



# Auditing, the Technological Revolution, and Public Good

Miklos A. Vasarhelyi

KPMG Distinguished Professor of AIS

Rutgers Business School

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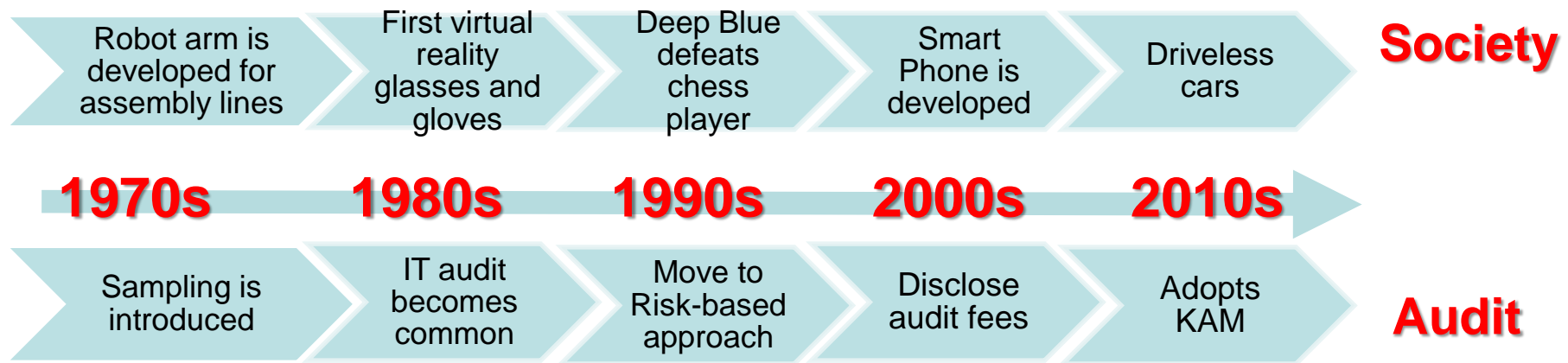
PIOB, MADRID

# THE STORY

The world is rapidly changing, technology enables a 365/24/7 economy

How has the audit profession evolved?

Some major transformations...



## DILEMMAS

1. Technology is moving much faster than its adoption in the assurance arena
2. If analytic methodologies find a material error how do you deal with prior periods?
3. What happens if in full population testing you find many thousands of exceptions?
4. If you are monitoring transactions and assuring before they go downstream is that substantive testing or control testing?
5. If analytic methodologies are not covered in the CPA exam how can the students be interested?

# Public Good

- 1) Adopt the audit data standard to create an easy interconnectivity of audit technology
- 2) Create an experimentation period of dual or multiple audit standards
- 3) Reengineer and re-imagine the structures of accounting and audit education
- 4) Collaborate among the monitoring and standard setters to accelerate and improve accounting and audit standards

## Outline

### The Continuous Audit and Reporting Lab

### Big Data and Analytics

- Analytics – the RADAR Project
- A Cognitive Assistant
- Deep Learning in Assurance
- Smart contracts using blockchain
- Exogenous Process Assurance

### Imagineering Audit 4.0

### Issues and what can be done now



## The CarLab

### Continuous Audit and Reporting Laboratory

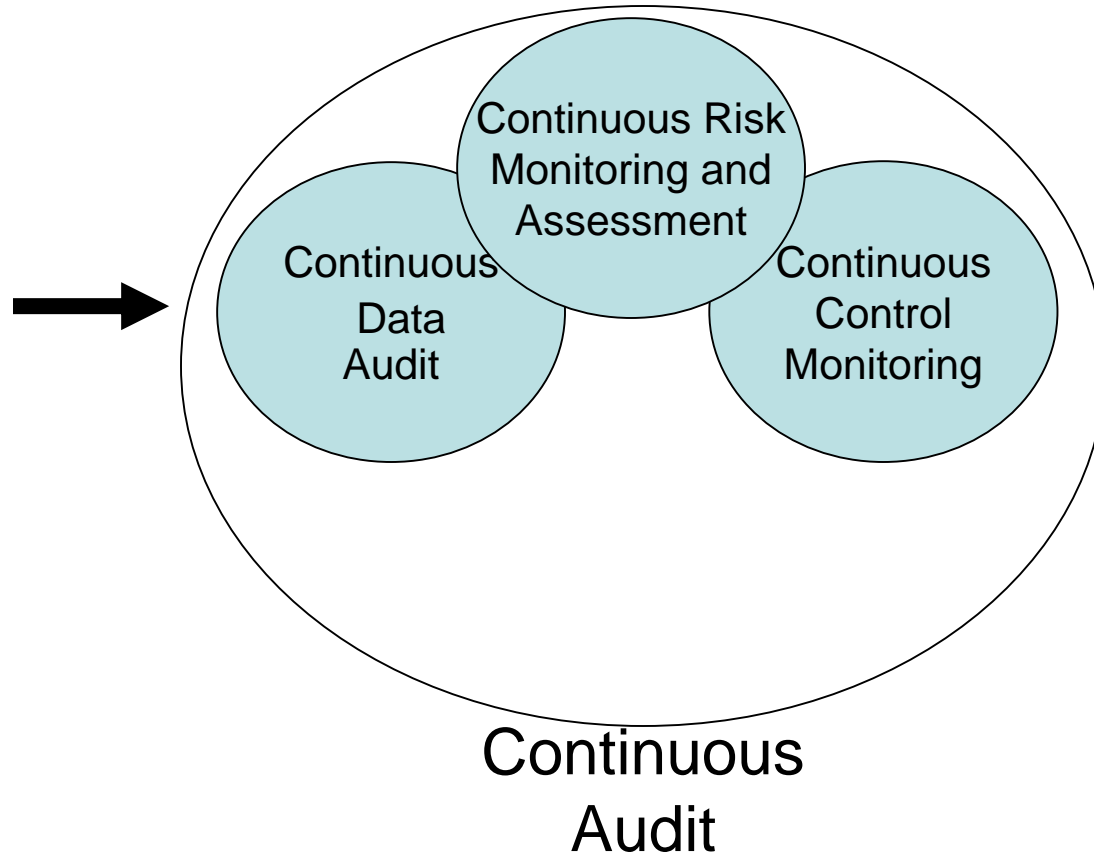
- Graduate School of Management
- Rutgers University



