



## Testing Times for the Contact Centre and Semantics

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Christopher J.O. Baker [bakerc@unb.ca](mailto:bakerc@unb.ca)



# Knowledge Discovery: Contact Centre

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- Business Challenges:
  - Lengthy diagnosis phase
  - Insufficient time for troubleshooting
    - Technical support teams spend 25 to 50% of time searching for answers
    - Unlinked information in knowledge-base silos and heterogeneous formats
    - Case escalation due to poor information find-ability
  - Cases languish as Tier 2 staff unavailable
  - OEMs outsourcing (pay per seat) to lower cost solution providers drives Contact Centres to be more productive.

## Problem Space

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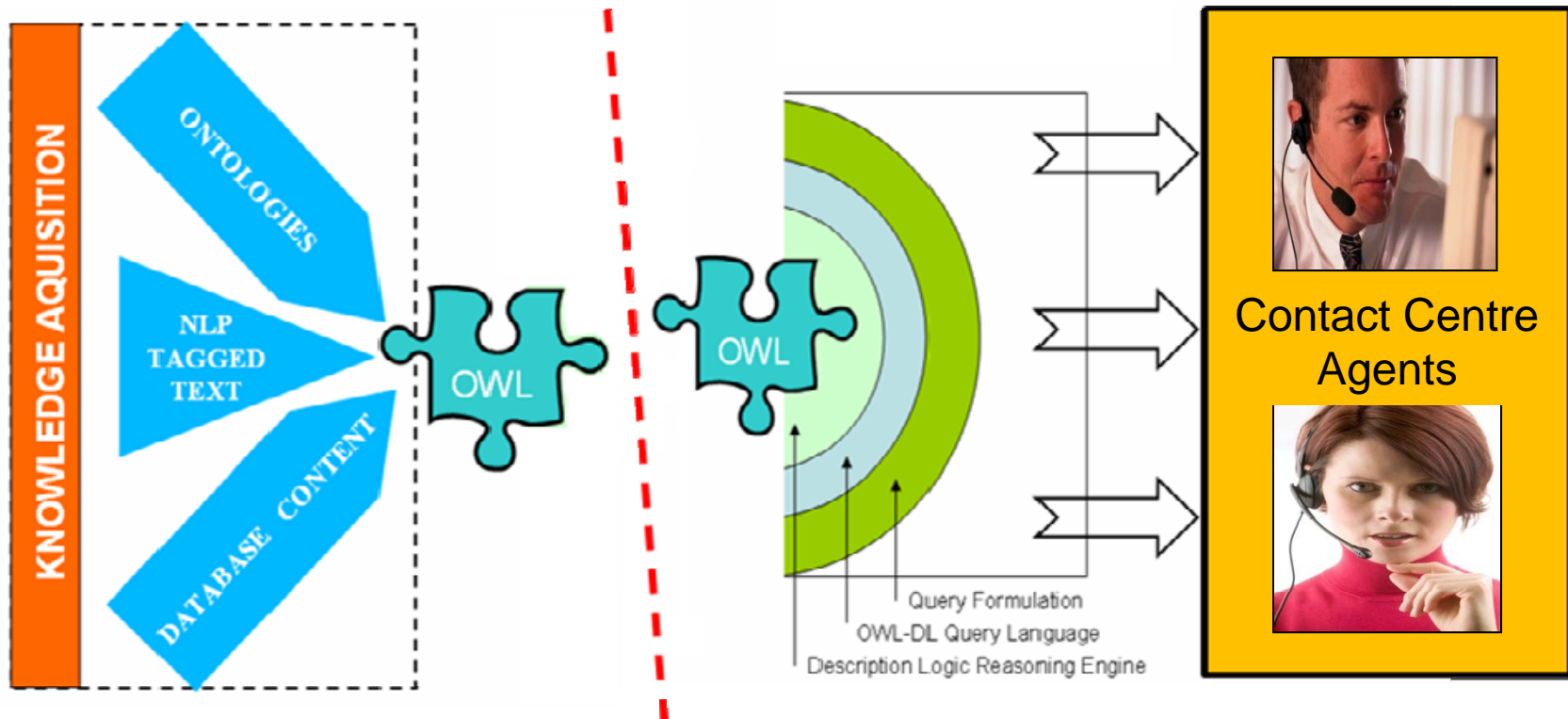
- Customer Relationship Management database (900 cases per year)
- Technical bulletins, technical publications (38,000 pages of content per release, 4 active releases).
- Existing search tools can search over products, product release but not complex Boolean searches of multiple terms.

