2020 Rutgers Governmental Accounting & Auditing Update Conference

12/03/2020

Miklos A. Vasarhelyi
Hussein Issa

Rutgers Business School
Outline

• Introduction
  – The CarLab *(Miklos)*
  – GASB Post-Implementation Review Project *(Miklos)*

• Back to the future: a vision
  – Objectives and Preliminaries *(Miklos)*
  – Architecture *(Hussein)*
  – Emerging technologies *(Hussein)*
  – Some immediate steps towards a digital strategy *(Miklos)*

• Conclusions *(Miklos)*

• APPENDIX: Some of our project
INTRODUCTION
THE CARLAB
All academic Accounting programs around the world are ranked annually by BYU. For many years now, the Accounting Information Systems (AIS) group at RBS has led the world in the application of information technology to the audit profession. We are very proud to announce that the just-released BYU rankings for 2019 confirm again the continued success of Rutgers Business School in both AIS and audit research:
# CarLab Analytic Research in Public Sector

<table>
<thead>
<tr>
<th>NYC Street Cleanliness and on-street Parking</th>
<th>IPSASB - XBRL</th>
<th>SICONFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazilian Navy</td>
<td>Brazil Health System Acquisition – Rio de Janeiro Municipality</td>
<td>Securities and Exchange Commission of Brazil (CVM)</td>
</tr>
<tr>
<td>PCAOB - Webcast</td>
<td>NPO Form990 Database</td>
<td>Rutgers Internal Audit</td>
</tr>
<tr>
<td>Audit with Blockchain &amp; Smart Contracts on the Government Sector</td>
<td>Open Government Financial Data</td>
<td>XBRL reporting for U.S. local governments</td>
</tr>
</tbody>
</table>
OUR EDUCATIONAL PROGRAMS AND DIGITAL LIBRARY
Rutgers Accounting Digital Library

**Over 500 Online Classes for Students, Faculty and Public**

- **Undergraduate**
  - Introduction to Financial / Managerial Accounting
  - Intermediate Accounting I & II
  - Advanced Accounting
  - Financial Accounting (Gold Series)
  - Auditing Principles
  - Management and Cost Accounting
  - Accounting Information Systems
  - Business Law I & II
  - Federal Taxation I
  - Accounting in the Digital Era
  - Decoding of Corporate Financial Communications

- **Graduate**
  - Accounting Principles and Practices
  - Information Technology
  - Government and Not-for-Profit Accounting
  - Advanced Auditing and Information Systems
  - Income Taxation

- **PhD**
  - Survey of Accounting Information Systems
  - Current Topics in Auditing
  - Machine Learning

- **Audit Analytics**
  - Introduction to Audit Analytics
  - Special Topics in Audit Analytics
  - Information Risk Management
Special Topics in Audit Analytics

