worldusabilityday

A Gold Mining Adventure

Using Natural Language Processing, Machine Learning, and Human-Centered Design to Find Gold in Unstructured Data

Chris Schilstra, MBA, SAFe, CSPO, CSM
Innovation Program Manager
Tantus Technologies, Inc.

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AGENDA

Interpreting Unstructured Listening Session Data

- Project Goals and Objectives
- Listening Session Process
- Find Gold in Unstructured Data
- Optimize NLP Visualizations With HCD
- HCD Project Outcomes
- Additional HCD Considerations/Puzzles

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PROJECT GOALS AND OBJECTIVES

Improve the review process of unstructured listening session data by leveraging Artificial Intelligence and Human-Centered Design.

Goals:

Use HCD, Machine Learning (ML) and Natural Language Processing (NLP) to:

- Achieve high reliability (>80%) accuracy for review of listening session data
- Minimize/manage opportunities for human bias

Objectives:

- Derive Themes
- Determine Sentiment

Listening Session Topic	Data Set
Prior Authorization	Data from several transcribed, national listening sessions summarized into one data set

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LISTENING SESSION PROCESS

Without AI	With AI
Conduct listening sessions with stakeholders	Conduct listening sessions with stakeholders
Transcribe recorded audio into text	Transcribe recorded audio into text
Manually sort text snippets into thematic groups	**Use NLP** to categorize data into thematic groups
Manually identify the sentiment of themes	**Use ML** to assign sentiment to themes
Retype findings into a management summary	Visualize themes/sentiment; **automate reporting**

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USE HCD AND NLP TO
Find Gold In Unstructured Data

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FIND GOLD IN UNSTRUCTURED DATA
THEMES

Themes

- Derive themes within unstructured data using Natural Language Processing
- Themes are scored and ranked by Tf-Idf* within the unstructured data

Sub-themes

- Derive sub-themes within themes through verb/adverb/adjective proximity and word frequency
- Sub-themes are scored and ranked by frequency

* **Tf-Idf = Term frequency, Inverse document frequency** – an algorithm used to evaluate how relevant or important a term is within a data set. The importance of a word increases proportionally to the number of times that word appears in the data set, but is offset by the frequency of the words in the data set.
https://en.wikipedia.org/wiki/Tf%E2%80%93idf

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FIND GOLD IN UNSTRUCTURED DATA
HCD FOR THEMES

- Replace manual derivation of themes, which is highly prone to bias, with NLP-driven, numerically-based derivation of themes
  - ➢ Automates/accelerates the speed of extracting themes
  - ➢ Reduces bias

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FIND GOLD IN UNSTRUCTURED DATA
SENTIMENT

Derive the Sentiment of unstructured data
using machine learning instead of manual sentiment assignment,
thereby reducing bias.

Positive Negative Neutral

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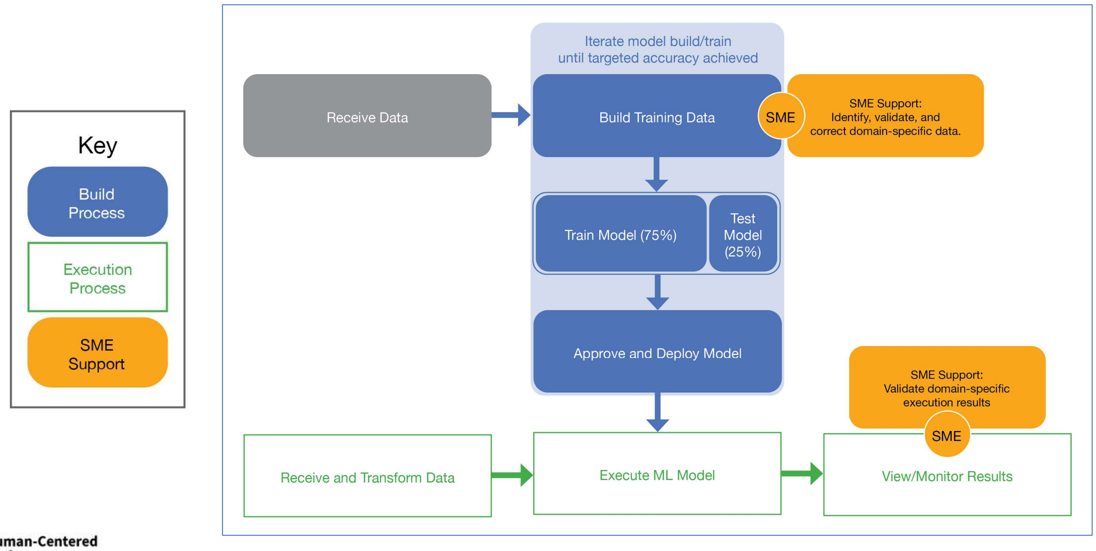
FIND GOLD IN UNSTRUCTURED DATA