## Agent Tasks

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- Need to link previous cases, symptoms, possible causes, suggested solutions and procedures from technical publications
- Trouble shoot workflow / decision tree.
- Multiple knowledge silos require CC agents to switch in “interfaces” (CRM vs.. Adobe) and a re-type of search terms.

# Semantic Knowledge Discovery: Contact Centre



- Custom Telecom Gazetteers
- Pellet Reasoner
- TopBraid Composer
- TopBraid Live/Ensemble
- GATE NLP - Framework
- OWL-DL Ontology
- OWL API

# Telecommunications Hardware Ontology

- Describes phone routing software
- Based on OWL-DL (OWL-2)

- Classes: 526
- Instances: 75,788
- Data Properties: 61
- Object Properties: 176
- Class Equivalencies: 31
- Class Disjunctions: 28
- Subclass Axioms: 524
- Inverse Objects: 50
- Description logic: **ALCHI(D)**
- Depth: 8 classes

## High Level Ontology

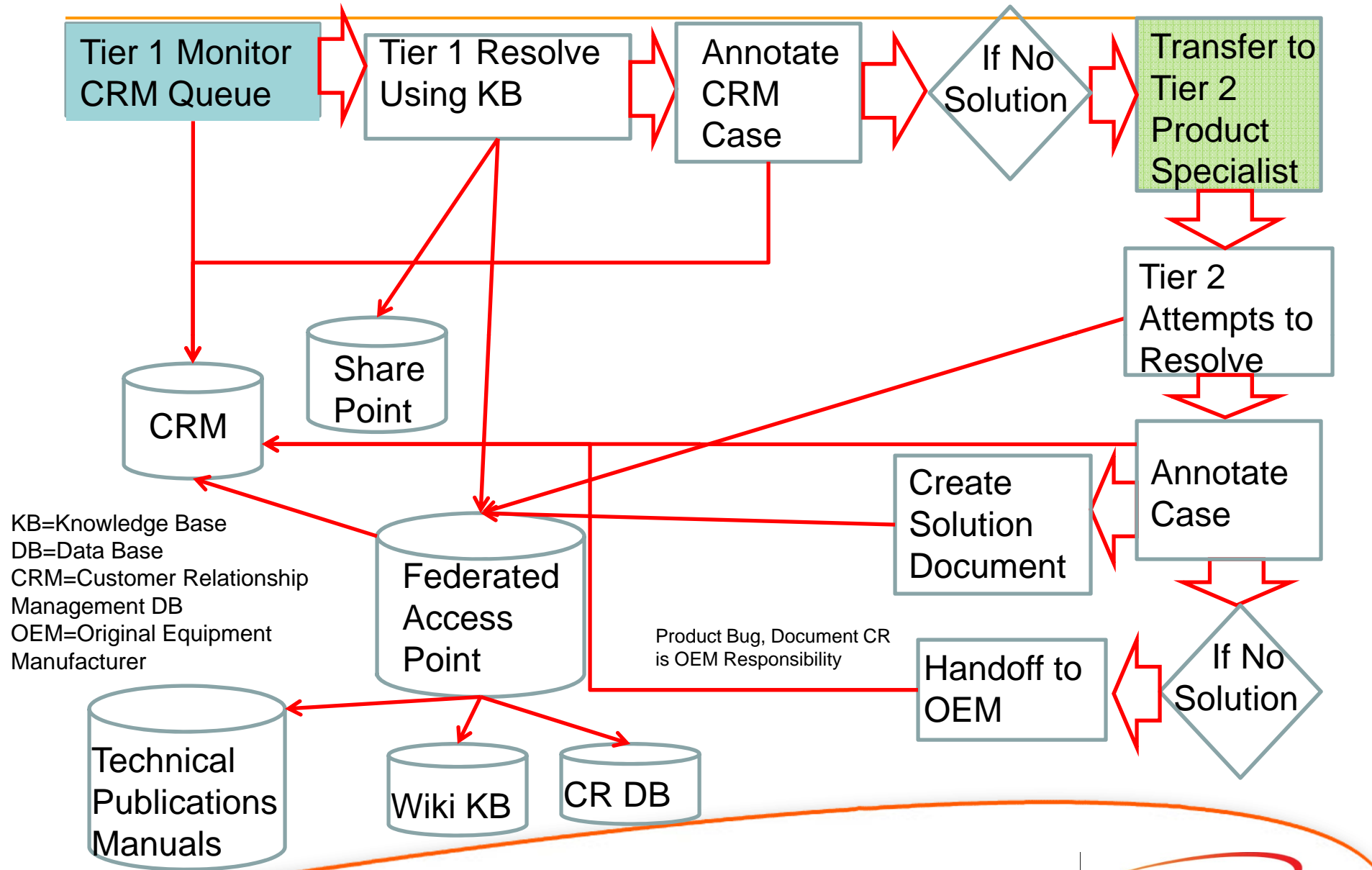
- owl:Thing (0 + 74957)
  - ▷ ● :Specifications (0 + 74656)
  - ▲ ● :Subject\_Domain (0 + 301)
    - ▷ ● :Applications (0 + 11)
    - ▷ ● :Base\_Software (0 + 1)
    - ▷ ● :Codec (1 + 2)
    - ▷ ● :Customer\_Task
    - ▷ ● :Features (1 + 9)
    - ▷ ● :Installation\_Location (0 + 2)
    - ▷ ● :Manufacturer (1 + 1)
    - ▷ ● :Network\_Infrastructure (0 + 13)
    - ▷ ● :Operating\_System (1 + 2)
    - ▷ ● :Possible\_Problems (0 + 5)
    - ▷ ● :Products (0 + 44)
    - ▷ ● :Software\_Release (1 + 6)
    - ▷ ● :Solution\_Procedure (0 + 39)
    - ▷ ● :Solution (1 + 4)
    - ▷ ● :Standards (1 + 10)
    - ▷ ● :Symptom (1 + 127)
    - ▷ ● :System\_Component (1 + 16)
    - :Telecommunications\_Hardware

