

Creating a Virtual Member of a Community of Practice

Karen Myers, SRI

Reid Smith, i2k Connect



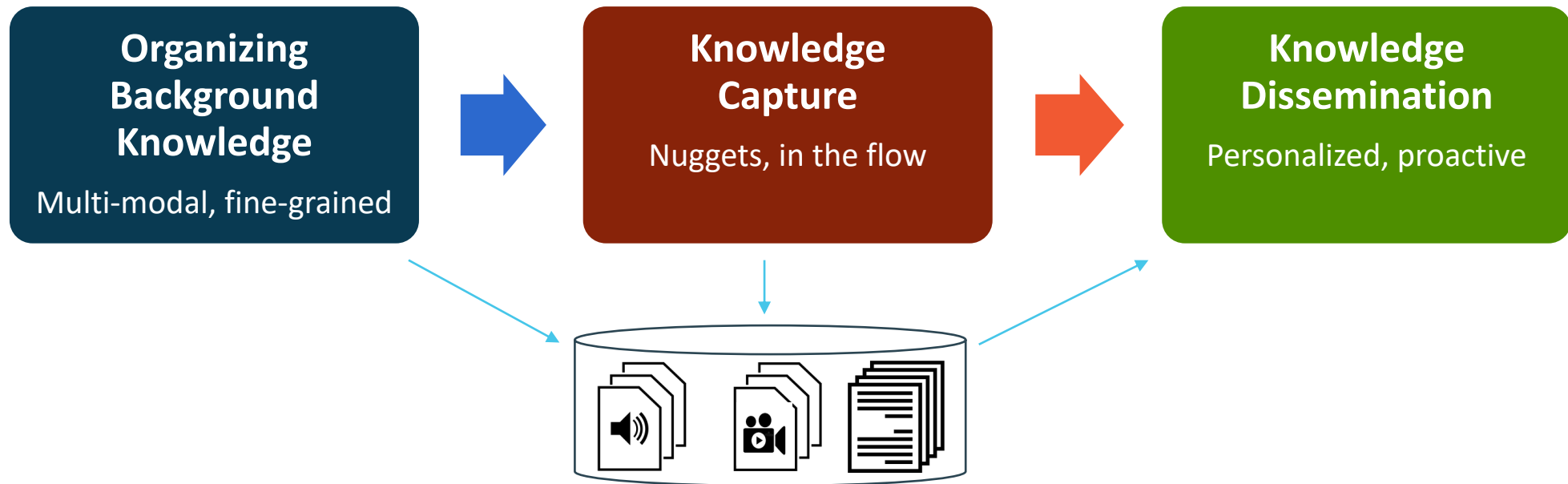
i2k Connect



Pacific Science & Engineering

DARPA KMASS: Knowledge Management at Scale and Speed

Objective: develop **technology** to enable effective use of documented knowledge, acquisition of new knowledge as part of regular workflows, and application of knowledge when and where it is required – *just in time, just enough, just for me.*





KMASS – Knowledge Management at Scale and Speed

Military replacements, rotations, and retirements occur frequently

- One third of US forces rotate in and out of theater every year
- For many deployments, rotations may be as frequent as every 1-12 months
- 30% of DoD personnel are eligible for retirement in 5 years



Face-to-face Knowledge Transfer

<https://www.darpa.mil/news-events/2021-06-21>

Well Planning: Knowledge Management Challenges

1. **Diversity of required knowledge:** technical, corporate policies, regulatory requirements, training materials, journal articles, news articles
2. **Real-world experience matters:** large gaps in knowledge between new and expert engineers / geoscientists
3. **Local context matters:** an expert with experience in one part of the world needs local input to operate safely and efficiently elsewhere
4. **High personnel turnover**
5. **Scale of the CoPs:** 100s – 1000s of members



<https://www.drillingsoftware.com/>

ATHENA Concept



ATHENA is a virtual member of your CoP

- It knows your industry, company, workflows, and tasks.
- It delivers multimodal info – text, diagrams, videos, and people to call.
- By observing your CoP at work, it can push the right information, at the right time, to the right person.

Expected Impact

- 1-2 orders of magnitude savings in time and effort
- Halving time to competency for new personnel

Technology Disruption

Large Language Models



Source: Large language models: What your data must include. Webz.io. (2023, March 22).
<https://webz.io/blog/machine-learning/large-language-models-what-your-data-must-include/>



What technologies are central to your KM program?

