Automate Contract Analysis in Auditing

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Introduction

- The contract is an important type of audit document throughout the audit process
Introduction

- Auditors examine contracts for *risk assessment*, *substantive test*, and *audit review*

<table>
<thead>
<tr>
<th>Risk Assessment</th>
<th>Substantive Test</th>
<th>Audit Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>Litigation Risk</td>
<td>Sales and Revenue</td>
<td>Uncovered Significant Error or Fraud</td>
</tr>
<tr>
<td>Loss Assessment</td>
<td></td>
<td></td>
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<tr>
<td>Expiring Patterns</td>
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</tbody>
</table>
Introduction

• In May 2014, FASB issued ASC 606 (effective after Dec. 15, 2017): *Revenue from Contracts with Customers*

**STEP 1**
- Identify the contract(s) with a customer

**STEP 2**
- Identify the performance obligations in the contract

**STEP 3**
- Determine the transaction price

**STEP 4**
- Allocate the transaction price to the performance obligations in the contract

**STEP 5**
- Recognize revenue when the entity satisfies a performance obligation
Introduction

• Despite the benefits of using contract analysis to generate solid audit evidence, auditors generally only examine so-called material contracts
  – Labor intensive
  – Legal expertise
  – Not cost-benefit efficient

• The development in automated text analysis has opened up opportunities for auditors to examine populations of contracts
  – Information extraction (Kanya and Geetha, 2007)
  – Text categorization (Namburu et al., 2008)
  – Risk dictionary (Cecchini et al., 2010)
  – Topic tracking and key words extraction (Lee and Kim, 2008)
Introduction

• According to Technological Process Reframing (TPR) theory, now is an appropriate time for auditors and regulators to evaluate automated contract analysis
  – TPR theory: the reconsideration of methods and processes on an area of endeavor consequent of the advent of a disruptive technology (Issa, Sun, and Miklos, working paper)
Introduction

• In this project, we propose a framework named Automate Contract Analysis System (ACAS)
  – Enhances current contract related audit procedures
Automate Contract Analysis System (ACAS) Framework

- Log Information
- Renegotiated Contract
- Newly Created Contract
- Audit Field Recognition
- Related Field Identification
- Abstract Generation
- Compliance Analysis
- Risk Analysis
- Litigation Risk Analysis
- Fraud Detection
- Missing contract
- Confirmation
- Opportunity Incentive
- Term-Clause Extraction
- Internal Control Testing
- Fair Value
- Accounting Estimation
- Derivative Valuation
Audit Procedures

Cushing, B. E., & Loebbecke, J. K. (1986) modified by Deniz Appelbaum
Comparing supporting documents (e.g. contracts) to the accounting records for the evaluation of internal control (AS No. 2)

Automatic matching contract terms and clauses with accounting records

Evaluate exposure to losses based on contracts to decide whether the account is significant (AS No. 2)

Loss assessment based on text mining

Change in contracts after tests of controls is evaluated to determine whether the effectiveness of company’s internal control is affected (AS No. 2; AS No. 5)

Log information of new or renegotiated contracts are maintained for examination
The materiality level can be affected by significant new contracts after initially established (AS No. 11). Continuous monitoring materiality level relevant terms and clauses from new or renegotiated contracts.

The employment and compensation contracts of executive officers are examined to assist identifying risk of material misstatement (AS No. 12). Extract content from compensation contracts and present compensation structure for risk analysis.
Documentation of auditing procedures includes the inspection of significant contracts or agreements (AS No. 3).

Automatic identify contract with its related audit area and provide key describing characteristics.

Contracts and other agreements are examined to identify related parties (AS No. 18).

Information of related parties in contracts are extracted by contract analysis tools for further investigation.

Confirming the existence and terms of important contracts is used for fraud detection (incentive and opportunity) (AU 316).

Significant terms and clauses are extracted for confirmation and other fraud identification analysis.
Related contracts are examined for auditing fair value measurements and accounting estimates (AU 328; AU 342)

Information of accounting measurement and valuation are obtained for matching with managements’ assertions

Auditing derivative instruments, hedging activities, and investments in securities are based on related contract terms (AU 332)

Valuation characteristics of derivatives, hedging, or other investments are extracted from related contracts and used as input of valuation models for evaluation

Reading contracts, loan agreements, leases, and other similar documents concerning litigation, claims, and assessments (AU 337)

Extract important litigation risk related clauses and terms for further investigation by specialist
Qualitative factors of evaluating audit results include examining the company’s compliance with contractual agreements and violations of contractual provisions (AS No.14).

Compliance analysis is performed by extract and aggregate information from identified related contracts and present such information to auditors for compliance evaluation.
Related Linguistic Analysis Techniques

- Topic tracking and key words extraction (Lee and Kim, 2008)
- Text categorization (Namburu et al., 2008)
- Association rule mining (Goh and Ang, 2007)
- Information extraction (Kanya and Geetha, 2007)
- Risk dictionary (Cecchini et al., 2010)
Case – Reinsurance Contract Information Extraction

- **Sample: 10 reinsurance contracts**
  - 3 sub contracts and 10 endorsements
  - Every contracts has around 29,530 words in 64 pages
  - Most contents and provisions are identical
  - PDF format

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**Convert PDF to Text**

<table>
<thead>
<tr>
<th>Optical character recognition (OCR)</th>
<th>OCR quality review</th>
</tr>
</thead>
</table>

**Identify Audit Related Data and Terms**

<table>
<thead>
<tr>
<th>Expert auditors identify key information</th>
<th>Regular expression</th>
</tr>
</thead>
</table>

**Information Extraction**

<table>
<thead>
<tr>
<th>Run python code</th>
<th>Formatting</th>
</tr>
</thead>
</table>
## Reinsurance Contract Information Extraction

<table>
<thead>
<tr>
<th>Contract Number</th>
<th>Policy Number</th>
<th>Period of Insurance</th>
<th>Limit of Liability</th>
<th>Retention</th>
<th>Gross premium</th>
<th>Retroactive date</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>From/To</td>
<td>Policy Aggregate</td>
<td>Each claim</td>
<td>Each Location Aggregate</td>
<td>Each Location Aggregate</td>
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Conclusion

• The development in automated text analysis has opened up opportunities for auditors to examine and analyze contracts effectively and efficiently

• We propose a framework named Automate Contract Analysis System (ACAS) to incorporate linguistic analysis techniques to help auditors perform audit procedures on contracts

• One of the ACAS information extraction function is demonstrated in a case with reinsurance contracts
Contribution

• Expand the scope of feasible audit work by including the contract analysis

• Provide a cost-benefit efficient solution to the problem of auditing the whole population of contracts

• Demonstrate the feasibility of incorporating text mining into audit procedures

• Adapting auditing to the movement into Big Data era
Future Work

• Develop specific contract analysis procedures under the ACAS framework

• Conduct case study on ACAS framework with more sample contracts

• Expand ACAS framework to assist auditors analyze more documents with text content
THANK YOU!