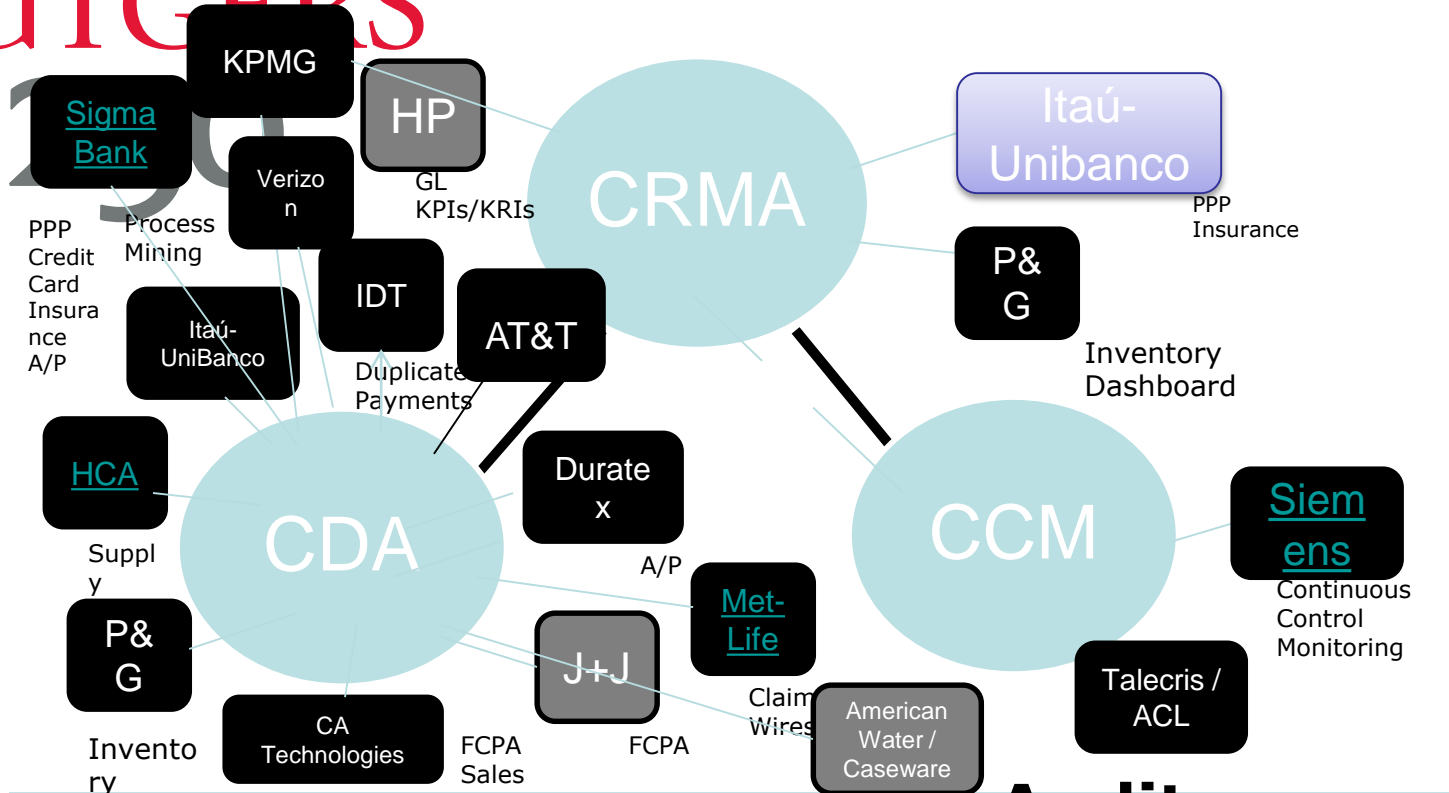
Rutgers Business School

## An evolving continuous audit framework

- Automation
- Sensing
- ERP
- E-Commerce







## Audit Automation

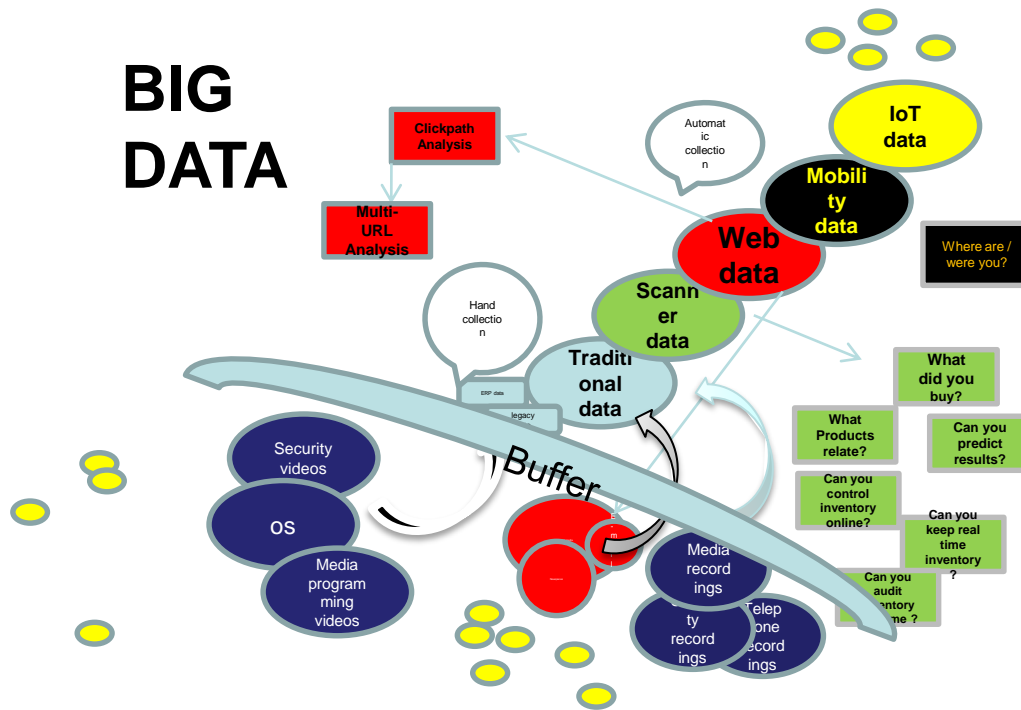
**P&G: Order to Cash**  
**Auditor Judgment**  
**Siemens- AAS Automation**  
**AICPA – ADS / APS**

## Audit

## Methodologies

- [Multidimensional Clustering](#)
- [Process Mining](#)
- [Continuity Equations](#)
- [Predictive Auditing](#)
- **Visualization**
- **Analytic Playpen**
- **Deep Learning**
- **Blockchain and Smart Contracts**
- **Cognitive decision assistant**

# **BIG DATA**



### 3 Vs: Volume, Variety & Velocity

# ANALYTICS

## Data Analytics

### Illustration: Revenue Three-Way Match

Entity ABC has revenue of €125 million generated by 725,000 transactions. The three way match procedure is executed with the following results:

	Amount (€)	%	Number of Transactions	%
No differences	119,750,000	95.8	691,000	95.3
Outliers:				
Quantity differences	3,125,000	2.5	16,700	2.3
Pricing differences	2,125,000	1.7	17,300	2.4

Note: Materiality for the audit of the financial statements as a whole is €1,000,000.

## Data Analytics

### Illustration 2– Predictive Analytic (cont.)

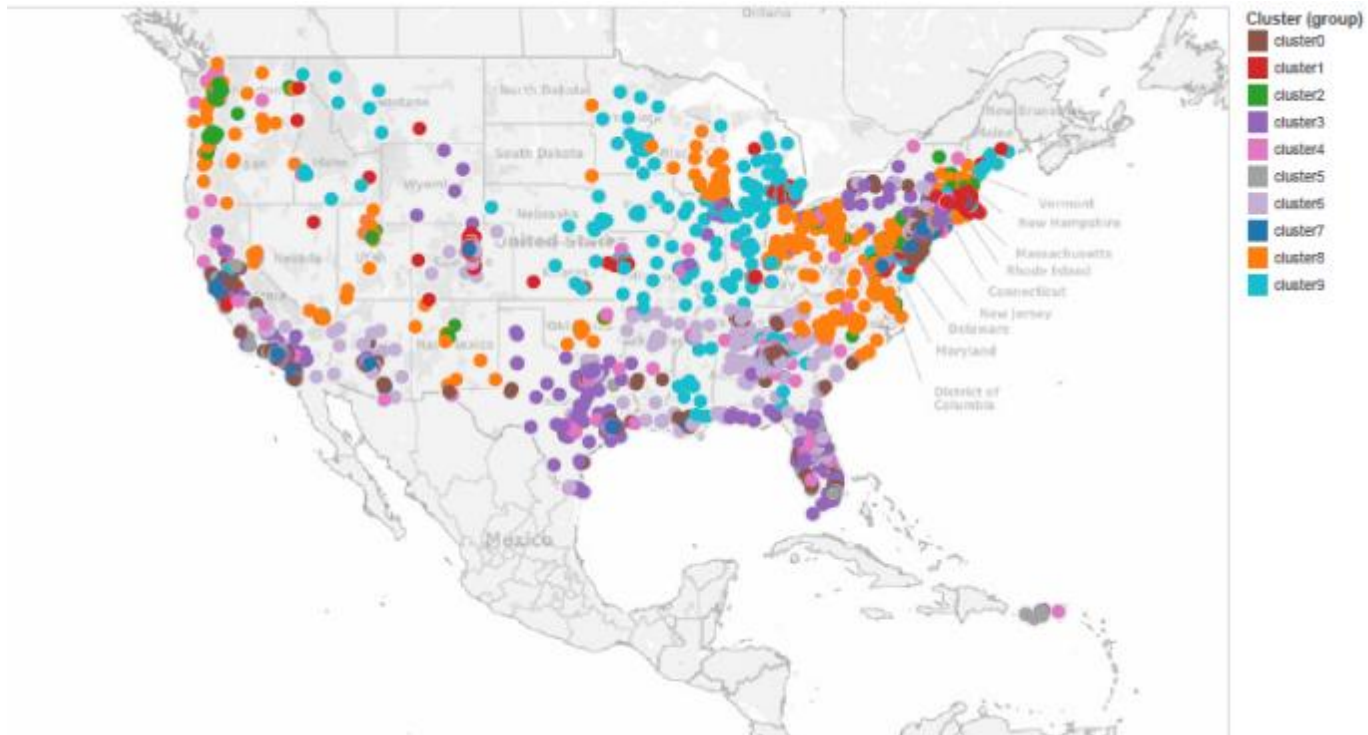
#### Data and Model Description

- Objective: Predict revenue at the store level (approximately 2,000 stores) for a publicly held retail company using internal company data and non-traditional data (e.g., weather).
- Forecasting daily store level sales (one step ahead forecasting).
- Multivariate regression model with / without the peer store indicator and weather indicators.
- AR(1)+...+AR(7) with / without the peer store indicator and weather indicators.

