCH_COMPLETED]    <-- timestamp: 10:30:15.400  (250ms later)
    |
    v
[SEARCH_RESULT_COUNT] <-- timestamp: 10:30:15.567  (167ms later, 444ms total)
    |
    v
User sees results, clicks one
    |
    v
[SEARCH_TAB_CLICK]    <-- timestamp: 10:30:18.890  (3.3s after results shown)
```

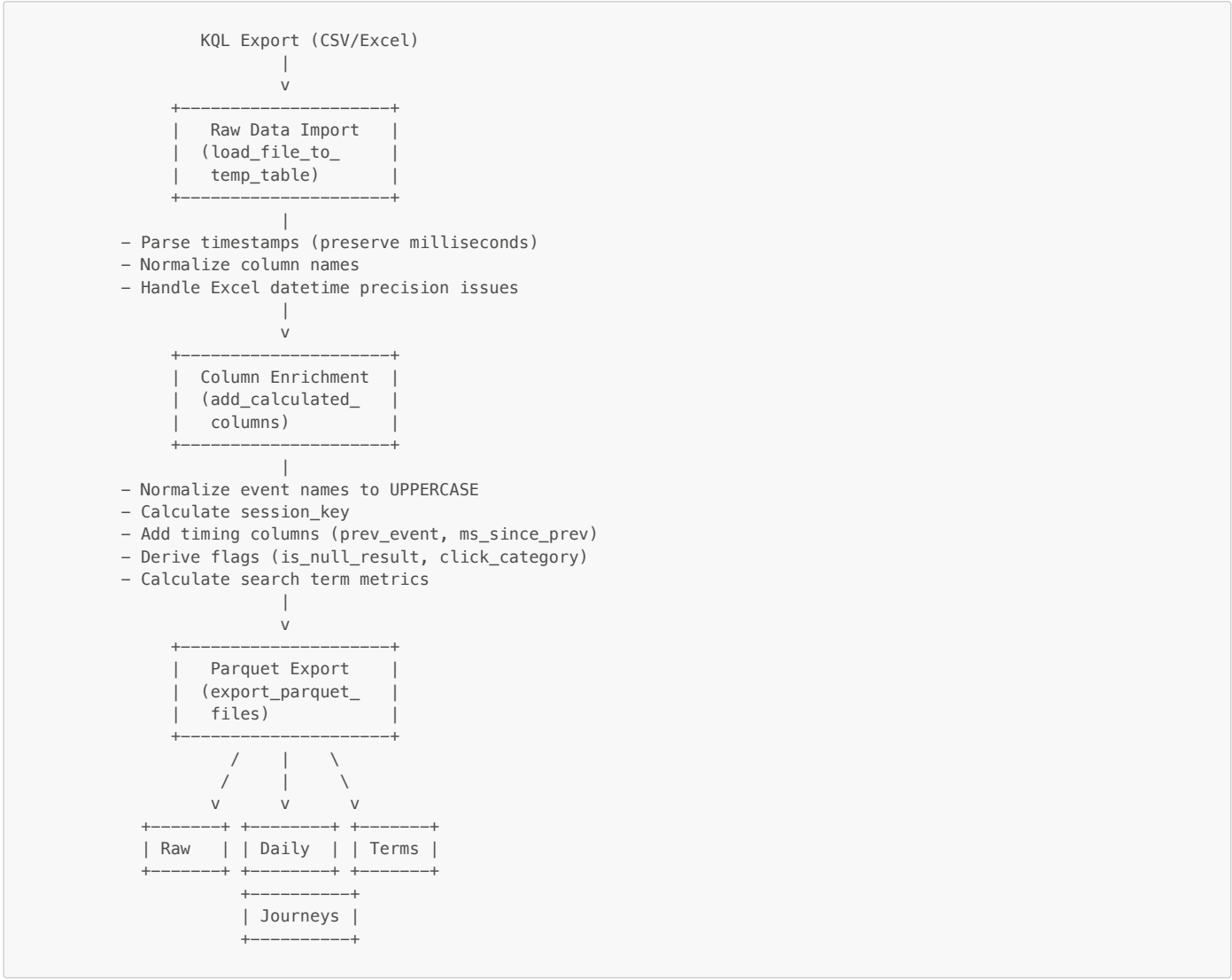
Example: Complete Session