1. Special Topics in Audit Analytics: Week 1 - Lecture 2: Analytics Big Data Audit Automation
   by Rutgers Web
   32:52

2. Special Topics in Audit Analytics: Week 1 - Lecture 3: The Audit Ecosystem
   by Rutgers Web
   17:41

3. Special Topics in Audit Analytics: Week 1 - Lecture 4: Audit Data Standard
   by Rutgers Web
   39:46

4. Special Topics in Audit Analytics: Week 2 - Lecture 2
   by Rutgers Web
   37:05

5. Special Topics in Audit Analytics: Week 3 - Lecture 1: Hypothesis Testing
   by Rutgers Web
   17:40

6. Special Topics in Audit Analytics: Week 3 - Lecture 2: Hypothesis testing 2
   by Rutgers Web
   12:20

7. Special Topics in Audit Analytics: Week 3 - Lecture 3: Confidence Interval
   by Rutgers Web
   8:49

8. Special Topics in Audit Analytics: Week 3 - Lecture 4: Two sample test
   by Rutgers Web
   24:39

9. Special Topics in Audit Analytics: Week 3 - Lecture 5: Two dependent sample test
   by Rutgers Web
   13:34

10. Special Topics in Audit Analytics: Week 3 - Lecture 6: Introduce R
    by Rutgers Web
    7:24

11. Special Topics in Audit Analytics: Week 3 - Lecture 7: Demonstration with R
    by Rutgers Web
    30:10

12. Special Topics in Audit Analytics: Week 4 - Lecture 1
    by Rutgers Web

13. Special Topics in Audit Analytics: Week 4 - Lecture 2
    by Rutgers Web

14. Special Topics in Audit Analytics: Week 4 - Lecture 3
    by Rutgers Web

15. Special Topics in Audit Analytics: Week 4 - Lecture 4
    by Rutgers Web

16. Special Topics in Audit Analytics: Week 4 - Lecture 5
    by Rutgers Web

17. Special Topics in Audit Analytics: Week 4 - Lecture 6
    by Rutgers Web

18. Special Topics in Audit Analytics: Week 4 - Lecture 7
    by Rutgers Web

19. Special Topics in Audit Analytics: Week 4 - Lecture 8
    by Rutgers Web

20. Special Topics in Audit Analytics: Week 4 - Lecture 9
    by Rutgers Web
GASB
Post-Implementation Review Project
Ben Yoon
Huaxia Li
Kevin Moffitt
Rutgers CarLab
July 2020
Project Objectives

• This project will build a dynamic information system that
  1) automatically captures the CAFRs from different governmental entities,
  2) parses relevant items from the CAFRs, and
  3) converts them into a structured data

• The structured data be easily used by the GASB to perform the post-implementation review (PIR) of the new GASB pension standards.

* In 2012, the GASB announced new pension standards (No. 67 and 68).
4 Steps of This Project

- This project consists of 4 steps.

- Rutgers has conducted initial pilot tests.
  - Step1: Collecting 36,676 CAFRs from 3 repositories
  - Step2: Converting PDF documents
  - Step3: Extracting 8 items from the CAFRs
  - Step4: Report with Excel format
Automatic CAFR Collection

• 36,676 CAFRs from multiple sources
  - GFOA (Government Finance Officers Association)
    : 16,161 CAFRs (4 years)
  - EMMA (Electronic Municipal Market Access)
    : 14,400 CAFRs (more than 10 years)
  - NJ Department of Education (Schools and School districts)
    : 6,115 CAFRs (9 years)

• Automatic CAFRs collection
  1) Analyzing webpage
  2) Web-crawling (Scrapy, open-source web-crawling framework written in Python)
Converting PDF

- **Automatic CAFRs conversion**
  - Utilizing open source program and commercial program

- **Text format PDF or Password locked PDF**
  - Apache Tika conversion tool

- **Image-scanned PDF file**
  - Commercial PDF conversion tool
  - Google’s Tesseract-OCR Engine (Optical Character Recognition)
  - MS-WORD’s OCR Engine
Extracting Information

- Pension liability Percentage (detail examples)

Example of Low Pension liability percentage

<table>
<thead>
<tr>
<th>1925 Police Officers’ Pension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actuarial net pension liability</td>
</tr>
<tr>
<td>Plan fiduciary net position</td>
</tr>
<tr>
<td>Net pension liability</td>
</tr>
<tr>
<td>Plan fiduciary net position as a percentage of total pension liability</td>
</tr>
</tbody>
</table>

Example of No pension liability percentage disclosure

Comprehensive Annual Financial Report
City of La Puente
California
For the Fiscal Year Ended
June 30, 2017
Extracting Information

Distribution of Plan Fiduciary Net Position as a % of the Total Pension Liability in 2017 (CAFRs from GFOA)
## Extracting Information