## Data Analytics

# Illustration 2 – Predictive Analytic (cont.)

Clustering Using Store Sales by Peer Group



## Data Analytics

### Illustration 3 – Clustering

Multidimensional clustering is a powerful tool to detect groups of similar events and identify outliers – Audit Sampling (AS 2315)

Can be used in most set of data examination procedures (preferably with a reduced set of data).

Looking for anomalous clusters and outliers from the clusters - Statistically complex.

Multidimensional Clustering for audit fault detection in an insurance and credit card settings and super-app Sutapat Thiprungsri, Miklos A. Vasarhelyi, and Paul Byrnes



## Data Analytics

# Illustration 3 – Clustering (cont.)



Rutgers AICPA Data Analytics Research Initiative

**RADAR**

## **The RADAR project**

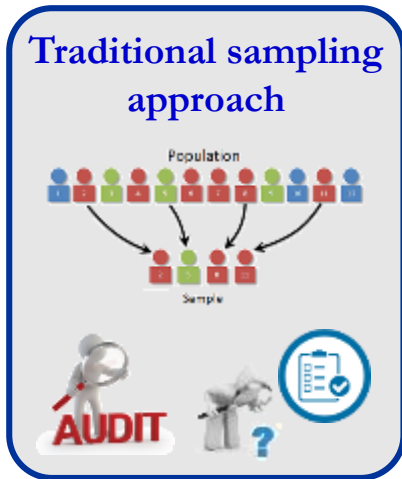
Rutgers, AICPA, CPA Canada, and 8 largest firms

Started officially in June 2016

3 projects currently

- Exceptional Exceptions (MADS)
- Process Mining
- Visualization as Audit Evidence

# Multidimensional Audit Data Selection (MADS)

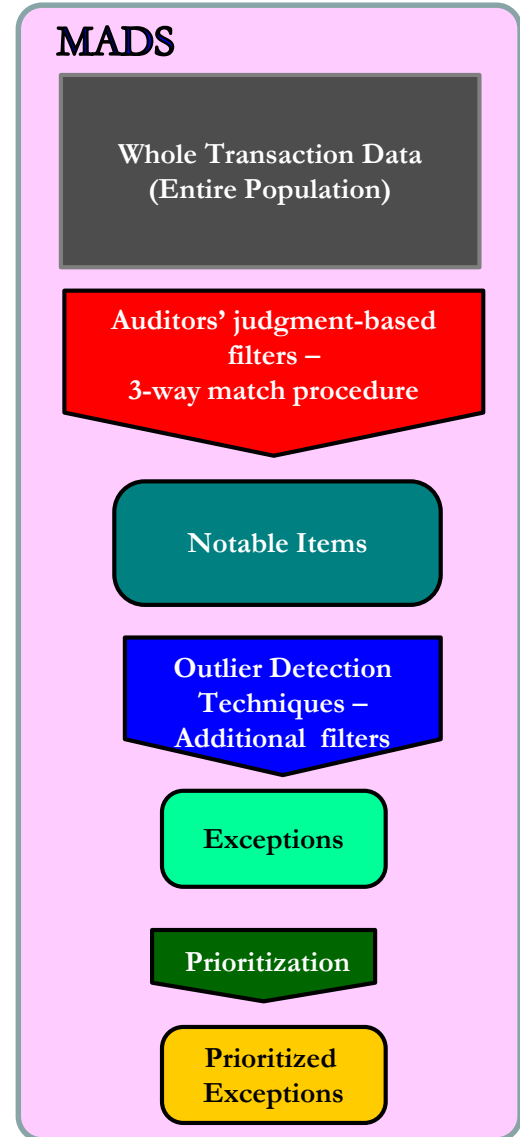


Advance in data processing ability & data analytic techniques allows auditors to evaluate the entire population instead of examining just a chosen sample.

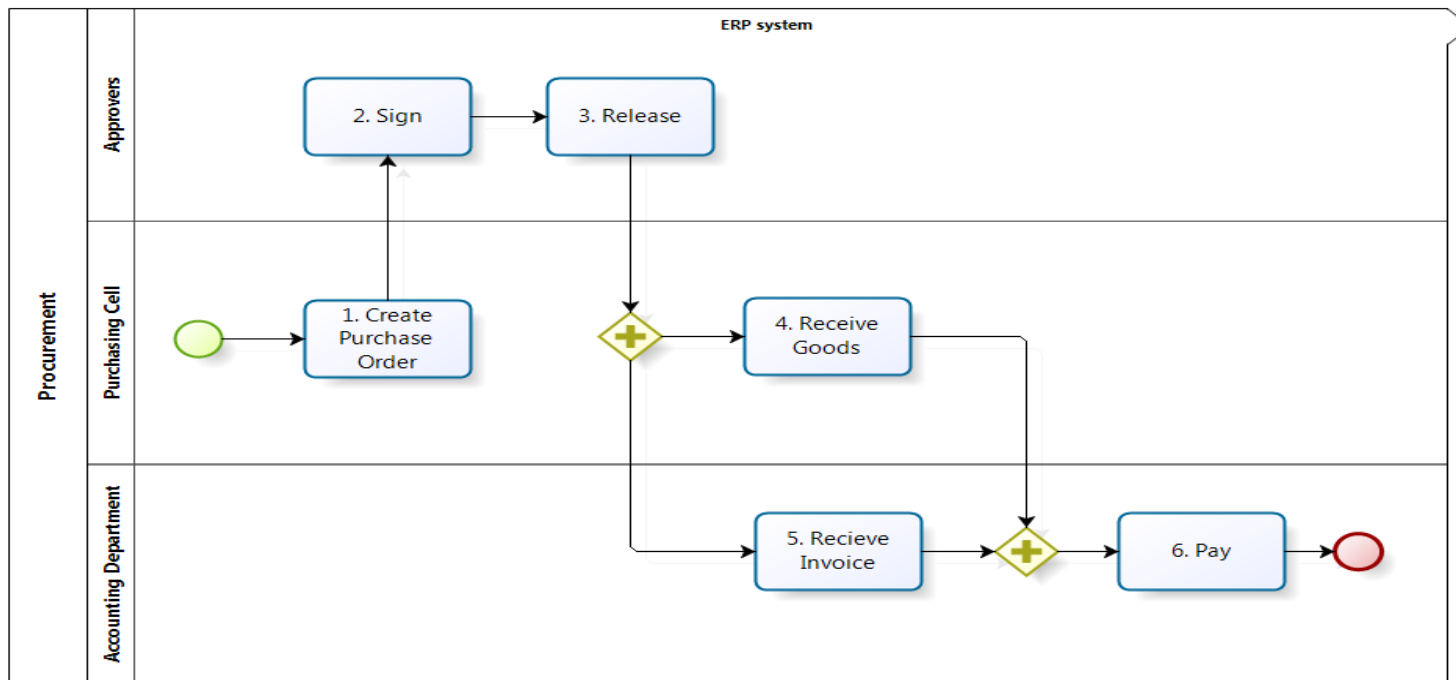


- BUT, often generate large numbers of outliers.
- Impractical for auditors to investigate entire outliers

- Crucial to develop a method that can help auditors effectively deal with large amounts of data, but also assist them to efficiently handle a massive number of outliers.