# Technical Support Contact Center FAQs

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- What are the product software error codes?
  - E.g. ADM0234
- What are the problem symptoms?
  - E.g. Unable to call 911
- What are the possible causes for a problem symptom?
  - E.g. Mis-configured system settings
- What is the solution for a possible problem?
  - E.g. Reset Emergency Services settings
- Where is the procedure for a solution?

# Case Resolution Process





# Contact Center Environment

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- Tier 1:
  - Information gathering/validation
  - Initial problem solving
  - Requires highly precise information
  - Needs simple-to-use user interface
- Tier 2:
  - Problem escalation or information not found
  - Requires high information recall
  - Requires advanced search capabilities



## Pilot Study: Query Types and Source Content

- Searches involve up to 4 terms, links to granular literature metadata and data in diverse (un)-structured formats.

	Type of Query
Existing Knowledge Base	Form query only
Semantic Solution	Form query on all ontology entities
	Pre-configured visual query (FAQ)
	Ad hoc visual query

	CRM DB	Bulletins	Technical Publications
Existing Knowledge Base	HTML	PDF only*	PDF only*
Semantic Solution	HTML	Word*	2 kinds of XML, FrameMaker*

\*Unstructured

# Search Engines

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- TopQuadrant Ensemble
  - Ontology editor, web search interface (Flex-based)
  - Web search interface customization via a Software Development Kit
- KIM by Ontotext AD
  - Search engine with separate Triple Store and Text processing pipeline (GATE)
  - Search interface customization requires Professional Services engagement with Ontotext
- Compared search paradigms
  - Structured search
  - Pattern search
  - Visual search as a FAQ type
  - Free Text as a FAQ type

# Semantic Solution: Structured Query Features

Lookup for patterns where

X, is a  which name is exactly =   
and X  Y

Y, is a  which name is exactly =   
and Y  Z

Z, is a  which name is exactly =   
and Z  A

Attribute restrictions

X	<input type="text"/>	is unknown
Y	<input type="text"/>	is unknown
Z	<input type="text"/>	is unknown

Software release  
5.5

Interested in  
X, Y and Z  Show only extracted entities.