```
Session: 2025-01-15_user123_session456

Event 1:  SEARCH_TRIGGERED      @ 10:30:15.123   (search term: "budget report")
Event 2:  SEARCH_STARTED        @ 10:30:15.150   (request to backend)
Event 3:  SEARCH_COMPLETED      @ 10:30:15.400   (results returned)
Event 4:  SEARCH_RESULT_COUNT   @ 10:30:15.567   (15 results displayed)
Event 5:  SEARCH_TAB_CLICK      @ 10:30:18.890   (user clicked a result)
Event 6:  SEARCH_TRIGGERED      @ 10:30:45.000   (user searches again: "2024 budget")
Event 7:  SEARCH_STARTED        @ 10:30:45.030
Event 8:  SEARCH_COMPLETED      @ 10:30:45.280
Event 9:  SEARCH_RESULT_COUNT   @ 10:30:45.400   (8 results displayed)
Event 10: SEARCH_TAB_CLICK      @ 10:30:52.500   (user clicked another result)
```

2. Processing Pipeline Overview

Data Flow



Key Transformations

1. Event Name Normalization

Raw event names come in mixed case from App Insights. We normalize to uppercase for consistent matching.

```
Input:  "Search_completed"
Output: "SEARCH_COMPLETED"
```

2. Session Key Generation

A unique session is identified by combining date + user + session ID:

```
session_key = session_date || '_' || user_id || '_' || session_id
-- Example: "2025-01-15_user123_abc789"
```

3. CET Timezone Conversion

All time-derived columns use Central European Time (CET/CEST) instead of UTC:

```
-- DuckDB:
timestamp_cet = timezone('Europe/Berlin', timestamp)

-- PostgreSQL:
timestamp_cet = timestamp AT TIME ZONE 'UTC' AT TIME ZONE 'Europe/Berlin'
```

This automatically handles:

- **CET (UTC+1)**: Standard time (late October to late March)
- **CEST (UTC+2)**: Daylight saving time (late March to late October)

Columns derived from CET timestamp:

- `session_date`: Extracted from CET timestamp (affects session boundaries)
- `session_key`: Uses CET-based session_date
- `event_hour`: Hour (0-23) in CET
- `event_weekday`: Day name in CET
- `event_weekday_num`: ISO day of week in CET
- `searches_morning/afternoon/evening/night`: Based on CET hour

Example (Winter - CET):

```
UTC timestamp:  2025-01-15 23:30:00.000  (late evening UTC)
CET timestamp:  2025-01-16 00:30:00.000  (early morning CET - next day!)
session_date:   2025-01-16               (CET date)
event_hour:     0                        (midnight hour in CET)
```

Example (Summer - CEST):

```
UTC timestamp:  2025-07-15 22:30:00.000  (late evening UTC)
CEST timestamp: 2025-07-16 00:30:00.000  (early morning CEST - next day!)
session_date:   2025-07-16               (CEST date)
event_hour:     0                        (midnight hour in CEST)
```

4. Search Term Normalization

Search terms are cleaned for consistent aggregation:

```
search_term_normalized = LOWER(TRIM(COALESCE(CP_searchQuery, searchQuery, query)))
-- Input:  "  Budget Report  "
-- Output: "budget report"
```

---

3. Timing Calculations

ms_search_to_result (User-Perceived Latency)

What it measures: The time from when a user initiates a search until they see results.

Event span: `SEARCH_TRIGGERED` --> `SEARCH_RESULT_COUNT`

How it's calculated:

```
-- Step 1: Track the most recent SEARCH_TRIGGERED timestamp
last_search_started_ts = LAST_VALUE(
    CASE WHEN name = 'SEARCH_TRIGGERED' THEN timestamp END
    IGNORE NULLS
) OVER (PARTITION BY session_key ORDER BY timestamp)

-- Step 2: Calculate time difference when SEARCH_RESULT_COUNT occurs
ms_search_to_result = DATEDIFF('millisecond', last_search_started_ts, timestamp)
-- Only when name = 'SEARCH_RESULT_COUNT'
```

Example:

```
Event: SEARCH_TRIGGERED      @ 10:30:15.123
Event: SEARCH_COMPLETED    @ 10:30:15.234
Event: SEARCH_RESULT_COUNT @ 10:30:15.567

ms_search_to_result = 10:30:15.567 - 10:30:15.123 = 444ms
```

ms_result_to_click (Decision Time)

What it measures: How long the user takes to click a result after seeing search results.

Event span: `SEARCH_RESULT_COUNT` --> `Click Event`

How it's calculated:

```
ms_result_to_click = ms_since_prev_event
-- Only when click_category IS NOT NULL AND prev_event = 'SEARCH_RESULT_COUNT'
```

Example:

```
Event: SEARCH_RESULT_COUNT @ 10:30:15.567
Event: SEARCH_TAB_CLICK    @ 10:30:18.890

ms_result_to_click = 10:30:18.890 - 10:30:15.567 = 3,323ms (3.3 seconds)
```

ms_since_prev_event (Inter-Event Timing)

What it measures: Time between any two consecutive events in a session.