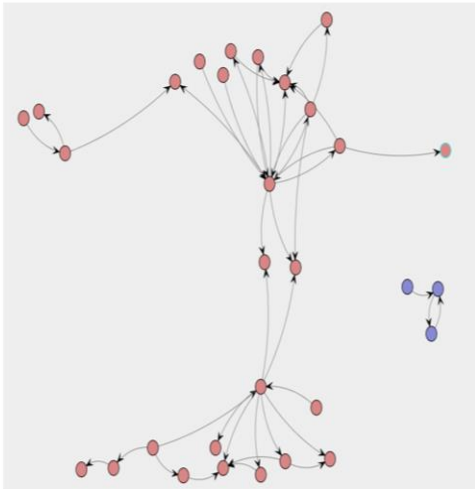


# Analytics for Internal Control Evaluation through Process Mining

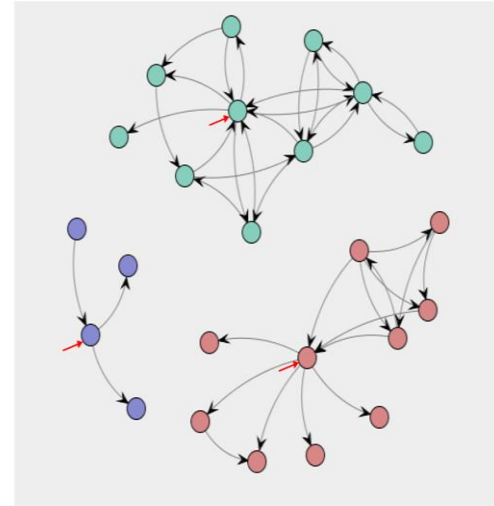


# Analytics for Internal Control Evaluation through Process Mining

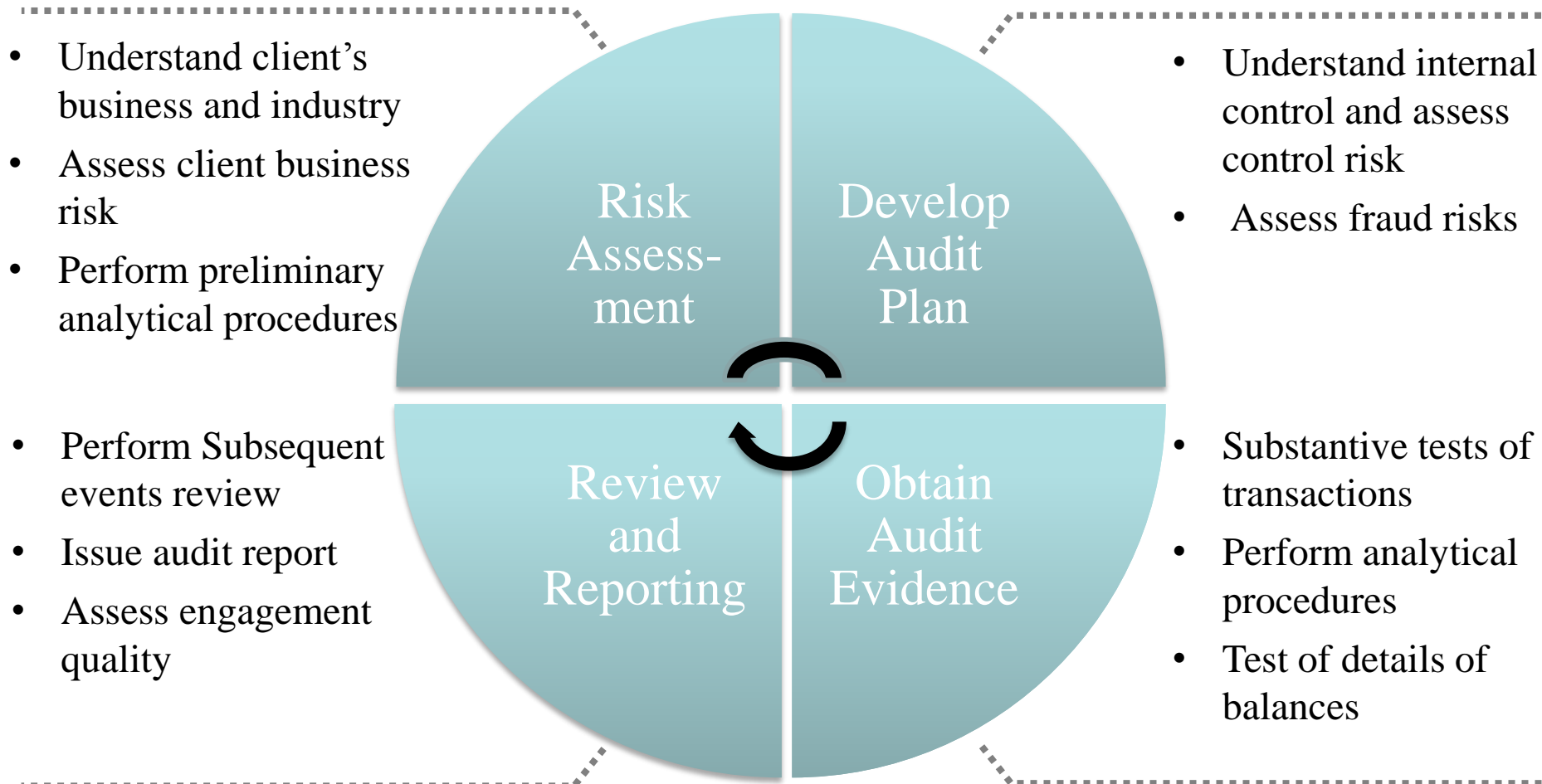
Social Network of the 742 Cases Without *Sign*  
and in Violation of SOD Controls



Social Network of 175 cases by three  
individuals violating SOD

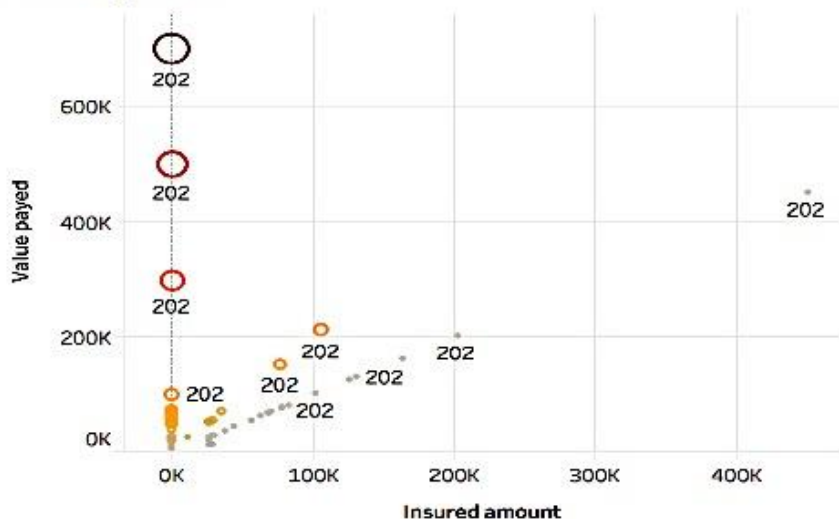


# Visualization in Audit Process

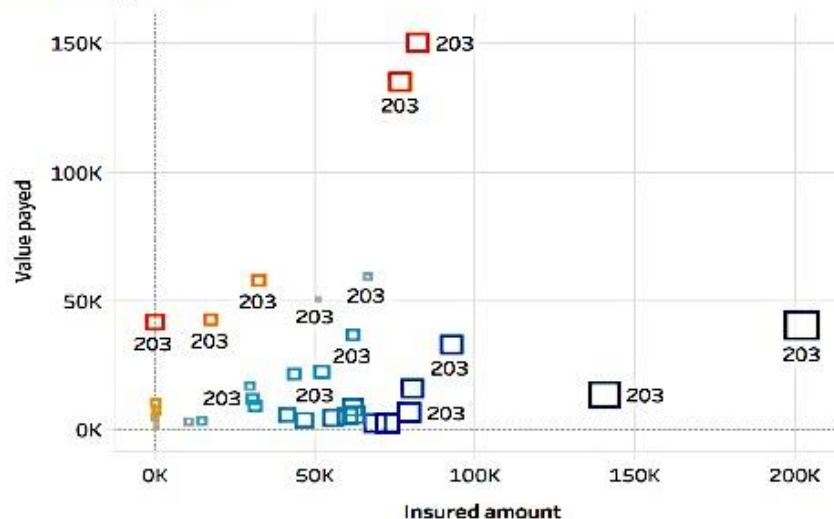


Dashboard: investigate the relationship between insured amount and actual payment amount by different coverage codes for the individual claims