- Example of the report

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>GFOA_2017_Data/AL/Municipality/GulfShoresAL.pdf</td>
<td>Unqualified Opinion</td>
<td>4/19/2018</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Not Mention</td>
<td>71.4%</td>
<td>8.0%</td>
</tr>
<tr>
<td>GFOA_2017_Data/AL/Municipality/DecaturAL.pdf</td>
<td>Unqualified Opinion</td>
<td>5/31/2018</td>
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<td>Yes</td>
<td>Not Mention</td>
<td>67.9%</td>
<td>7.8%</td>
</tr>
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<td>GFOA_2017_Data/AL/Municipality/TuscaloosaAL.pdf</td>
<td>Unqualified Opinion</td>
<td>6/7/2018</td>
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<td>Yes</td>
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<td>74.3%</td>
<td>3.8%</td>
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<tr>
<td>GFOA_2017_Data/AL/Municipality/PrattvilleAL.pdf</td>
<td>Unqualified Opinion</td>
<td>3/23/2018</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Not Mention</td>
<td>71.0%</td>
<td>7.8%</td>
</tr>
<tr>
<td>GFOA_2017_Data/AL/Municipality/HuntsvilleAL.pdf</td>
<td>Unqualified Opinion</td>
<td>NA</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Not Mention</td>
<td>63.7%</td>
<td>7.8%</td>
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<tr>
<td>GFOA_2017_Data/AL/Municipality/HooverAL.pdf</td>
<td>Unqualified Opinion</td>
<td>3/28/2018</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Not Mention</td>
<td>74.5%</td>
<td>7.8%</td>
</tr>
<tr>
<td>GFOA_2017_Data/AR/Enterprise Fund(s)/ArkansasWaterandSewerCommissionAR.pdf</td>
<td>Unqualified Opinion</td>
<td>1/12/2018</td>
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<td>Yes</td>
<td>No</td>
<td>Not Mention</td>
<td>NA</td>
<td>NA</td>
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<td>GFOA_2017_Data/AR/Enterprise Fund(s)/ArkansasLotteryCommission.pdf</td>
<td>Unqualified Opinion</td>
<td>11/28/2017</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Not Mention</td>
<td>75.5%</td>
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<tr>
<td>GFOA_2017_Data/AZ/Municipality/SedonaAZ.pdf</td>
<td>Unqualified Opinion</td>
<td>12/15/2017</td>
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<td>Yes</td>
<td>Not Mention</td>
<td>67.1%</td>
<td>8.0%</td>
</tr>
</tbody>
</table>
Some immediate steps

- Require directly processable format (CSV, text, not PDF)
- Create a common store a la open data (e.g. EDGAR)
- Use our robot / methodology to make the data store more compliant
- Publish some PIR results with exception reporting
Back to the future: a vision of leapfrogging

– Objectives & Preliminaries
– Architecture
– Emerging technologies
– Progressing
  • Immediate steps
  • Intermediary
  • The Big vision
OBJECTIVES & PRELIMINARIES
What could government reporting really do?

• Assessing accountability
• Serve as a basis for financing of government entities
• Report / measure service reductions
• Provide a basis for armchair audits
  – The public see government finances (operations???)
• Rank and compare states / municipalities
• Compliance with laws and regulations
• Further understand the implementation of budgets
• Predict events (bankruptcy, shortfalls, social pathologies)
• Further understand the investments in infrastructure and the status of infrastructure
• Replace a myriad of existing reports (a la SBR in Holland)
Preliminaries

• In the sixties corporate financial information reports explained about 60% of the valuation today about 5% (see the End of Accounting by Lev and Gu)

• Auditors today still use judgmental samples of 50 to evaluate populations of millions of transactions

• Analysts/ loan officers of municipal titles use nearly manual methods to evaluate municipal titles in the lack of comprehensive comparative databases

• 85% of S&P 500 firms publish non-GAAP info and 35% have some form of assurance. Typically SASB and Integrated reporting information

3 core information values

- Timely (continuous)
- Standardized
- Informational
  - Current
  - Past
  - Future
  - Scope of information (not only financial)
  - Rapid response
  - Qualitative and quantitative
  - Interactive for the government
ARCHITECTURE
Stakeholders

- Citizens
- Analysts
- Bond Investors
- Creditors
- Legislative and oversight bodies
- Policy makers
- Auditors
- Journalists
- Lobbyists
- Preparers
- etc
ELEMENTS OF ENHANCED GOVERNMENT REPORTING

CONVERGENCE TO “NEAR REAL-TIME”

Galileo Carlab’s Response

- Technology
- Measurement
- Information

- Accountability
- Understandable Disclosures
- System Reliability
- Financial and Non-Financial Measures
- Information Dissemination
Government Open Data and Armchair Auditors