```
ms_since_prev_event = DATEDIFF('millisecond',
    LAG(timestamp) OVER (PARTITION BY session_key ORDER BY timestamp),
    timestamp
)
```

Example:

```
Event 1: SEARCH_TRIGGERED      @ 10:30:15.123  --> ms_since_prev = NULL (first event)
Event 2: SEARCH_COMPLETED    @ 10:30:15.234  --> ms_since_prev = 111ms
Event 3: SEARCH_RESULT_COUNT @ 10:30:15.567  --> ms_since_prev = 333ms
Event 4: SEARCH_TAB_CLICK    @ 10:30:18.890  --> ms_since_prev = 3,323ms
```

Time Buckets

Timing values are bucketed for easier visualization:

Metric	Bucket	Range
search_to_result	`< 0.5s`	0-499ms
	`0.5–1s`	500-999ms
	`1–2s`	1000-1999ms
	`2–5s`	2000-4999ms
	`> 5s`	5000ms+
	`No Result`	NULL (no SEARCH_RESULT_COUNT event)
result_to_click	`< 2s (quick)`	0-1999ms
	`2–5s`	2000-4999ms
	`5–10s`	5000-9999ms
	`10–30s`	10000-29999ms
	`30–60s`	30000-59999ms
	`> 60s (browsing)`	60000ms+
	`No Click`	NULL (user didn't click)

---

4. Business Rules & Classifications

is_null_result

Definition: The search returned zero results.

```
is_null_result = CASE
    WHEN name = 'SEARCH_RESULT_COUNT' AND CP_totalResultCount = 0 THEN true
    WHEN name = 'SEARCH_RESULT_COUNT' AND CP_totalResultCount > 0 THEN false
    ELSE NULL  -- Only meaningful for SEARCH_RESULT_COUNT events
END
```

Example:

```
Event: SEARCH_RESULT_COUNT with CP_totalResultCount = 0
--> is_null_result = true (user saw "No results found")

Event: SEARCH_RESULT_COUNT with CP_totalResultCount = 15
--> is_null_result = false (user saw 15 results)
```

click_category

Definition: Categorizes click events by type of interaction.

```
click_category = CASE
    WHEN name = 'SEARCH_RESULT_CLICK' THEN 'Result'
    WHEN name = 'SEARCH_TRENDING_CLICKED' THEN 'Trending'
    WHEN name = 'SEARCH_TAB_CLICK' THEN 'Tab'
    WHEN name = 'SEARCH_ALL_TAB_PAGE_CLICK' THEN 'Pagination_All'
    WHEN name = 'SEARCH_NEWS_TAB_PAGE_CLICK' THEN 'Pagination_News'
    WHEN name = 'SEARCH_GOTO_TAB_PAGE_CLICK' THEN 'Pagination_GoTo'
    WHEN name = 'SEARCH_FILTER_CLICK' THEN 'Filter'
    ELSE NULL  -- Not a click event
END
```

is_success_click

Definition: True only for clicks that indicate the user found content.

```
is_success_click = CASE
    WHEN name = 'SEARCH_RESULT_CLICK' THEN true
    ELSE false
END
```

Note: `SEARCH_TRENDING_CLICKED` is NOT a success click - it's a search initiation via suggestion (the user hasn't found content yet, they've just started a search journey).

journey_outcome (Session-Level)

Definition: Classifies how a search session ended based on user engagement level.

```
journey_outcome = CASE
    WHEN success_click_count > 0 THEN 'Success'
    WHEN click_count > 0 AND success_click_count = 0 THEN 'Engaged'
    WHEN result_count > 0 AND null_result_count = result_count THEN 'No Results'
    WHEN result_count > 0 AND click_count = 0 THEN 'Abandoned'
    ELSE 'Unknown'
END
```

Categories explained:

- **Success**: User clicked on an actual search result (found content)
- **Engaged**: User interacted with tabs, pagination, or filters but didn't click a result (browsed but didn't find)
- **No Results**: All search attempts returned 0 results
- **Abandoned**: Had results displayed but no interaction at all
- **Unknown**: Incomplete session data

Note: Uses `success_click_count` (SEARCH_RESULT_CLICK only) for Success, and `click_count` (all clicks) for Engaged.

Example scenarios:

Scenario	success_click_count	click_count	result_count	null_result_count	Outcome
User searched, clicked a result	1	1	1	0	**Success**
User clicked tabs/pagination only	0	2	1	0	**Engaged**
User searched, got 0 results	0	0	1	1	**No Results**
User searched, saw results but didn't click	0	0	1	0	**Abandoned**
Incomplete session data	0	0	0	0	**Unknown**

session_complexity

Definition: Categorizes sessions by number of **user actions** (searches + clicks).

This counts only user-initiated events:

- **Searches**: `SEARCH_TRIGGERED` events (user pressed Enter or clicked search)
- **Clicks**: All click events (`SEARCH_RESULT_CLICK`, `SEARCH_TAB_CLICK`, `SEARCH_TRENDING_CLICKED`, pagination clicks, `SEARCH_FILTER_CLICK`)

It excludes backend telemetry events like `SEARCH_STARTED`, `SEARCH_COMPLETED`, `SEARCH_RESULT_COUNT` which inflate counts without representing user engagement.