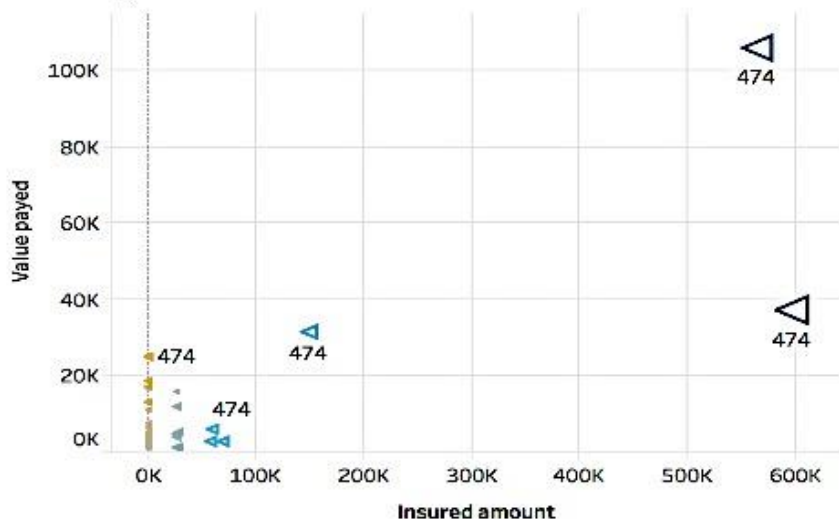
Coverage-202



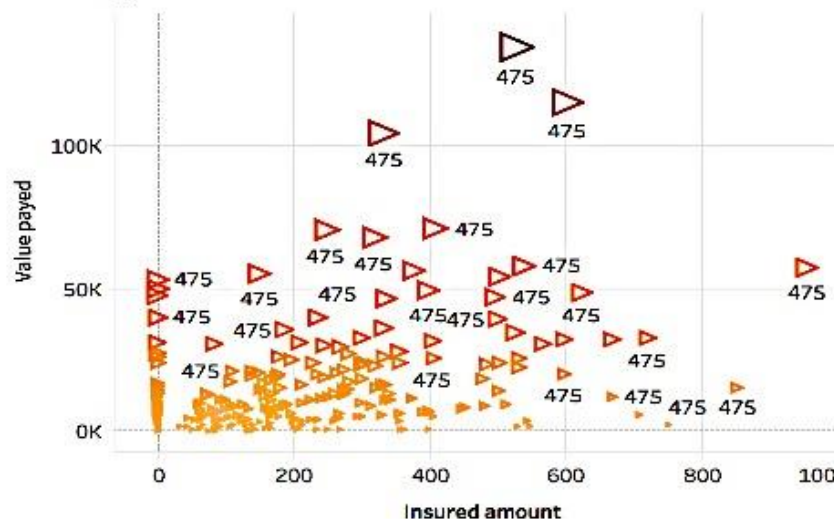
Coverage-203



Coverage-474



Coverage-475







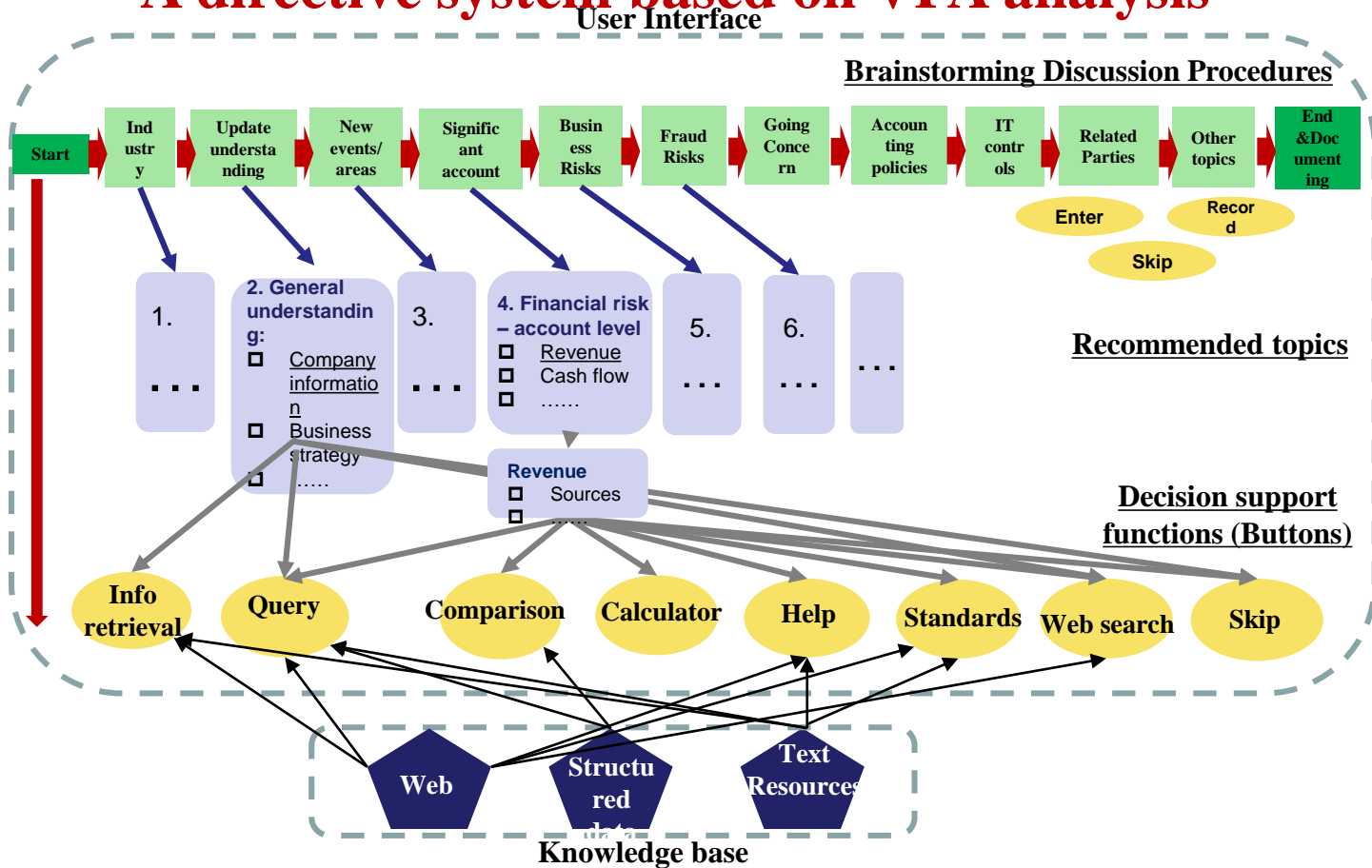
Developing an intelligent cognitive assistant for  
brainstorming meeting in audit planning and risk  
assessment

Qiao Li

Miklos Vasarhelyi

2017/5/2

# Proposed Framework for the Intelligent System - A directive system based on VPA analysis



Ting Sun

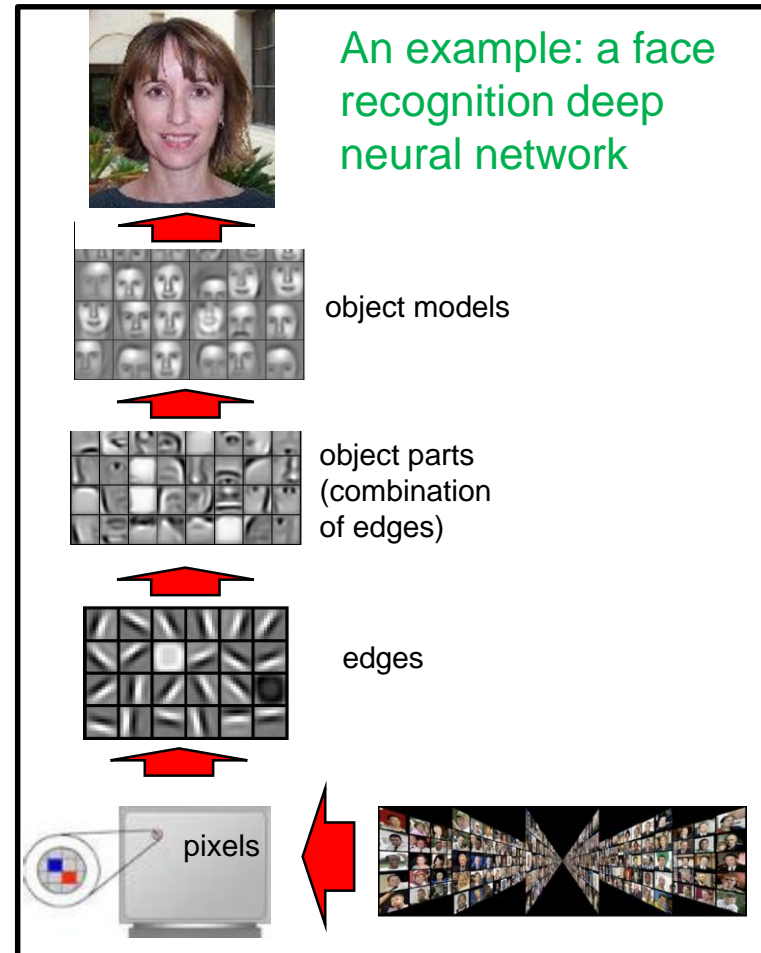
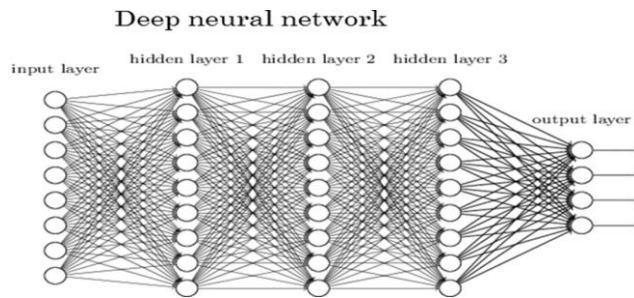
And

Miklos A. Vasarhelyi

# **DEEP LEARNING IN AUDITING**

# Background: Deep learning

Deep learning employs deep neural networks to simulate how the brain learns.