Search for

KIM

Select Class To Begin

- Adding (1)
- Administering
- Backing Up (2)
- Changing (2)
- Configuring (2)

Search Configuring SPARQL Editor

<input type="checkbox"/>	comment :	<input type="text"/>
<input type="checkbox"/>	enables Solution :	<input type="text"/>
<input type="checkbox"/>	has Procedure for Component :	<input type="text"/>
<input type="checkbox"/>	has Product :	<input type="text"/>
<input type="checkbox"/>	has Product Component :	<input type="text"/>
<input type="checkbox"/>	has Software Release Version :	<input type="text"/>
<input type="checkbox"/>	label :	<input type="text"/>
<input type="checkbox"/>	occurs in Paragraph :	<input type="text"/>
<input type="checkbox"/>	occurs in Sentence :	<input type="text"/>
<input type="checkbox"/>	occurs in Text Segment :	<input type="text"/>
<input type="checkbox"/>	occurs in Topic :	<input type="text"/>

Ensemble

- Class, entity, object property selection
- Class unions
- Attribute restrictions for filtering
- Saving query

# Semantic Solution: Pattern Query Features

KIM

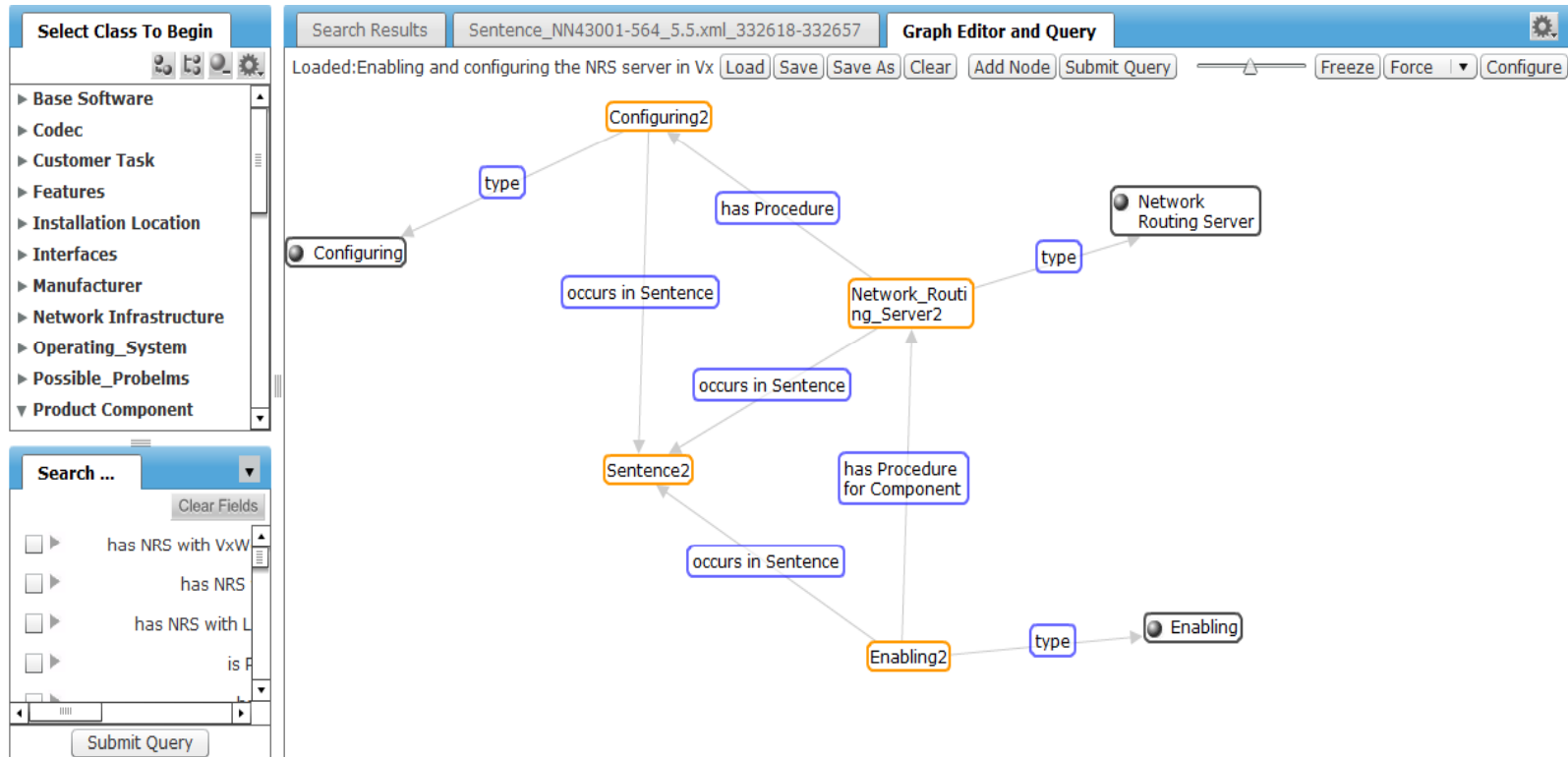
The screenshot displays the KIM Semantic Solution Pattern Query interface, which is organized into several sections:

- Choose predefined entity pattern:** A dropdown menu labeled "Patterns:" showing a list of predefined patterns. The first pattern is selected and highlighted in blue: "Test 1: Configuring the system-wide settings in Vx". Other visible patterns include "Test 1, 2: Two procedures for component", "Test 2: Two procedures", "Test 2: Disable or Restart the NRS server", and "Test 2: Procedure for component".
- A Pattern about:** A section with five input fields for defining a pattern:
  - Sol. procedure: [text input]
  - Component: [text input]
  - has Feature: [text input]
  - Application: [text input]
  - Software release: 5.0 [dropdown menu]
- Interested in:** A dropdown menu labeled "Patterns:" with "Sentences" selected.
- Show only extracted entities:** A checkbox that is currently unchecked.
- Search for:** A section with two buttons: "DOCUMENTS" and "ENTITIES".
- TRY FREE QUERY:** A blue button located at the bottom right of the interface.

- Select a pattern and designate entities
- Auto-complete
- Attribute restrictions
- Save query

# Semantic Solution: Visual Query using Ensemble

FAQ Visual Query: Network Routing Server has a Configuring and Enabling Procedure



- Select a class and designate entities
- Auto-complete
- Attribute restrictions
- Save query

## Features: Free Text Query (FAQ)

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	KIM	TopQuadrant Ensemble
Query Language	SeRQL	SPARQL
Create query text	Yes	Yes
Save with a label	Yes	Yes
Edit Label	Yes	Yes
Delete query	Yes	No
Change query	No	No
Customized list of FAQ type questions	Not able to create lists for each user type	Yes
Limitations	n/a	Saving the Query must be done within the confines of the Visual Query interface (limited SPARQL functionality)

## Pilot Test Design (1 of 2)

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- Phase 1: Ontology and TopQuadrant Ensemble Interface Usability Test
  - Can users find answers to common queries
    - Tier 1: Structured search, pre-built general FAQ search, pre-built specific FAQ as a visual query search
    - Tier 2: Structured search, create general FAQ, pre-built specific visual query search
- Phase 2: Scenario Testing with TopQuadrant Ensemble
  - Role-play of interaction with customer to test
    - Troubleshooting
    - Does information retrieved address symptoms or, provide procedures for solutions (recall and precision)
    - At what point did escalation occur and why