USING ML TO FIND SENTIMENT



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FIND GOLD IN UNSTRUCTURED DATA

AI MODEL ACCURACY

- Trained and executed the following models to compare results
  - BERT (Google)
  - RoBERTa (Facebook)
  - DistilBERT (A smaller and lighter version of the BERT model)
- A pre-trained model with 150 Gb of data
- Results – RoBERTa produced superior results

Model	Creator	Accuracy	F1 Score	MCC	Eval_Loss
RoBERTa	**Facebook**	**0.8210**	**0.8210**	**0.6746**	**0.5046**
DistilBERT	Cornell University	0.7354	0.7354	0.4932	0.7595
BERT	Google	0.7310	0.7310	0.6282	0.5615

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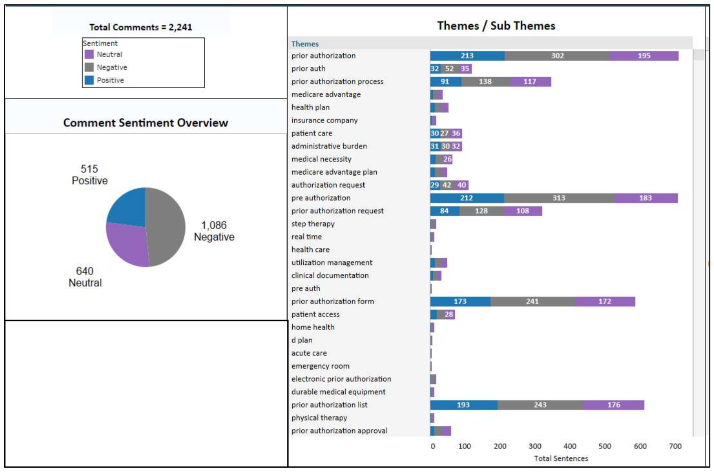
FIND GOLD IN UNSTRUCTURED DATA

LISTENING SESSION THEMES WITH SENTIMENT



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PROJECT GOALS AND OBJECTIVES ATTAINED

Goals achieved:

- Achieved high reliability (>80%) accuracy for sentiment assignment of listening session data
- Minimized human bias by utilizing ML and NLP modeling

Objectives	Results
Derive Themes/sub-themes	• Deep learning algorithms determine the themes based on prevalence of text content and determine sub-themes based on theme proximity and frequency

Determine Sentiment	• Achieved >80% accuracy
	• Machine learning algorithms determine sentiment at multiple levels:
	    • Overall sentiment
	    • Sentiment by themes
	    • Sentiment by stakeholders

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Optimize NLP Visualizations With HCD