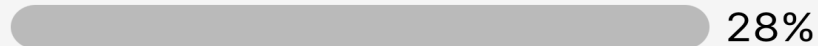
Microsoft 365



In-house



Other

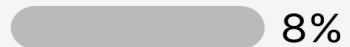


Google Docs Editors Suite

Slide Show



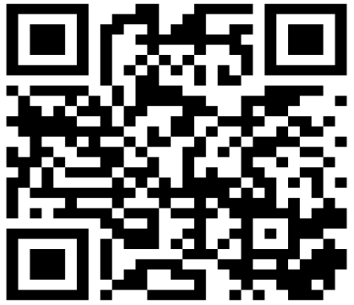
Slack



eGain



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Are you using a Large Language Model (LLM) in your KM program? If so, which ones?

GPT family (ChatGPT, GPT3.5, GPT4)



CoPilot



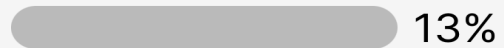
Other



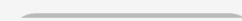
LLAMA



Claude



Mixtral



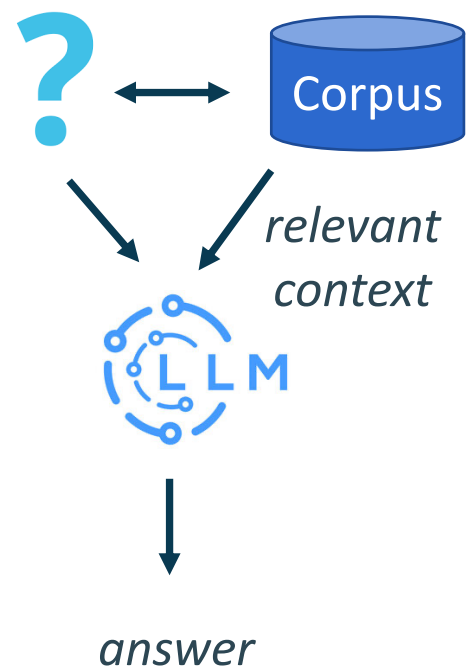
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Background Knowledge

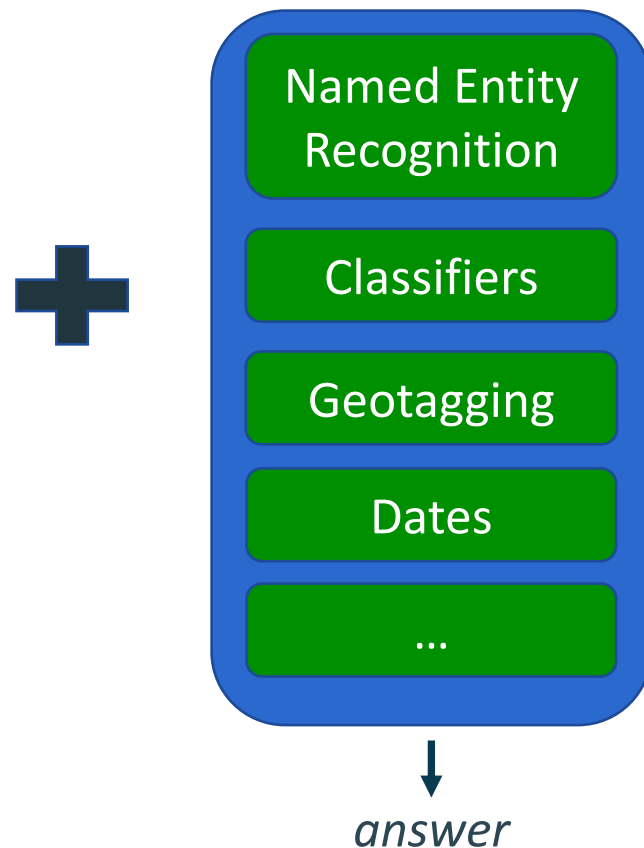
- Goal
 - Ingest and process documents to enable fine-grained retrieval and 'zero-click' answer delivery
- ATHENA Approach
 - Multimodal processing
 - Hybrid Search: LLM + RAG + Agents

Current commercial / open-source RAG approaches are insufficient for QA

Retrieval-Augmented Generation (RAG)



Search Agents



Answers Rather than Documents

What is the total depth of 15/9-F-7?