## Pilot Test Design (2 of 2)

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- Phase 3: Usability and Scenario Test of KIM
  - Repeat of Phase 1 and 2 objectives with a interface that has
    - Structured Search
    - FAQ interface (Free Text query)
    - Pattern Search (new search paradigm)

## Scenario Testing

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- Customer has phone system where the Network Routing Server's end-point keeps de-registering
- Goal: have the Tier 1 complete as much of the troubleshooting workflow as possible. (36 of 42 procedures)
- Involves navigation over 75,000+ instances of content (sentences, paragraphs, topics)
- Tests levels of granularity required (sentence, paragraph, topic, multiple subordinate topics)
- 18,000 pages of content across 3 software releases and 2000 previous technical support cases

## Ensemble Usability Testing: Description

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- Tested 4 specific procedure queries for time and find ability/display of information
  - Compared old technique (search Knova and PDFs) to new
    - Old search term: “IP Security” in the Release 5.5 documents
    - New search has multi-term search with a more concise relationship matrix with suggested relationships to refine the search :
      - Solution\_Procedure: “Confirming” (25+ other tasks)
      - hasFeature: “IP Security” (many features)
      - hasProcedure\_for\_System\_Component: “Active Call Server” (as opposed to Signalling Server)
      - usesApplication: “CLI” (as opposed to LD 117, NRS Manager)
      - softwareRelease “5.5” (as opposed to 5.0 or 6.0)
  - New techniques
    - Execute a semantic form search (3 sets of test results)
    - Execute a visual query saved as a FAQ (3 sets of test results)
    - Create a visual query (2 sets of test results)

## Scenario Testing: Description

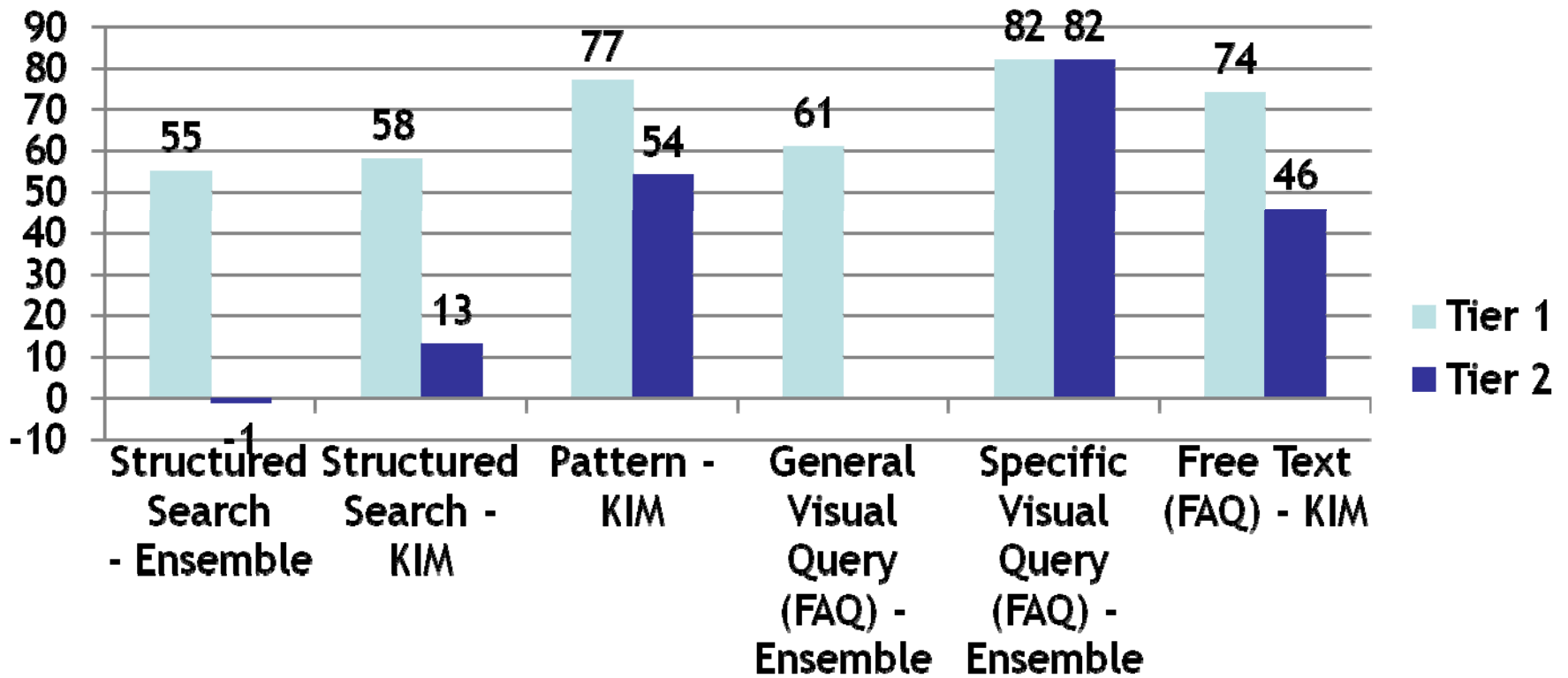
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- Took users through the whole NRS Deregistration troubleshooting workflow
- Note on process:
  - Workflow: Has 2 or more task flows
  - Task flow: Has 1 or more procedures
  - Procedure: Has 1 or more steps
    - Need to be conducted in order (Output of one procedure is input for another)