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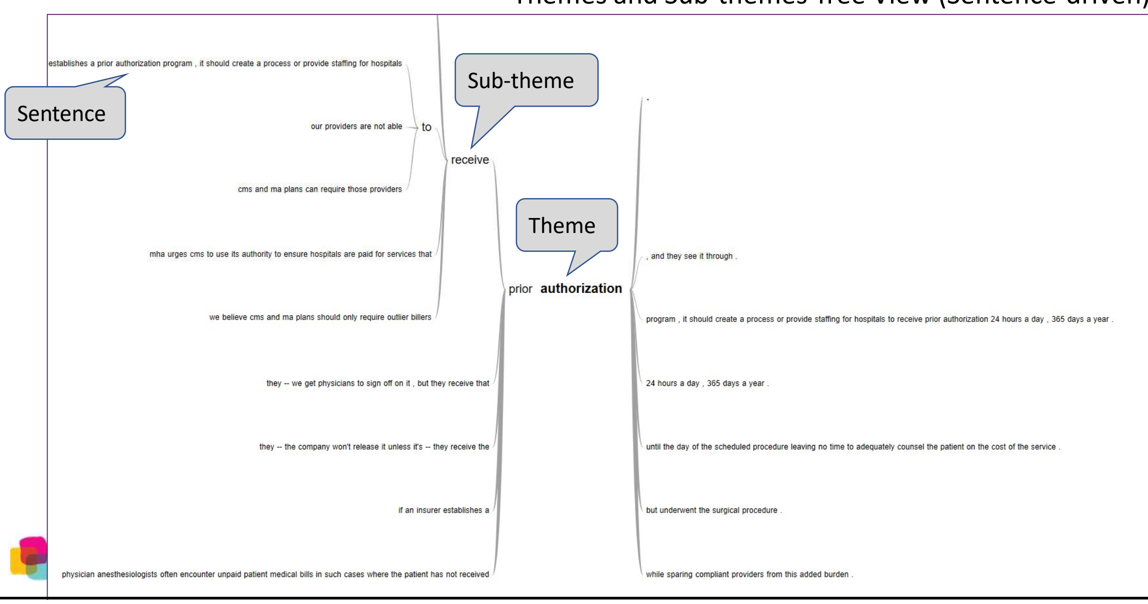
OPTIMIZING NLP VISUALIZATIONS – ATTEMPT 1

Themes and Sub-themes Tree View (Sentence-driven)



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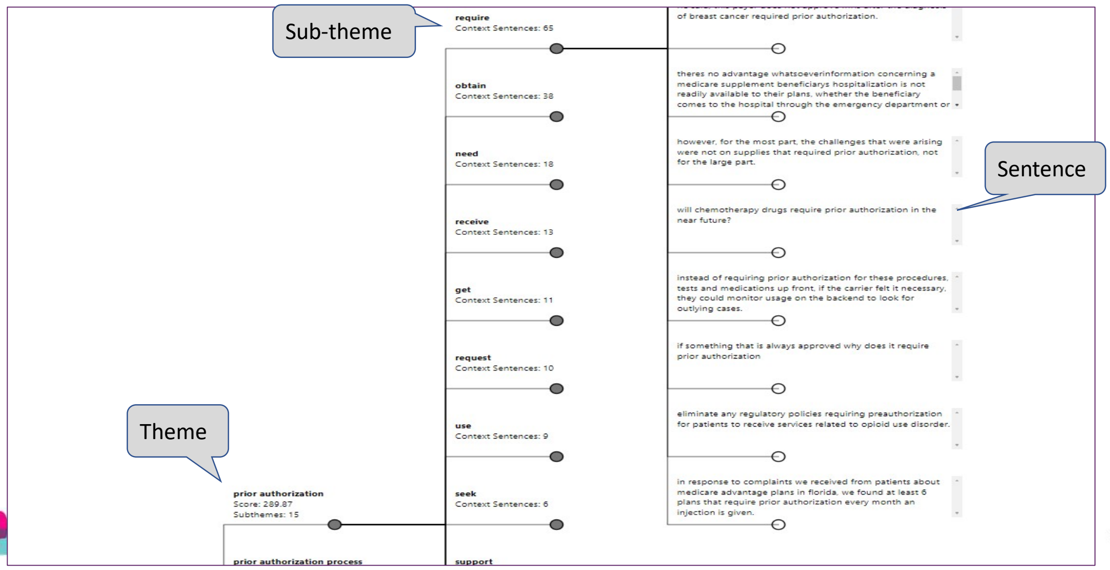
OPTIMIZING NLP VISUALIZATIONS – ATTEMPT 2

Themes and Sub-themes (Theme-driven View)