The total depth of 15/9-F-7 is 1083 m MD / 1077 m TVD

[Final Well Report for Well 15/9-F-7](#)

4 of 31	
<i>Prospect</i>	Voive
<i>Licence</i>	PL 046BS
<i>Template centre coordinates:</i>	
<i>Latitude</i>	58°26'29,807" N
<i>Longitude</i>	01°53'14,929" E
<i>UTM Co-ordinates</i>	6 478 563,523 m N 435 050,021 m E
<i>Slot centre coordinates N-2H:</i>	
<i>Latitude</i>	58° 26' 29,869" N
<i>Longitude</i>	01° 53' 14,858" E
<i>UTM Co-ordinates</i>	6 478 565,478 m N 435 048,9071 m E
<i>RKB to MSL</i>	54,9m
<i>Water depth</i>	91mMSL
<i>Spud date</i>	17 th September 2007
<i>TD reached</i>	3 rd October 2007
<i>Total Depth</i>	1083 m MD / 1077 m TVD
<i>Total Drilling Days</i>	17
<i>Final Well Status</i>	Completed for water production

Final Well Report
For



Well: 15/9-F-7



Rig: Mærsk Inspirer

Geoservices		StatoilHydro	
Date :		Date :	
Signed :		Signed :	

Revision number: Date:

LLMs on their own: Bing/Copilot

Lacks domain understanding



You

what is the total depth of $15/9 f-7$?



Copilot



Your personal and company data are protected

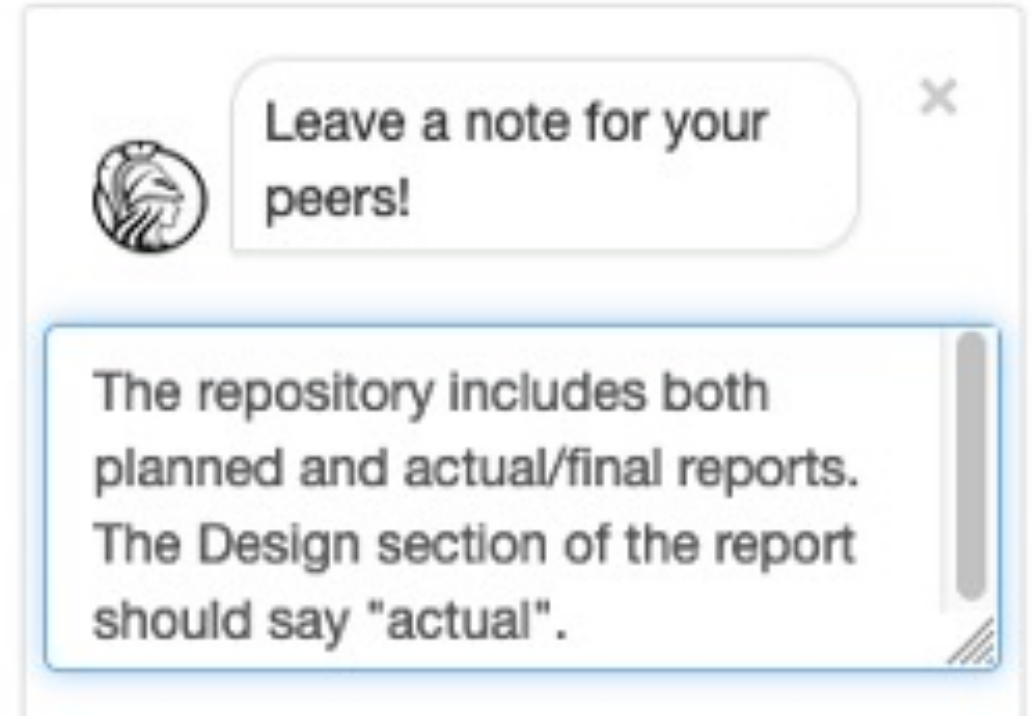
The total depth of the expression $15/9 f-7$ depends on the context in which it is used. Let's break it down:

1. $15/9$: This fraction simplifies to $5/3$.
2. f : The variable "f" represents an unknown value or function. Without further context, we cannot determine its specific value.
3. -7 : Subtract 7 from the result of the previous steps.

