Testing Times for the Contact Centre and Semantics

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Knowledge Discovery: Contact Centre

• 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

- 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

- 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: ALC(HI(D))
  - Depth: 8 classes
Technical Support Contact Center FAQs

• 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

**Tier 1 Monitor CRM Queue**

**Tier 1 Resolve Using KB**

**Annotate CRM Case**

**If No Solution**

**Transfer to Tier 2 Product Specialist**

**Tier 2 Attempts to Resolve**

**Annotate Case**

**Create Solution Document**

**Handoff to OEM**

**If No Solution**

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**KB=Knowledge Base**

**DB=Data Base**

**CRM=Customer Relationship Management DB**

**OEM=Original Equipment Manufacturer**

**Federated Access Point**

**Technical Publications Manuals**

**Share Point**

**Wiki KB**

**CR DB**

**Completed**
Contact Center Environment

• 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.

<table>
<thead>
<tr>
<th>Type of Query</th>
<th>CRM DB</th>
<th>Bulletins</th>
<th>Technical Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Knowledge Base</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Form query only</td>
<td>HTML</td>
<td>PDF only*</td>
<td>PDF only*</td>
</tr>
<tr>
<td>Semantic Solution</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Form query on all ontology entities</td>
<td>HTML</td>
<td>Word*</td>
<td>2 kinds of XML, FrameMaker*</td>
</tr>
<tr>
<td>Pre-configured visual query (FAQ)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ad hoc visual query</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Unstructured
Search Engines

- 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

- Class, entity, object property selection
- Class unions
- Attribute restrictions for filtering
- Saving query
Semantic Solution: Pattern Query Features

- 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)

<table>
<thead>
<tr>
<th>Feature</th>
<th>KIM</th>
<th>TopQuadrant Ensemble</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Language</td>
<td>SeRQL</td>
<td>SPARQL</td>
</tr>
<tr>
<td>Create query text</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Save with a label</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Edit Label</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Delete query</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Change query</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Customized list of FAQ type questions</td>
<td>Not able to create lists for each user type</td>
<td>Yes</td>
</tr>
<tr>
<td>Limitations</td>
<td>n/a</td>
<td>Saving the Query must be done within the confines of the Visual Query interface (limited SPARQL functionality)</td>
</tr>
</tbody>
</table>
Pilot Test Design (1 of 2)

- **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)

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

- 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

- 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

- 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)

<table>
<thead>
<tr>
<th>Task flow</th>
<th># of procedures</th>
<th>New Tier level responsible</th>
<th>Old Tier level responsible</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-7</td>
<td>36</td>
<td>1</td>
<td>1 and 2</td>
<td>Tier 2 often became involved at task flow 3 and 4 with old toolset</td>
</tr>
<tr>
<td>8</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
Pilot Study: Results

% Change Compared to PDF Search

- Structured Search: Ensemble - 55%
- Structured Search: KIM - 58%
- Pattern KIM - 77%
- General Visual Query (FAQ): Ensemble - 61%
- Specific Visual Query (FAQ): Ensemble - 82%
- Free Text (FAQ): KIM - 74%

Tier 1 and Tier 2 comparisons are shown.
Conclusions

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

- 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

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

- 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

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

- Research Focus
  - Single source content development and re-use
  - Semantic knowledge management
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  – Bradley Shoebottom\textsuperscript{2}: Knowledge Engineer
  – Alex Kouznetzov\textsuperscript{1}: Text Mining Engineer
  – Michael Doyle\textsuperscript{2}: Network Infrastructure

• Testing Team
  – Karen Lewis\textsuperscript{2}: Information Architect
  – Innovatia Technical support team
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\textsuperscript{1} UNBSJ, \textsuperscript{2} Innovatia
Questions?

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Dependencies of Contact Centre Metrics

<table>
<thead>
<tr>
<th>Tier</th>
<th>Metric</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1</td>
<td>Utilization</td>
<td>Less time in training or mentoring (Tier 2); more time resolving cases (Tier 1)</td>
</tr>
<tr>
<td></td>
<td>Case Closed Timeframe</td>
<td>Less time spent in research (Tier 1)/handoff to Tier 2</td>
</tr>
<tr>
<td></td>
<td>First Call Resolution</td>
<td>Less cases escalated to Tier 2 or to Manufacturer</td>
</tr>
<tr>
<td></td>
<td>Overall Filtration Rate</td>
<td>Tier 1 can handle more products. Move from a per person headcount/per client to a per case handled and multi-client support model</td>
</tr>
<tr>
<td></td>
<td>Revenue Model</td>
<td></td>
</tr>
</tbody>
</table>

First Call Resolution and Filtration rate impact Case Closed Timeframe