- Countries are undertaking initiatives to open third-party access to data regarding financial and operational information of governments (O'Leary 2015; Schneider et al. 2015)

- Following the open data movement, “armchair auditors” are playing an increasingly important role in crowdsourced monitoring of government expenditures
  - Armchair auditor: anyone who has interest in government spending

Interested parties:
- Professional auditors

Barriers:
- Tools
- Rules

Interested parties:
- Citizens
- Press
- Business competitors
- Political competitors
Data formats

- PDF (Human readable)
- Raw Text
- Word
- CSV/Excel
- Relational DB
- Machine readable
- Taxonomy

Reasoning Capability, Metadata, Context & Knowledge Representation

Time, Effort, Money
Machine readable format for State and Local U.S. Government Financial Reports.

Original PDF

This PDF must be manually extracted!
Track the Funds!

Agency = 10.307, total spent: $903,890

RUTGERS

10.307 reports here

$671,285

Where is the missing $199,271 of 10.307??

RUTGERS

Ohio received 10.307 funds of $33,334 from Rutgers 22000003

Ohio State

RUTGERS

Where is the missing $199,271 of 10.307??
EMERGING TECHNOLOGIES
The Emerging Technological Landscape

• Artificial Intelligence
• Drones
• RPA/IPA
• Blockchain
• Text mining
• Process mining
• Image and video recognition
• And many more
Artificial Intelligence
How does AI work?
Machine Learning

https://www.linkedin.com/pulse/building-machine-learning-infrastructure-pat-alvarado/
Examples of What Machine Learning can do

<table>
<thead>
<tr>
<th>INPUT A</th>
<th>RESPONSE B</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Picture</td>
<td>Are there human faces? (0 or 1)</td>
<td>Photo tagging</td>
</tr>
<tr>
<td>Loan Application</td>
<td>Will they repay the loan? (0 or 1)</td>
<td>Loan approvals</td>
</tr>
<tr>
<td>Ad plus user information</td>
<td>Will user click on ad? (0 or 1)</td>
<td>Targeted online ads</td>
</tr>
<tr>
<td>Audio clip</td>
<td>Transcript of audio clip</td>
<td>Speech recognition</td>
</tr>
<tr>
<td>English Sentence</td>
<td>French Sentence</td>
<td>Language translation</td>
</tr>
<tr>
<td>Sensor from plane engine, etc</td>
<td>Is it about to fail?</td>
<td>Preventive maintenance</td>
</tr>
<tr>
<td>Car camera and other sensors</td>
<td>Position of other cars</td>
<td>Self-driving cars</td>
</tr>
</tbody>
</table>

Source: Andrew Ng
Drones

Hey! Watch out! You just can't desert Muscles in on everyone else's businesses, can you?
Drones

- Inspection
- Damage assessment
- Surveillance
- Bridges
E&Y University Drones for Inventory Case Studies! Bryan’s Amazing Animals
ROBOTIC PROCESS AUTOMATION
Robotic Process Automation

- RPA is a software that can automate repetitive and rule-based tasks.

- RPA robots are capable of mimicking many—if not all—human user actions.

- They log into applications, move files and folders, copy and paste data, fill in forms, extract structured and semi-structured data from documents, scrape browsers, and more.
Robotic Process Automation

- RPA is ideal for “swivel chair” processes in which the inputs from some applications are processed using rules and the outputs are then entered in other applications (Lacity et al., 2015).

Interoperability
Tasks that RPA deals with

- Definable
- Standardized
- Rule-Based
- Repetitive
- Machine-readable inputs

12/8/2020
RPA simple functions

- Open, read, and create emails
- Log in to enterprise apps
- Move files and folders
- Copy and paste
- Fill in forms
- Read and write to databases
- Follow decision rules

- Collect statistics
- Extract data from documents
- Make calculations
- Obtain human input via emails and workflow
- Pull data from the internet
- Keystrokes
Audit with RPA-Tax software case study