To calculate the total depth, we need more information about the value of "f." If you have additional context or specific values for "f," please provide them, and I'll be happy to assist further! 😊

Knowledge Capture

- Goal
 - Capture knowledge “nuggets” in-the-flow
 - i.e., local knowledge, lessons learned, tips/insights
- ATHENA Approach
 - Spoken/NL to enable capture with minimal disruption to current task
 - Implicit capture of relevant context



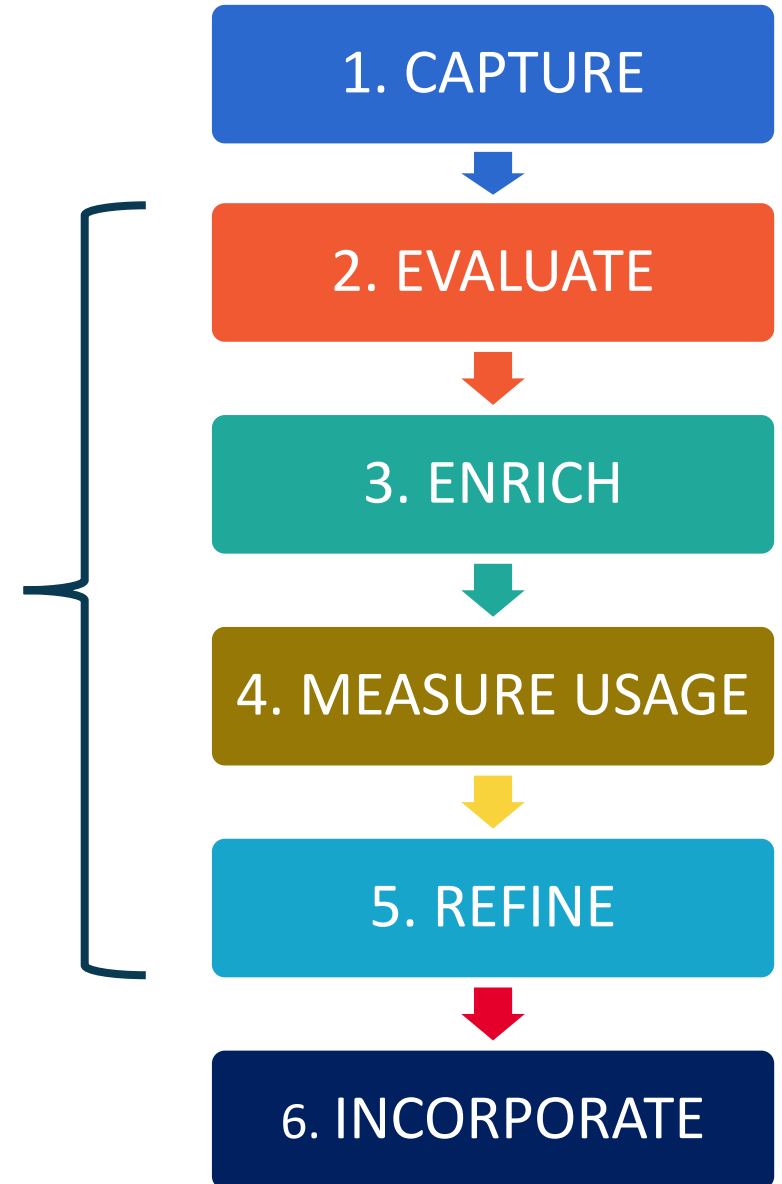
Nuggets captured “in the wild” have quality issues

LLM-assisted Nugget Improvement

Objective: improve consistency, accessibility, and comprehensiveness of captured nuggets

Approach: use Large Language Models combined with research on knowledge elicitation to improve raw nuggets