```
user_actions = search_count_in_session + click_count

session_complexity = CASE
    WHEN user_actions = 1 THEN 'Single Action'
    WHEN user_actions <= 3 THEN 'Simple'
    WHEN user_actions <= 10 THEN 'Medium'
    ELSE 'Complex'
END
```

Complexity	User Actions	Typical Scenario
Single Action	1	Quick search, no click
Simple	2-3	Search + click, or 2 searches
Medium	4-10	Multiple searches and/or clicks
Complex	>10	Extended research session

had_reformulation

Definition: Did the user refine/change their search query within the session?

```
had_reformulation = CASE
    WHEN unique_search_terms > 1 THEN true
    ELSE false
END
```

Example:

```
Session with searches: "budget", "2024 budget", "budget report Q4"
--> unique_search_terms = 3
--> had_reformulation = true (user refined their search)
```

recovered_from_null

Definition: Did the user eventually find content (click on a result) despite getting zero results initially?

```
recovered_from_null = CASE
    WHEN null_result_count > 0 AND success_click_count > 0 THEN true
    ELSE false
END
```

Note: Uses `success_click_count` (SEARCH_RESULT_CLICK only), not `click_count`. Navigating tabs/pagination after a null result is not considered "recovery" - only clicking actual content counts.

Example:

```
Session: Search "bugdet" (typo) --> 0 results
         Search "budget" --> 15 results --> Click on result
--> null_result_count = 1, success_click_count = 1
--> recovered_from_null = true
```

AppInsights Identifiers: user_id and session_id

The `user_id` and `session_id` values come from Azure Application Insights telemetry. Understanding their behavior is important for interpreting user cohort and session metrics.

user_id (Cookie-based)

- AppInsights uses a browser cookie to generate and persist the `user_id`
- The same user will have the same `user_id` across sessions as long as the cookie exists
- A **new** `user_id` will be generated if:
  - The user clears their cookies
  - The user switches to a different browser
  - The user uses incognito/private browsing mode
  - The cookie expires

Implication for "Returning Users": The `returning_users` metric may undercount actual returning users if they clear cookies or switch browsers. It may also overcount if multiple people share the same browser.

session_id (Activity-based)

- A `session_id` persists for the duration of a user's active session
- A session is defined as a **period of activity separated by less than 30 minutes of inactivity**
- After **30 minutes of inactivity**, a new `session_id` is generated for the next activity
- Closing the browser typically ends the session (new session on return)

Implication for Session Metrics: Users who take long breaks (>30 min) during research will appear as multiple sessions. Quick tab-switching between searches will remain in the same session.

User Cohort: is_users_first_session

Definition: Is this the first time we've seen this user search?

```
user_session_number = ROW_NUMBER() OVER (
    PARTITION BY user_id
    ORDER BY session_start
)
is_users_first_session = CASE WHEN user_session_number = 1 THEN true ELSE false END
```

New vs Returning Users (Daily)

Definition: Count of users who are new vs returning on each day.

```
-- First, find when each user first appeared
first_seen_date = MIN(session_date) GROUP BY user_id