Task flow	# of procedures	New Tier level responsible	Old Tier level responsible	Comment
1-7	36	1	1 and 2	Tier 2 often became involved at task flow 3 and 4 with old toolset
8	6	2	2	

# Pilot Study: Results

% Change Compared to PDF Search



## Conclusions

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1. Biggest impact is with Tier 1. Time saved and 100% findability
2. Tier 1 able to find answers to the desired point handover point to Tier 2 tasks
3. Tier 2 has more tasks and toolset features to learn - longer learning curve
4. Structured Search results almost the same between products
5. Pattern search enables the biggest time savings.
6. FAQ search is very good, but requires pre-configuration and storage

## Participant Comments

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- Visual Query tool (Ensemble) is good to help build visualization, but has usability issues (Tier 1 and 2)
- Structured Search in KIM requires high precision to take advantage of its power
  - Tier 2: Like it because they tend to think conceptually
- Pattern Search is “most practical and I can use it right away”
  - Tier 1: Like it because they tend to think in entities

# Impact on Contact Center Performance Metrics

Metric	Impact of Semantic Solution	Tier Impact
Utilization (Productive versus non-productive time)	Less time in training/mentoring More time solving cases More time maintaining knowledge base	2 1 and 2 2
First Call Resolution	Information found the first time, less time spent in research or hand-off of case	1 2
Case Closed Timeframe (Total elapsed time)	Decreased case duration due to less time spent in research	1 and 2
Filtration Rate (Escalation) [Linked to First Call Resolution]	Less cases escalated to Tier 2 or to Manufacturer	2
Revenue Model	Move from a per person headcount/per client to a per case handled and multi-client support model	1 and 2



## Business Outlook in Contact Centre Vertical

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- Contact Centres employ 18,000 (10% of workforce) in New Brunswick, Canada and provides over CDN\$1 billion to provincial economy
- Semantic Solution:
  - Projected saving for Tier 1 is 26% of overall case resolution cost
  - Re-usable methodology applicable across multiple telecommunications products
  - Business driver in cost reduction, platform customizations, professional services

# Innovatia Research

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- Funded by a CDN \$4 million grant from the Atlantic Innovation Fund of the Atlantic Canada Opportunities Agency



Atlantic Canada  
Opportunities  
Agency

Agence de  
promotion économique  
du Canada atlantique

- Research Focus
  - Single source content development and re-use
  - Semantic knowledge management

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## Questions ?

[www.innovatia.net](http://www.innovatia.net)

Christopher J.O. Baker [bakerc@unb.ca](mailto:bakerc@unb.ca)



# Dependencies of Contact Centre Metrics