Nugget Life-cycle

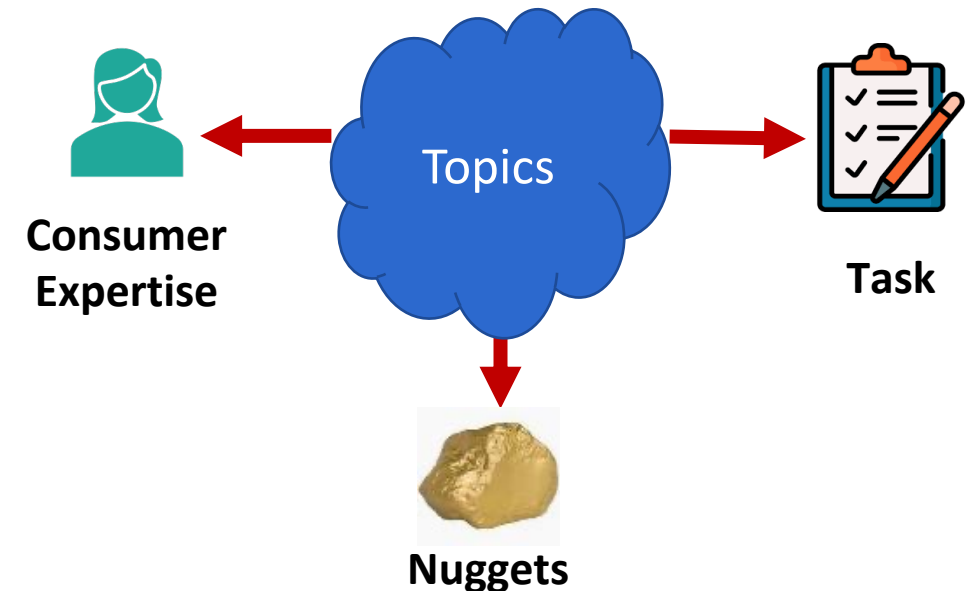


Audience Activity: Discussion (10 minutes)

1. How do you curate / verify captured knowledge?

Dissemination

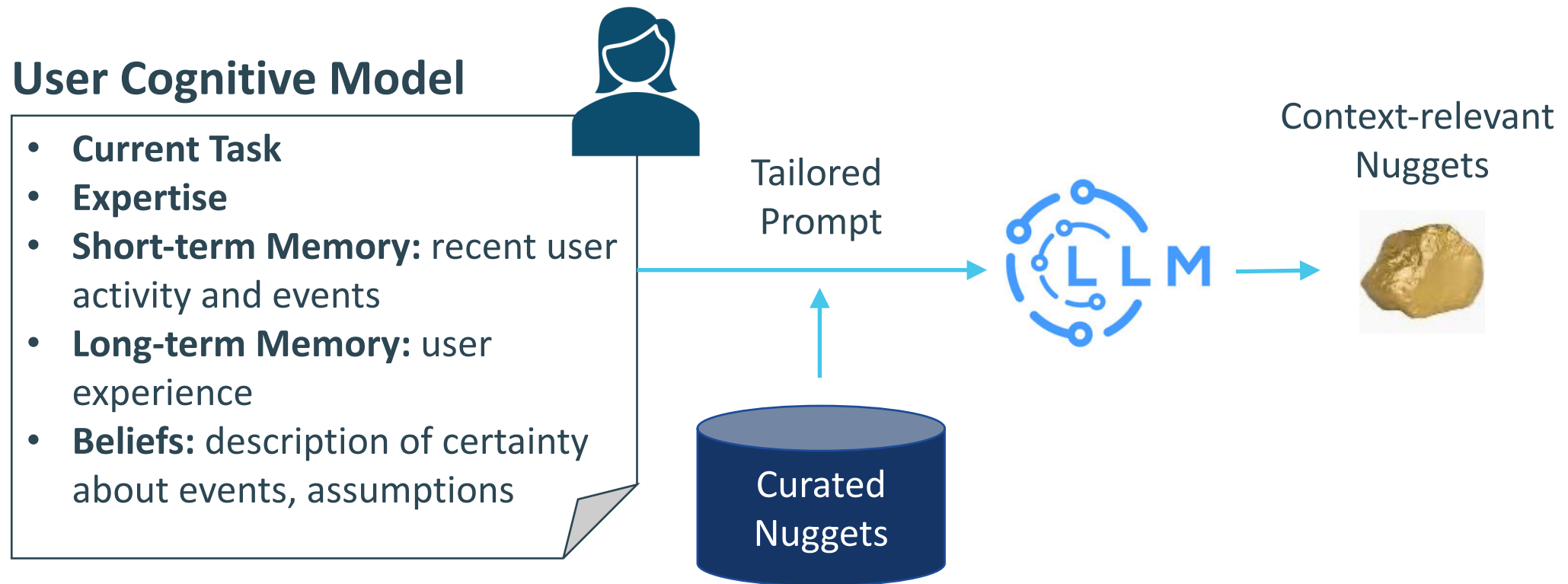
- Goal
 - Deliver appropriate knowledge when and where it is required - *just in time, just enough, just for me.*
- ATHENA Approach
 - When possible, use Push (volunteer assistance)
 - Also enable Pull (assist by responding to questions)



Topic modeling connects Consumers with Nuggets for a given task

User Modeling via LLMs

Idea: augment LLM-based retrieval with a “Cognitive Model” of a user to enable personalization and context relevance





ATHENA Insights



Hi there! I'm ATHENA, your new AI assistant. I'm here to help with your tasks today. I'll send you a message if I know anything that could help you out.