-- Then classify on each day
new_users = COUNT(DISTINCT CASE WHEN session_date = first_seen_date THEN user_id END)
returning_users = COUNT(DISTINCT CASE WHEN session_date > first_seen_date THEN user_id END)
```

---

5. Output Files & Column Definitions

searches_raw.parquet

Granularity: One row per event (click, search, result)

Use case: Detailed event-level analysis, debugging

Column	Type	Description	Example
`timestamp`	Timestamp	Event timestamp in UTC (microsecond precision)	2025-01-15 10:30:15.567123
`timestamp_cet`	Timestamp	Event timestamp in CET/CEST (microsecond precision)	2025-01-15 11:30:15.567123
`timestamp_cet_str`	String	CET timestamp as string for Power BI	2025-01-15 11:30:15.567
`name`	String	Event type (normalized to uppercase)	SEARCH_RESULT_COUNT
`user_id`	String	Anonymous user identifier	user_abc123
`session_id`	String	Session identifier	sess_xyz789
`session_key`	String	Composite key: date_user_session (CET date)	2025-01-15_user_abc123_sess_xyz789
`session_date`	Date	Date of the event (CET-based)	2025-01-15
`event_order`	Integer	Sequence number within session	3
`prev_event`	String	Previous event type in session	SEARCH_COMPLETED
`ms_since_prev_event`	Integer	Milliseconds since previous event	333

Column	Type	Description	Example
search_term_normalized	String	Cleaned search query	budget report
is_null_result	Boolean	True if zero results returned	false
click_category	String	Click type (General/All/News/GoTo/People)	General
last_search_started_ts	Timestamp	Most recent SEARCH_TRIGGERED timestamp	2025-01-15 10:30:15.123

searches_journeys.parquet

Granularity: One row per search session

Use case: Session-level behavior analysis, funnel metrics

Column	Type	Description	Calculation
session_date	Date	Date of session	
session_start	Timestamp	First event timestamp	MIN(timestamp)
session_start_str	String	Session start as string	STRFTIME for Power BI compatibility
total_events	Integer	Events in session	COUNT(*)
search_count_in_session	Integer	SEARCH_TRIGGERED events	COUNT(SEARCH_TRIGGERED)
result_count	Integer	SEARCH_RESULT_COUNT events	COUNT(SEARCH_RESULT_COUNT)
click_count	Integer	Click events	COUNT(click_category IS NOT NULL)
unique_search_terms	Integer	Distinct queries	COUNT(DISTINCT search_term)
null_result_count	Integer	Zero-result events	SUM(is_null_result)
max_total_results	Integer	Max results shown	MAX(CP_totalResultCount)
sec_search_to_result	Float	Seconds: search to results	MIN(ms_search_to_result) / 1000
sec_result_to_click	Float	Seconds: results to click	MIN(ms_result_to_click) / 1000
total_duration_sec	Float	Session length in seconds	(MAX - MIN timestamp) / 1000
first_event_hour	Integer	Hour of first event (0-23 CET)	MIN(event_hour)
last_event_hour	Integer	Hour of last event (0-23 CET)	MAX(event_hour)
result_clicks	Integer	SEARCH_RESULT_CLICK events	COUNT(click_category='Result')
trending_clicks	Integer	SEARCH_TRENDING_CLICKED events	COUNT(click_category='Trending')
tab_clicks	Integer	SEARCH_TAB_CLICK events	COUNT(click_category='Tab')
pagination_clicks	Integer	All pagination clicks	COUNT(click_category LIKE 'Pagination%')
pagination_all_clicks	Integer	All tab pagination	COUNT(click_category='Pagination_All')
pagination_news_clicks	Integer	News tab pagination	COUNT(click_category='Pagination_News')
pagination_goto_clicks	Integer	GoTo tab pagination	COUNT(click_category='Pagination_GoTo')
filter_clicks	Integer	SEARCH_FILTER_CLICK events	COUNT(click_category='Filter')
success_click_count	Integer	Success clicks (SEARCH_RESULT_CLICK only)	COUNT(is_success_click=true)
includes_first_search_of_day	Boolean	Session has day's first search	MAX(is_first_search_of_day)
search_to_result_bucket	String	Latency category	See Time Buckets
result_to_click_bucket	String	Decision time category	See Time Buckets
session_duration_bucket	String	Session length category	< 5s, 5-30s, 30-60s, 1-3 min, etc.
journey_outcome	String	Session result	Success/Engaged/Abandoned/No Results
had_reformulation	Boolean	User changed query	unique_search_terms > 1
session_complexity	String	Session size category	Based on user actions (searches + clicks)
search_to_result_sort	Integer	Sort order for latency bucket	1-6 for Power BI sorting
result_to_click_sort	Integer	Sort order for click time bucket	1-7 for Power BI sorting
session_duration_sort	Integer	Sort order for duration bucket	1-6 for Power BI sorting
journey_outcome_sort	Integer	Sort order for outcome	1=Success, 2=Engaged, 3=Abandoned, 4=No Results
session_complexity_sort	Integer	Sort order for complexity	1-4 for Power BI sorting

Column	Type	Description	Calculation
had_null_result	Boolean	Had zero-result search	null_result_count > 0
recovered_from_null	Boolean	Success despite null result	null_result > 0 AND success_click > 0
user_session_number	Integer	User's session sequence	ROW_NUMBER per user
is_users_first_session	Boolean	First time user	user_session_number = 1
distinct_click_categories	Integer	Tab types clicked	COUNT(DISTINCT click_category)
had_tab_switch	Boolean	Clicked multiple tabs	distinct_click_categories > 1

searches_daily.parquet

Granularity: One row per day

Use case: Daily KPIs, trend analysis

Column	Type	Description	Calculation