## **Dissertation Essays**

**Research 1. The incremental informativeness of management sentiment for internal control material weakness prediction:**  
*An application of deep learning to textual analysis for conference calls*

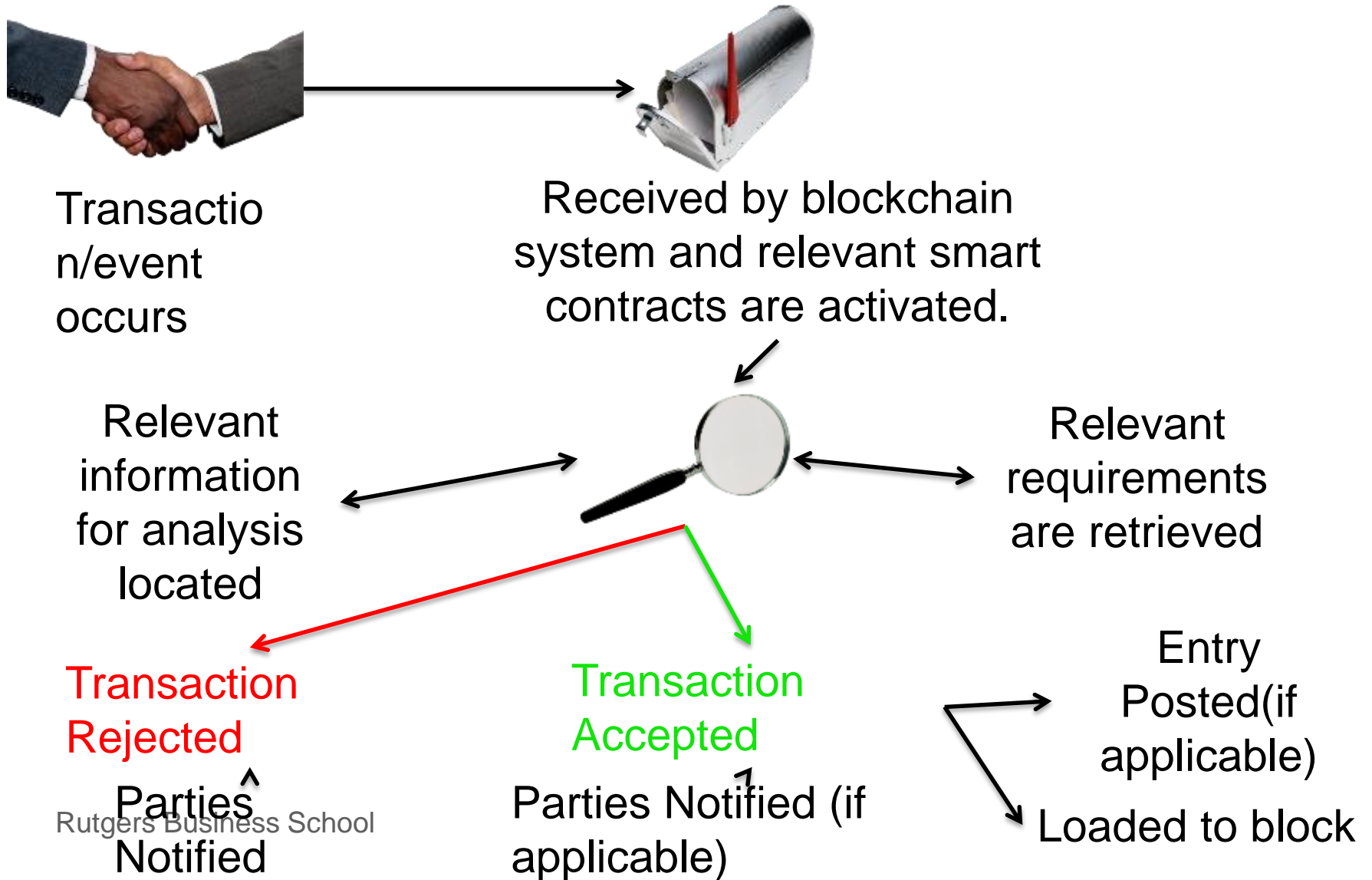
**Research 2. The performance of sentiment feature of 10-K MD&As for financial misstatements prediction:**  
*A comparison of deep learning and bag of words approach*

**Research 3. Do Social Media Messages Provide Clues for Audit Planning?**  
*- An Application of Deep Learning Based Textual Analysis of Tweets to Audit Fee Prediction*

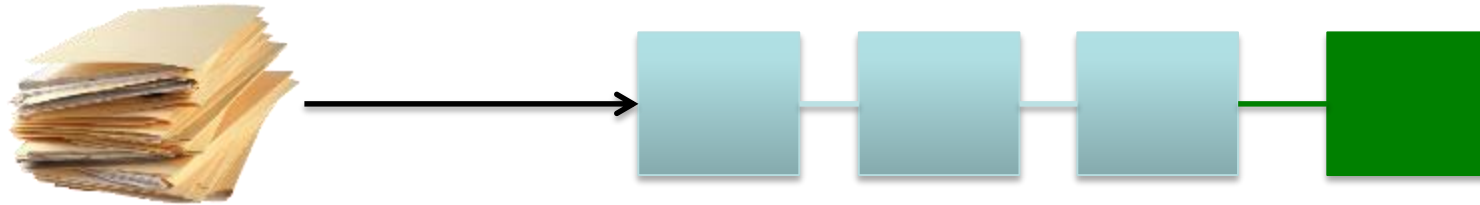
Jamie Frieman and Miklos A Vasarhelyi

# **SMART CONTRACTS USING BLOCKCHAIN**

# Proposed Environment



# Proposed Environment cont.



Validated transactions/events are compiled to form a block

The new block is time stamped and added to the existing chain



**Auditors**

Rutgers Business School



**Management**



**Shareholders**



**Armchair Auditors**



Can a system (data) be audited without going directly into the client data?

# **ASSURANCE WITH EXOGENOUS (BIG) DATA**

# Can there be auditing without getting data directly from the client?

Of course assertions by management are needed (to be verified)

Big data provides a plethora of information progressively more and more relevant

Moon (2016) showed that social media can indicate variances in revenue streams (his CRMA dissertation)

Revenues show high correlation with items such as advertising, social media utterances, supply chain flows, transactions in electronic purchases, IoT measures, etc.

Costs can be associated to online prices, third party orders, process discontinuities, etc.

Most models until more research is performed are ad hoc

# Can there be auditing without getting data directly from the client? (cont)

The level of probable error on these measurements is clearly larger but much less susceptible to tampering

Easier (likely) to create a continuous reporting system that can serve for assurance

Standards would have to radically change

IS THIS AUDITING?

# Exogenous Evidence Integration

What data will be considered evidence?

Measurements	Measurement variables	Assurance of	Quality compared with traditional
Facebook/twitter/news mentions	Name mentions Positive / negatives Sentiment Text meaning	Risk faced Product popularity Sales level	Different
Calls / mails to customer services	Classification of type and outcome by agent	Reserve for product replacement Bad debt estimates	Different
Internet of Things (IoT) records of equipment usage	Sensor data (e.g. weather data)	External Verification	Better
Face recognition of clients	Metadata of videos and pictures: time, location, identity of the person	Fraud	Less accurate but exogenous so it is not intrusive
Video footage	Number of cars in parking lots	Estimates of sales revenue	Less accurate, but more difficult (costlier) to falsify
Geo-locational data	GPS coordinates Zip codes	Efficiency Fraud (collision) FCPA (kickbacks)	Accurate