Summary information about the well can typically be found in the Final Well Report, also called the End of Well Report.



Total Depth (abbreviated as TD) can typically be found in a table with other key well properties such as drilling rig, license, and operator.



Leave a note for your peers!



What is the total depth for 15/9-F-7?



Answer

The total depth for 15/9-F-7 is 1083 m MD / 1077 m TVD

[Final Well Report for Well 15/9-F-7](#)

Source(s)

[Documents](#) [Videos](#)

Final Well Report for Well 15/9-F-7

/files/corpus/files/Volve/Well_logs/14.DIV.REPORTS/15_9-F-7/15-9-f-7_nr_002_FWR_MUD.pdf

page 1 – ...Final **Well** Report For ...7 Rig: Mærsk Inspirer Geoservices StatoilHydro Date: Date: Signed...

page 2 – ...Statoil **Well**: ...7 Contents 1. INTRODUCTION...3 2. **WELL** & RIG DATA...

page 3 – ...Statoil **Well**: ...7 1. Introduction 1.1. Purpose of the project ...7 is desig...

[Volve](#) Nov-26-2008, 20:02:58 GMT



Recommendation to Drill: Volve Field, Well NO 15/9-F-7 and NO 15/9-F-9

/files/corpus/.../15_9-F-7/14.DIV.REPORTS/15_9_F_7_F_9_Recommendation_to_Drill.doc.pdf

page 1 – ...Volve field Recommendation to drill NO **15/9**-...7 NO ...9 Volve RA 00116 Classi...

page 3 – ...Volve field Doc. no. Recommendation to drill Volve RA 00116 NO **15/9**-...7 Valid from Rev. ...

[Volve](#) Apr-12-2007, 07:30:45 GMT



Final Well Report: Drilling and Completion of Well NO 15/9-F-7

/files/corpus/.../14.DIV.REPORTS/15_9-F-7/Volve_15_9_F-7_Drilling_and_Completion_EOWR.pdf

page 1 – ...FINAL **WELL** REPORT Drilling and Completion Licence no: PL046BS ...**Well**: NO ...

page 2 – ...StatoilHydro FINAL **WELL** REPORT Drilling and Completion Licence no: PL046BS ...**Well**: NO

page 3 – ...FINAL **WELL** REPORT Doc no StatoilHydro Drilling and Completion Licence no: PL046BS ...**Well**: NO

[Volve](#) Sep-30-2022, 17:15:53 GMT



Evaluation

Findings

- Strong preference for ATHENA over baselines
- Strong preference for LLM style interactions, answers
- Achieved high accuracy on granular retrieval (paragraphs 85%, video clips 82%)
- In-the-flow nugget capture substantially decreased capture time (62%)
- Expert nugget curation and delivery led to significant improvement in solution quality and task time
- Participants unable to succeed on any task with the Baseline LLM+RAG system



- **Q1 2023**
 - ~100 SPE volunteers
 - Prescribed and volunteered questions
 - Baseline: pre-LLM Q&A technology
- **Q2 2023**
 - ~80 SPE volunteers
 - Prescribed tasks
 - Expert nuggets, captured nuggets
 - Baseline: SharePoint search
- **Q1 2024**
 - 6 SRI/i2k staff
 - Prescribed tasks
 - Expert nuggets
 - Baseline: Commercial LLM (Claude) + RAG



What metrics have you used to evaluate your KM technology?

User participation



User satisfaction



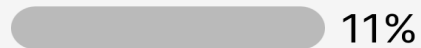
Task quality, efficiency



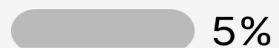
Business impact



Other



System Usability Scale



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Take-aways on KM Technology

- **Documents are no longer atomic:** knowledge can be extracted from tables, sentences, video clips, etc.
- Capture of insights can be accomplished in-context with **minimal distraction from task**, but **curation is needed to ensure utility**
- **Pushing personalized content** based on task focus and expertise can yield significant performance improvement

LLMs have changed the landscape for Knowledge Management –
and there's more to come!

Considerations when Embracing LLMs

- **Trust:** LLMs are good at “reading” a document but you have to find it first
- **Verification:** necessary to check LLM results
- **Controllability:** even with instruction models, cannot guarantee that responses will respect the framing or local conventions; debugging is hard
- **Latencies:** may exceed user tolerance levels
- **Cost:** computational budget can explode
- **Intellectual Property:** data and documents may be retained or used for training