date	Date	The day	
total_events	Integer	All events	COUNT(*)
unique_sessions	Integer	Distinct sessions	COUNT(DISTINCT session_key)
unique_users	Integer	Distinct users	COUNT(DISTINCT user_id)
unique_search_terms	Integer	Distinct search queries	COUNT(DISTINCT search_term_normalized)
search_starts	Integer	SEARCH_TRIGGERED events	COUNT(SEARCH_TRIGGERED)
result_events	Integer	SEARCH_RESULT_COUNT events	COUNT(SEARCH_RESULT_COUNT)
click_events	Integer	Click events	COUNT(click_category)
null_results	Integer	Zero-result events	SUM(is_null_result)
result_events_with_results	Integer	Results with >0 hits	SUM(is_clickable_result)
sessions_with_results	Integer	Sessions that got results	From session_stats CTE
sessions_with_clicks	Integer	Sessions with clicks	From session_stats CTE
sessions_abandoned	Integer	Results but no click	sessions_with_results - sessions_with_clicks
sum_search_term_length	Integer	Sum of query lengths	SUM(search_term_length) - for weighted avg in DAX
sum_search_term_words	Integer	Sum of word counts	SUM(search_term_word_count) - for weighted avg in DAX
search_term_count	Integer	Count of queries	COUNT(search_term_length IS NOT NULL)
first_searches_of_day	Integer	First searches of day	COUNT(is_first_search_of_day)
success_clicks	Integer	Success clicks (SEARCH_RESULT_CLICK only)	COUNT(is_success_click=true)
clicks_result	Integer	SEARCH_RESULT_CLICK events	COUNT(click_category='Result')
clicks_trending	Integer	SEARCH_TRENDING_CLICKED events	COUNT(click_category='Trending')
clicks_tab	Integer	SEARCH_TAB_CLICK events	COUNT(click_category='Tab')
clicks_pagination	Integer	All pagination clicks	COUNT(click_category LIKE 'Pagination%')
clicks_pagination_all	Integer	All tab pagination	COUNT(click_category='Pagination_All')
clicks_pagination_news	Integer	News tab pagination	COUNT(click_category='Pagination_News')
clicks_pagination_goto	Integer	GoTo tab pagination	COUNT(click_category='Pagination_GoTo')
clicks_filter	Integer	SEARCH_FILTER_CLICK events	COUNT(click_category='Filter')
day_of_week	String	Day name	DAYNAME(session_date)
day_of_week_num	Integer	ISO day number (1=Mon)	ISODOW(session_date)
searches_night	Integer	Searches 03:00-09:00 CET (APAC)	Hour-based filter (CET)
searches_morning	Integer	Searches 09:00-16:00 CET (CET)	Hour-based filter (CET)
searches_afternoon	Integer	Searches 16:00-22:00 CET (Americas)	Hour-based filter (CET)
searches_evening	Integer	Searches 22:00-03:00 CET (Dead time)	Hour-based filter (CET)
new_users	Integer	First-time users today	Users where first_seen = today
returning_users	Integer	Repeat users today	Users where first_seen < today

searches_terms.parquet

Granularity: One row per search term per day

Use case: Search term performance analysis, content gap identification

Column	Type	Description	Calculation
session_date	Date	The day	
search_term	String	Normalized search query	LOWER(TRIM(query))
word_count	Integer	Words in query	COUNT of spaces + 1
search_count	Integer	Times searched today	COUNT(SEARCH_TRIGGERED)
unique_users	Integer	Users who searched this	COUNT(DISTINCT user_id)
unique_sessions	Integer	Sessions with this term	COUNT(DISTINCT session_key)
result_events	Integer	Result events for term	COUNT(SEARCH_RESULT_COUNT)
null_result_count	Integer	Zero-result count	SUM(is_null_result)
sum_result_count	Integer	Sum of result counts	SUM(cp_total_result_count) - for weighted avg in DAX
click_count	Integer	All clicks from this term	COUNT(click_category)
success_click_count	Integer	Success clicks (SEARCH_RESULT_CLICK only)	COUNT(is_success_click=true)
clicks_result	Integer	SEARCH_RESULT_CLICK events	COUNT(click_category='Result')
clicks_trending	Integer	SEARCH_TRENDING_CLICKED events	COUNT(click_category='Trending')
clicks_tab	Integer	SEARCH_TAB_CLICK events	COUNT(click_category='Tab')
clicks_pagination	Integer	All pagination clicks	COUNT(click_category LIKE 'Pagination%')
clicks_pagination_all	Integer	All tab pagination	COUNT(click_category='Pagination_All')
clicks_pagination_news	Integer	News tab pagination	COUNT(click_category='Pagination_News')
clicks_pagination_goto	Integer	GoTo tab pagination	COUNT(click_category='Pagination_GoTo')
clicks_filter	Integer	SEARCH_FILTER_CLICK events	COUNT(click_category='Filter')
clicks_with_timing	Integer	Clicks with timing data	COUNT(click after SEARCH_RESULT_COUNT)
sum_sec_to_click	Float	Sum of click times	SUM(ms_result_to_click) / 1000 - for weighted avg in DAX
searches_night	Integer	Searches 03:00-09:00 CET (APAC)	Hour-based filter (CET)
searches_morning	Integer	Searches 09:00-16:00 CET (CET)	Hour-based filter (CET)
searches_afternoon	Integer	Searches 16:00-22:00 CET (Americas)	Hour-based filter (CET)
searches_evening	Integer	Searches 22:00-03:00 CET (Dead time)	Hour-based filter (CET)
first_seen_date	Date	First day term appeared	MIN(session_date) over all time
is_new_term	Boolean	First appearance today	session_date = first_seen_date
month_num	Integer	Month number (1-12)	For seasonality analysis

6. Power BI Calculated Columns

These columns are created in Power BI using DAX and are not present in the parquet files.

searches_terms Table

Query_Length_Bucket

Categorizes search queries by word count for visualization.