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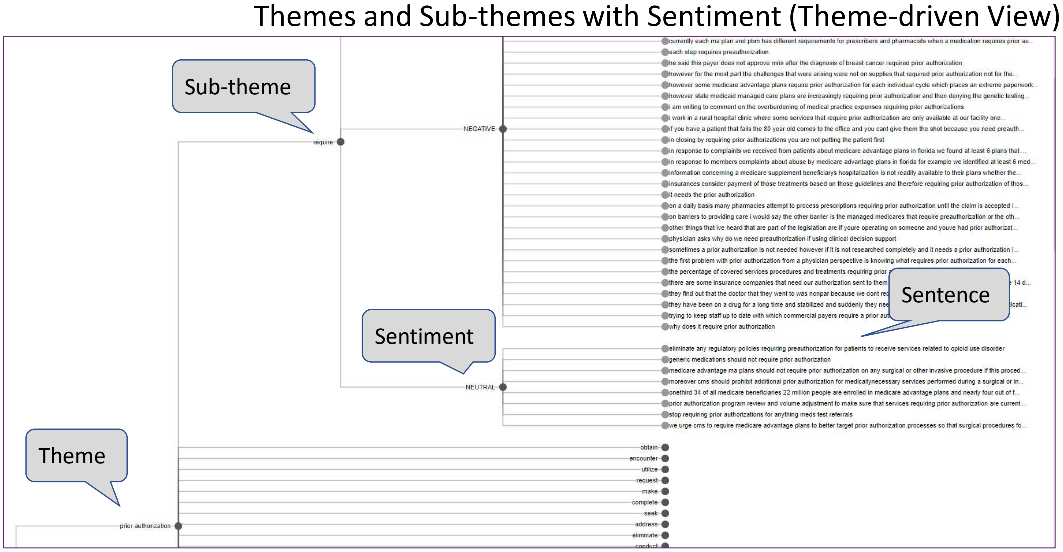
OPTIMIZING NLP VISUALIZATIONS – ATTEMPT 3

Themes and Sub-themes with Sentiment (Theme-driven View)



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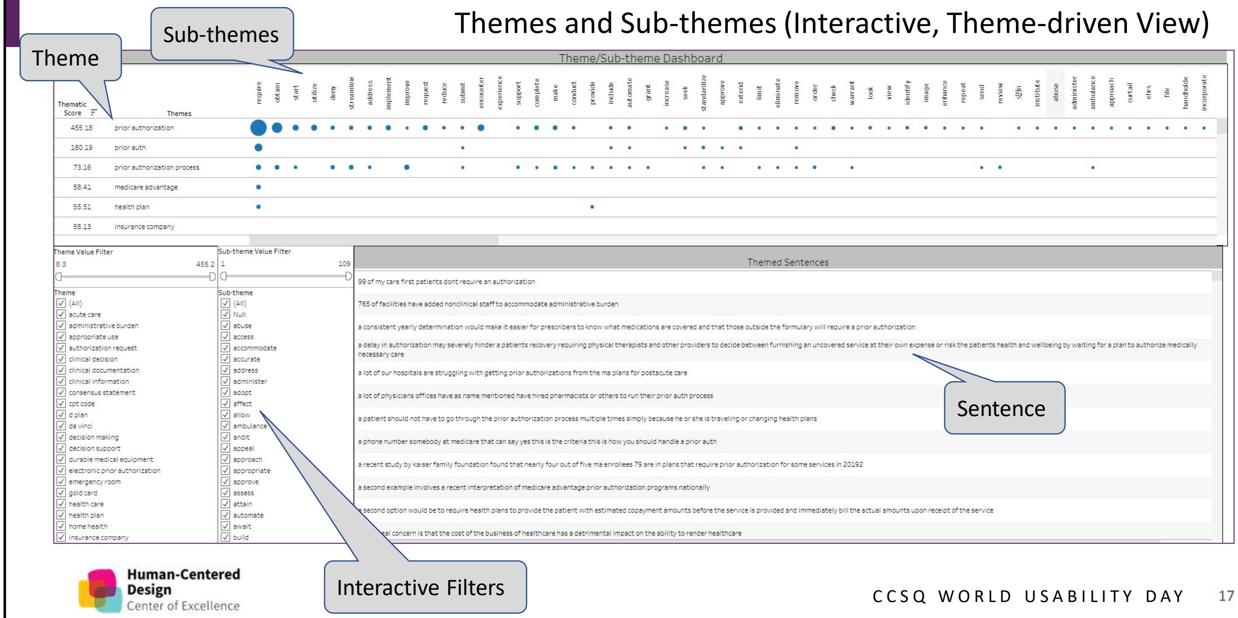
OPTIMIZING NLP VISUALIZATIONS – ATTEMPT 4 SUCCESSFUL