# **AUTOMATING THE AUDIT**

# Audit Production Line

Phase	AI-Enabled Automated Audit Process	Traditional Audit Process
Pre-planning	<ul style="list-style-type: none"> <li>-AI collects and analyzes Big Data (exogenous)</li> <li>-Data related to the client's organizational structure, operational methods, and accounting and financial systems feed into AI system</li> </ul>	<ul style="list-style-type: none"> <li>-Auditors examines client's industry</li> <li>-Auditor examines client's organizational structure, operational methods, and accounting and financial systems</li> </ul>
Contracting	<ul style="list-style-type: none"> <li>-AI uses the estimate of the risk level (from phase 1) and calculates audit fees, number of hours</li> <li>-AI analyzes a database of contracts &amp; prepares contract</li> <li>-Auditor and Client sign contract</li> </ul>	<ul style="list-style-type: none"> <li>-Engagement Letter prepared by the auditor based on the estimated Client risk</li> <li>-Auditor and client sign contract</li> </ul>
Understanding Internal Controls and Identifying Risk Factors	<ul style="list-style-type: none"> <li>-Feed flowcharts, questionnaire answers, narratives, into AI and use image recognition and text mining to analyze them</li> <li>-Use Drones to conduct the walkthrough, then use AI to analyze the generated video</li> <li>-Use visualization and pattern recognition to identify Risk factors</li> <li>-AI aggregates all this data to Identify Fraud and illegal acts risk factors</li> </ul>	<ul style="list-style-type: none"> <li>-Document understanding (flowcharts, questionnaires, narratives, walkthrough)</li> <li>-Auditor aggregates this information and uses their judgment to identify risks factors</li> <li>-Understanding of IC to determine the scope, nature, and timing of substantive tests.</li> </ul>
Control Risk Assessment	<ul style="list-style-type: none"> <li>-Continuous Control Monitoring Systems examine controls continuously</li> <li>-AI runs Process mining to verify proper IC implementation</li> <li>-Logs are automatically generated to ensure their</li> </ul>	<ul style="list-style-type: none"> <li>-Examination of the client's IC policies and procedures</li> <li>-Risk assessment for each attribute</li> <li>-Test of controls</li> <li>-Reassess risk</li> <li>-Document testing of controls.</li> </ul>

# Audit Production Line (Continued)

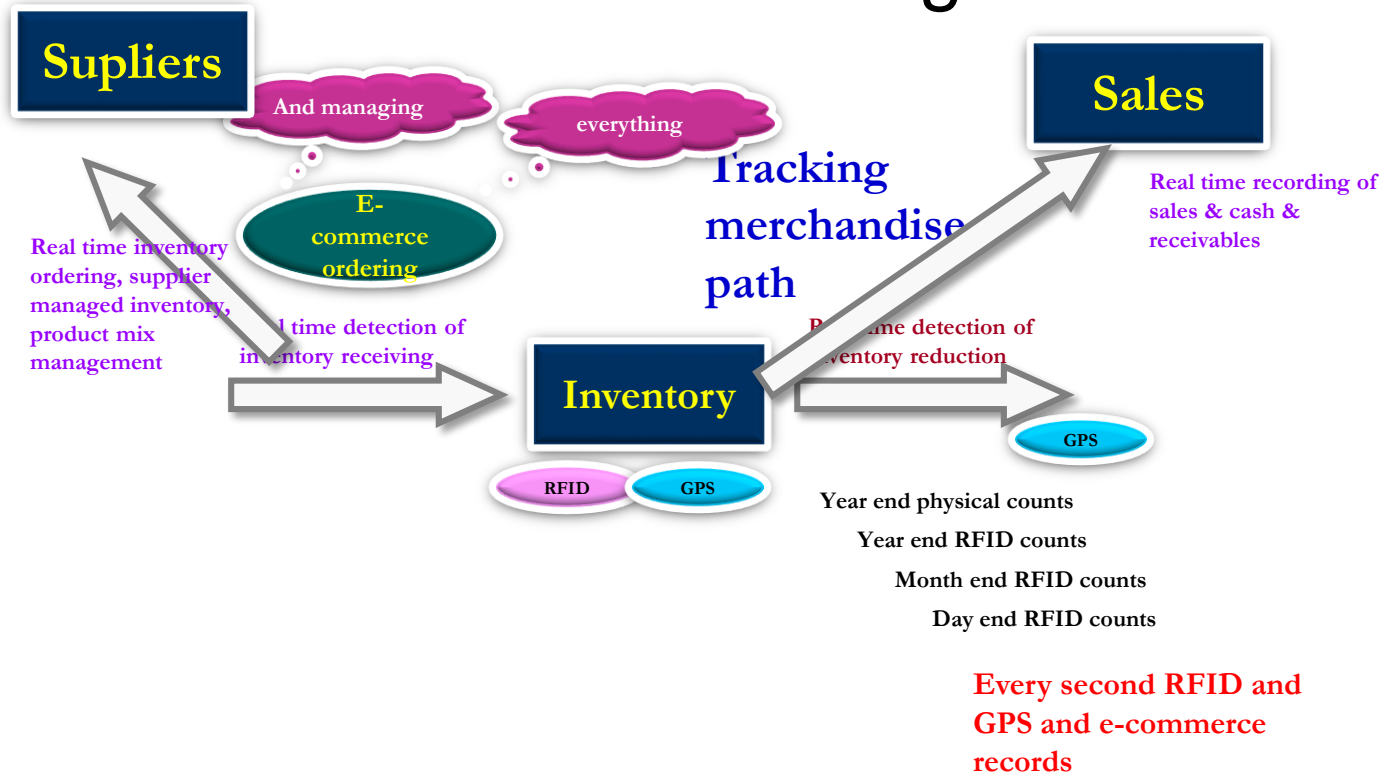
Phase	AI-Enabled Automated Audit Process	Traditional Audit Process
Substantive tests	<ul style="list-style-type: none"> <li>-Continuous Data Quality Assurance to ensure quality of data and evidence</li> <li>-AI examines data provenance</li> <li>-Continuous test of details of transactions on 100% of the population</li> <li>-Continuous test of details of balances (at all times)</li> <li>-Continuous pattern recognition, outlier detection, benchmarks, visualization</li> </ul>	<ul style="list-style-type: none"> <li>-Periodical Sampling-based tests, and nature, extent, and timing depend on IC tests</li> <li>-Tests of details of a sample of transactions</li> <li>-Test of details of balances (at a certain point in time)</li> <li>-Analytical procedures</li> </ul>
Evaluation of Evidence	<ul style="list-style-type: none"> <li>-This becomes part of the previous phase</li> </ul>	<ul style="list-style-type: none"> <li>-Auditor must evaluate the sufficiency, clarity, and acceptability of collected evidence. Accordingly, the auditor may either collect more evidence, or withdraw from engagement.</li> </ul>
Audit Report	<ul style="list-style-type: none"> <li>-AI uses a predictive model to estimate the various risks identified</li> <li>-Audit report can be continuous (graded 1-00 for example) rather than categorical (clean, qualified, adverse, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>-Auditor aggregates previous information to issue a report</li> <li>-Report is categorical: Clean, qualified, adverse, etc.</li> </ul>