```
Query_Length_Bucket =
SWITCH(
    TRUE(),
    searches_terms[word_count] = 1, "1 word",
    searches_terms[word_count] = 2, "2 words",
    searches_terms[word_count] = 3, "3 words",
    searches_terms[word_count] = 4, "4 words",
    searches_terms[word_count] >= 5, "5+ words",
    "Unknown"
)
```

Query_Length_Sort

Sort order for Query_Length_Bucket. Set "Sort by column" in Power BI.

```
Query_Length_Sort =
SWITCH(
    TRUE(),
    searches_terms[word_count] = 1, 1,
    searches_terms[word_count] = 2, 2,
    searches_terms[word_count] = 3, 3,
    searches_terms[word_count] = 4, 4,
    searches_terms[word_count] >= 5, 5,
    99
)
```

Term_Outcome

Classifies search term performance into actionable categories based on **success clicks** (content discovery).

```
Term_Outcome =
VAR nullRate = DIVIDE([null_result_count], [result_events], 0)
VAR ctr = DIVIDE([success_click_count], [search_count], 0)
RETURN
SWITCH(
    TRUE(),
    nullRate = 1, "Zero Results",
    nullRate > 0.5, "Mostly No Results",
    ctr = 0, "No Clicks",
    ctr < 0.2, "Low CTR",
    "Success"
)
```

Note: Uses `success_click_count` (SEARCH_RESULT_CLICK only), not `click_count` (all clicks).

Category	Meaning	Action
Zero Results	100% null rate	Content gap - add content
Mostly No Results	>50% null rate	Partial gap - improve coverage
No Clicks	Has results but 0 clicks	Poor relevance - tune ranking
Low CTR	<20% click rate	Suboptimal - review content
Success	Good performance	Monitor

searches_journeys Table

Journey_Type

Combines outcome and behavior flags for segmentation.

```
Journey_Type =
searches_journeys[journey_outcome] &
IF(searches_journeys[had_reformulation], " (Refined)", "") &
IF(searches_journeys[recovered_from_null], " (Recovered)", "")
```

---

7. Power BI Measures

These measures are created in Power BI for aggregated calculations.

Search Effectiveness Score

Combined metric considering both success CTR and null rate. Higher is better.

```
Search Effectiveness Score =
VAR ctr = DIVIDE(SUM(searches_terms[success_click_count]), SUM(searches_terms[search_count]), 0)
VAR nullRate = DIVIDE(SUM(searches_terms[null_result_count]), SUM(searches_terms[result_events]), 0)
RETURN
(ctr * 100) - (nullRate * 50)
```

Note: Uses `success_click_count` (SEARCH_RESULT_CLICK only) for accurate content discovery measurement.

Score interpretation:

- Positive scores: Good performance (CTR outweighs null rate penalty)
- Near zero: Balanced but could improve
- Negative scores: High null rates hurting performance

Term Success CTR %

Success click-through rate for search terms (actual content clicks only).

```
Term Success CTR % =
DIVIDE(
    SUM(searches_terms[success_click_count]),
    SUM(searches_terms[search_count]),
    0
) * 100
```

Term All Clicks Rate %

All clicks rate including navigation (tabs, pagination, filters).

```
Term All Clicks Rate % =
DIVIDE(
    SUM(searches_terms[click_count]),
    SUM(searches_terms[search_count]),
    0
) * 100
```

Term Null Rate %

Percentage of searches returning zero results.

```
Term Null Rate % =
DIVIDE(
    SUM(searches_terms[null_result_count]),
    SUM(searches_terms[result_events]),
    0
) * 100
```

Weighted Avg Search Term Length

Correctly weighted average across days (use instead of AVERAGE on avg_search_term_length).