Themes and Sub-themes (Interactive, Theme-driven View)



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ATTAINED PROJECT GOALS AND OBJECTIVES

Goals achieved:

- Identified a visualization technique that made it possible to interpret listening session data with a large number of themes/sub-themes and their associated sentiment by using an interactive dashboard.

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HCD Project Outcomes

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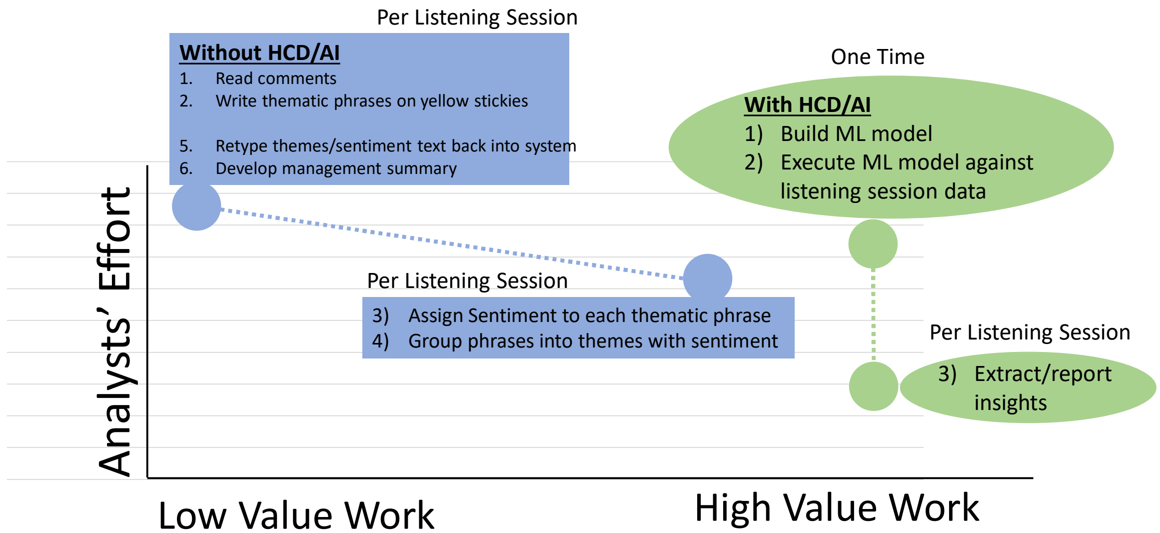
HCD/AI MOVES ANALYSTS FROM LOW-VALUE TO HIGH-VALUE WORK



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HCD HELPS TO FIND GOLD IN UNSTRUCTURED DATA

- Artificial Intelligence automates previously manual tasks which:
  - Achieve high reliability (>80%) accuracy
  - Minimize human bias
  - Accelerate the speed of review for each listening session
  - Move analysts from low-value to high-value work
- Interactive visualizations are far superior to static visualizations by maximizing human-centered design to target insights, including:
  - Numerous filters
  - Drill-down capability (theme->sub-theme->sentiment)
- Accurate, SME-driven labelling of machine learning training data is crucial to modeling success

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ADDITIONAL HCD CONSIDERATIONS/PUZZLES

Themes/Sentiment

- Static Data Set vs Changing Data Set
  – Changing data sets increase complexity and tracking overhead
- Subject Matter Expert Data Labelling

Visualizations

- Multiple Months of Listening Session Data
  – Increases visualization complexity
  – How to track the review process as data changes over months

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Tantus Technologies Inc.

Chris Schilstra, MBA, SAFe, CSPO, CSM
Innovation Program Manager, PM3

Mobile: 410-440-9003
Office: 410.907.8200 x 131

cschilstra@tantustech.com
www. tantustech.com

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THANK YOU

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