- Open a Parameters files (excel)
- Start the tax software
- Use user credentials (from the parameters file) to log in
- Message popup asking for user input (Captcha)
- Navigate to the client’s records (based on the parameters file)
- Open the client’s records
- Initiate Import process
  - Navigate to the needed file (based on the parameters file)
  - Import the file (multiple steps)
- Run Analyses (e.g. depreciation)
- Initiate Export process
  - Navigate to the needed folder (based on the parameters file)
  - Export the file (multiple steps) in Excel format
  - Rename the file (unique, with date and client name)
  - Save in the Export folder
- Open the exported file in Excel
  - Run a Macro in Excel (data manipulation, pivot, sheet creation, etc)
  - Save the final file
PROGRESSING – BABY STEPS
Many non-financial reporting disclosures

- Performance measures
- Sustainability reports
- Going concern
- FERC
- IRS
- CENSUS

- Exogenous data
- Internal forecasts
Plentiful of external (exogenous) data

- XBRL enabled real-time comparative benchmarks
- Links to vendors and suppliers (enrich the value chain information)
- Required disclosure of related parties like dependent SPEs if not consolidated
  - (a requirement of disclosure even for private companies that are SPElike and non-consolidated…)
  - research needed to understand all types of related entities that are of this type and are not consolidated
- Information on the markets of the product lines
Types of Measures in Use

• Typical Measures:
  – Quality of Output
  – Customer Satisfaction/Retention
  – Employee Turnover
  – Employee Training
  – R&D Productivity
  – Environmental Competitiveness, and
  – Company-specific measures.

Source: New Corporate Performance Measures
Immediate Steps

• GET RID OF PDFs (recommend processable files)

• Create Database of CAFRs (use AI / text mining to make them credibly compatible) - EDBCAFRS

• Enrich this with exogenous variables

• Create comparative Dashboard

• Hyperlink to relevant sources of information in particular dynamic exogenous variables
Longer term steps

- Create and require reporting on a set of standardized reports in XBRL-GL
- Move towards more frequent reports and explanatory transition matrices (a la Siconfi)
- Create standardized connectivity to ERP’s and software of major vendors to allow the existence of an “government accounting data standard.”
- Link government disclosures to open data standards and available data
- Run machine learning based diagnostics for prediction or critical issues
- Create an automatic methodology of continuous assurance as an overlay
Conclusions

• A few simple steps could substantially help creating a baseline for digital strategy
• The key issue for effective government reporting is not at this stage accounting standards but the needs of digital enablement to satisfy a wider range of stakeholder
• While business and human behavior has become very digital reporting has remained in the paper pushing model
• Is essential to create a government measurement and disclosure model that is more frequent, timely, standardized, encompass a much wider set of variables and provides the basis for “armchair audits” with open data
• The important issue is data accessibility (machine readable) rather than the format itself (XML, XBRL, etc) because technology changes
SOME OF OUR PROJECTS
Big data and algorithmic trading against periodic and tangible asset reporting: the need for U-XBRL

Dr. Miklos A. Vasarhelyi
KPMG Distinguished Professor Rutgers Business School - Newark & New Brunswick
Director, Rutgers Accounting Research Center & Continuous Auditing & Reporting Lab

Duo (Selina) Pei
PhD Student Rutgers Business School - Newark & New Brunswick
APPLICATIONS OF DATA ANALYTICS: VISUALIZATION AND CLUSTER ANALYSIS OF GOVERNMENTAL DATA – TWO CASE STUDIES

ESSAY 2: COOPERATION WITH THE VOLCKER ALLIANCE
Continuous Monitoring and Audit Methodology for Medication Procurement

Wenru Wang – Rutgers University
Miklos A. Vasarhelyi – Rutgers University
Overview

• Continuous monitoring and audit system for exception and anomaly detections.
New York City Street Cleanliness: Apply Text Mining Techniques to Social Media Information

Huijue Kelly Duan¹
Mauricio Codesso²
Zamil Alzamil³

¹Rutgers, the State University of New Jersey
²Northeastern University
³Majmaah University
Continuous Intelligent Pandemic Monitoring (CIPM)

Huijue Kelly Duan
Hanxin Hu
Miklos Vasarhelyi

Accounting Information System
Rutgers, the State University of New Jersey