```
Weighted Avg Search Term Length =
DIVIDE(
    SUM(searches_daily[sum_search_term_length]),
    SUM(searches_daily[search_term_count]),
    0
)
```

Weighted Avg Search Term Words

Correctly weighted average across days.

```
Weighted Avg Search Term Words =
DIVIDE(
    SUM(searches_daily[sum_search_term_words]),
    SUM(searches_daily[search_term_count]),
    0
)
```

Weighted Avg Sec to Click

Correctly weighted average click time (for terms aggregation).

```
Weighted Avg Sec to Click =
DIVIDE(
    SUM(searches_terms[sum_sec_to_click]),
    SUM(searches_terms[clicks_with_timing]),
    0
)
```

Example: Full Data Flow

Raw Input (from App Insights)

```
timestamp,name,user_Id,session_Id,CP_searchQuery,CP_totalResultCount
2025-01-15 10:30:15.123456,Search_Started,user123,sess456,budget report,
2025-01-15 10:30:15.234567,Search_Completed,user123,sess456,budget report,
2025-01-15 10:30:15.567890,Search_Result_Count,user123,sess456,,15
2025-01-15 10:30:18.890123,Search_Tab_Click,user123,sess456,,
```

After Processing (searches_raw.parquet)

timestamp	name	session_key	prev_event	ms_since_prev	search_term	is_null_result	click_categ
10:30:15.123	SEARCH_TRIGGERED	2025-01-15_user123_sess456	NULL	NULL	budget report	NULL	NULL
10:30:15.234	SEARCH_COMPLETED	2025-01-15_user123_sess456	SEARCH_TRIGGERED	111	NULL	NULL	NULL
10:30:15.567	SEARCH_RESULT_COUNT	2025-01-15_user123_sess456	SEARCH_COMPLETED	333	NULL	false	NULL
10:30:18.890	SEARCH_TAB_CLICK	2025-01-15_user123_sess456	SEARCH_RESULT_COUNT	3323	NULL	NULL	General

Aggregated (searches_journeys.parquet)

session_date	total_events	search_count	click_count	sec_search_to_result	sec_result_to_click	journey_outcome
2025-01-15	4	1	1	0.44	3.32	Success

Calculation breakdown:

- `sec_search_to_result`: 10:30:15.567 - 10:30:15.123 = 444ms = 0.44s
- `sec_result_to_click`: 10:30:18.890 - 10:30:15.567 = 3323ms = 3.32s
- `journey_outcome`: click_count > 0 --> "Success"

Version History

Version	Date	Changes
1.0	2025-01-15	Initial documentation
1.1	2025-01-16	Added missing parquet columns (click breakdowns, sort columns, timing aggregates), Power BI calculated columns section, Power BI measures section
1.2	2025-01-23	Added CET timezone support: timestamp_cet columns, CET-based session_date/event_hour/event_weekday, updated time distribution documentation
1.3	2025-01-23	Expanded event documentation: added initialization events, SEARCH_STARTED distinction, click event details (SEARCH_RESULT_CLICK, SEARCH_TRENDING_CLICKED, SEARCH_FILTER_CLICK, SEARCH_FAILED)
1.4	2025-01-26	Updated click categories (Result, Trending, Tab, Pagination_*, Filter). Added is_success_click (SEARCH_RESULT_CLICK only - trending clicks are search initiation, not content discovery). Updated journey_outcome to use success_click_count. Changed time distribution to regional alignment (0-8 APAC, 8-12 EMEA, 12-18 overlap, 18-24 Americas).
1.5	2025-01-26	Added "Engaged" journey_outcome category for sessions with navigation clicks but no result clicks. Updated recovered_from_null to use success_click_count. Sort order: 1=Success, 2=Engaged, 3=Abandoned, 4=No Results.
1.6	2025-01-26	Changed session_complexity to use user actions (searches + clicks) instead of all telemetry events. Renamed "Single Event" to "Single Action".
1.7	2025-01-26	Added AppInsights Identifiers section explaining user_id (cookie-based) and session_id (30-min inactivity timeout) behavior and implications for metrics.

Version	Date	Changes
1.8	2025-01-29	Updated time distribution buckets to align with regional business hours: APAC (03-09 CET), CET (09-16 CET), Americas (16-22 CET), Dead time (22-03 CET). Column names unchanged for Power BI compatibility.
1.9	2025-01-29	Removed pre-calculated rate/average columns that cannot be aggregated: click_rate_pct, null_rate_pct, session_success_rate_pct, session_abandonment_rate_pct, avg_searches_per_session, avg_search_term_length, avg_search_term_words, avg_sec_to_click. Use DAX measures with building block columns instead.