The Thinking that must go into change

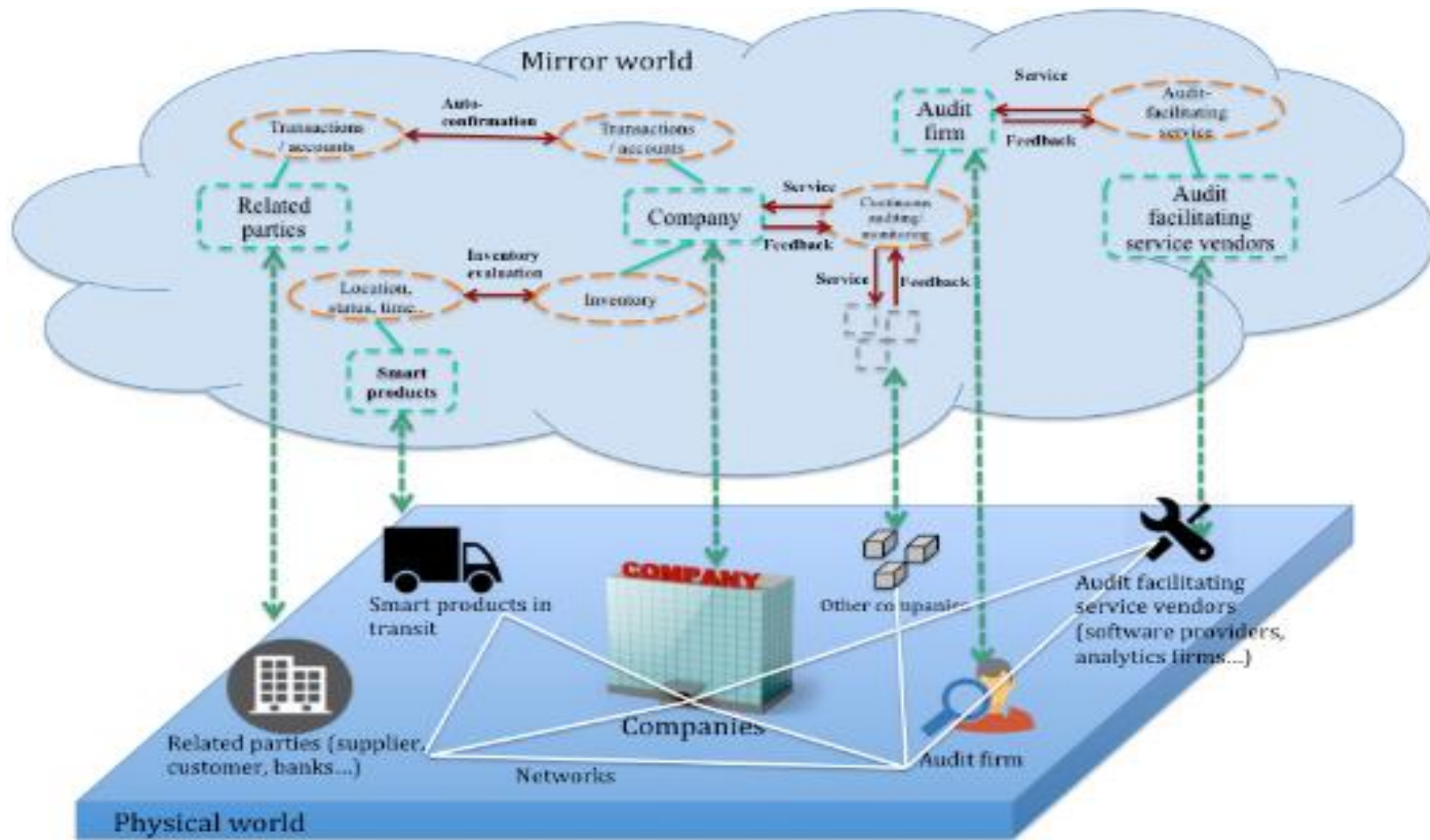
# **IMAGINEERING THE FUTURE AUDIT**



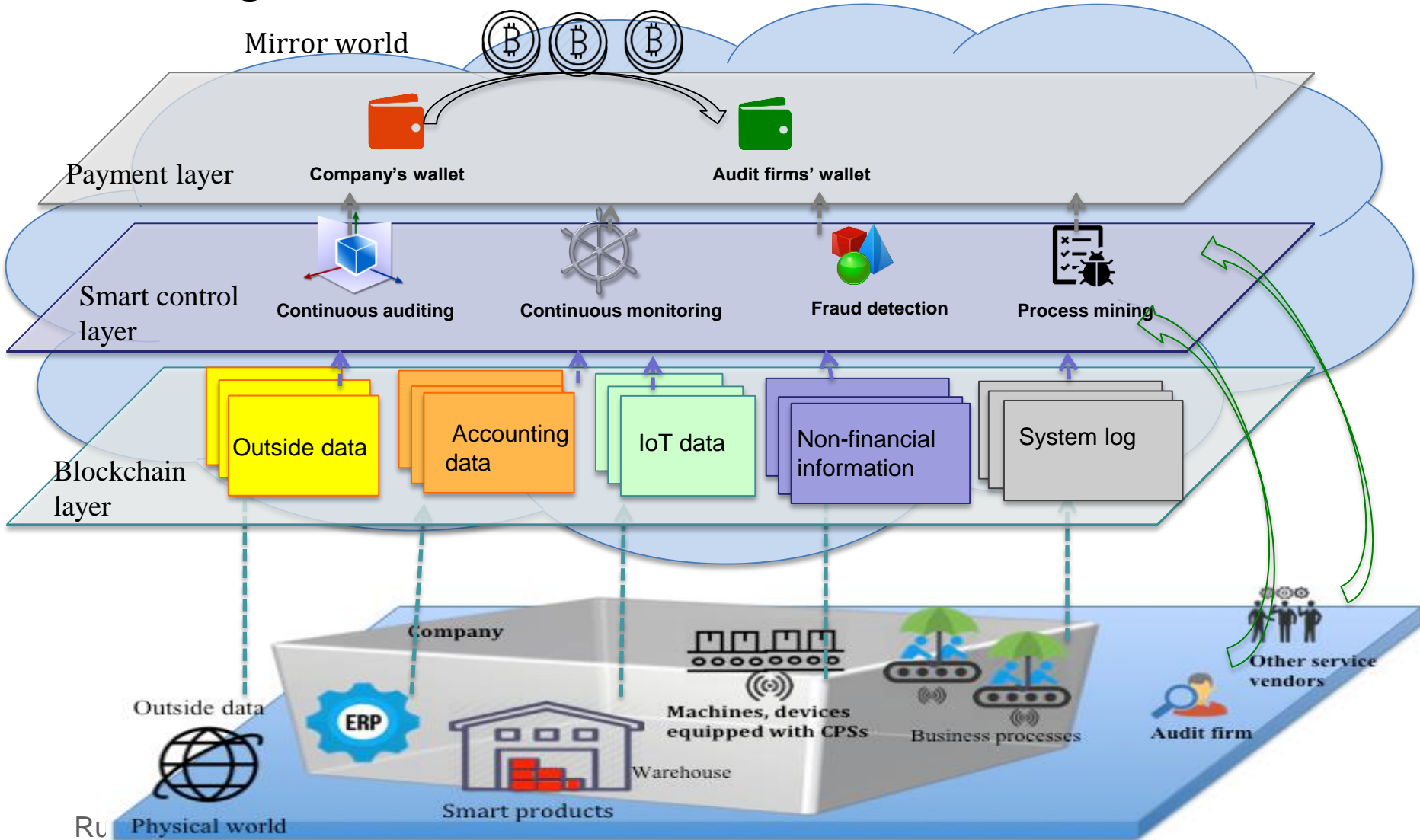
# ASSURING INVENTORY and other things



# Basic Structure and Functions of Audit 4.0



# Linking Blockchain to Audit 4.0

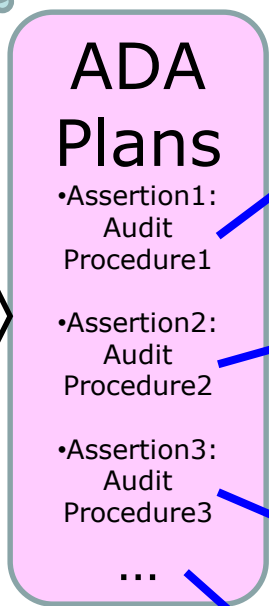
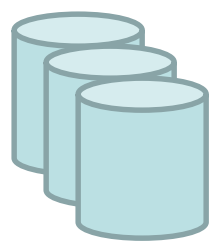


# **ISSUES AND WHAT CAN BE DONE NOW**

# AUDIT DATA STANDARD

Corporate data stores

Audit Data Standards



Audit apps



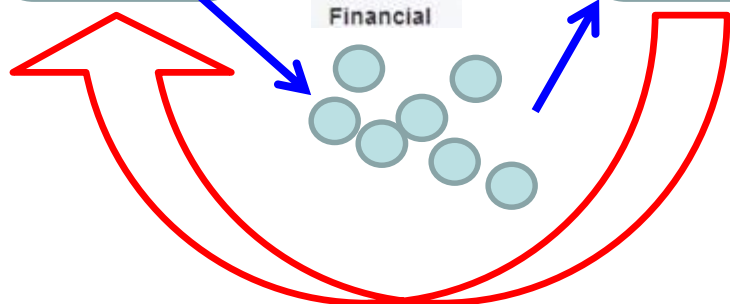
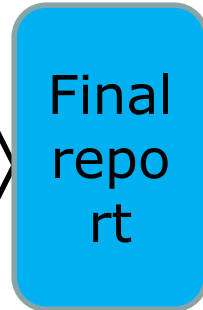
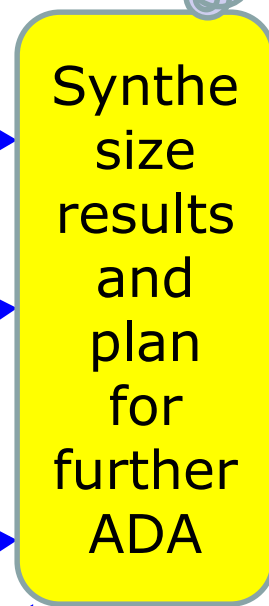
General Ledger



Accounts Receivable



Financial



# **AN EXPERIMENTATION PROGRAM**

# An experimentation program for New GAAS

## **Objective:**

To substantially accelerate the inclusion of modern analytic and monitoring methods and explore new forms of audit evidence.

## **Execution:**

Agreement between the audit client, the audit firm, the standard-setter, and an academic institution (e.g. Rutgers University):

A safe harbor provision indicating the relaxation of existing audit standards (i.e. PCAOB, IAASB) on participating audit engagements.

Agreed upon procedures that will act as substitutes to traditional audit procedures.

The client IT team would provide access to presumably large amounts of system generated data (i.e. more data than in traditional engagements); the client's IA team would participate in the program.

Specification of the audit area and engagement that will be targeted for examination.

The audit for the selected business process can be examined from its initial (i.e. planning) to concluding audit phase (audit wrap-up).



# EDUCATION

# What should auditors know in Analytics

We need our staff to be aware of the tools and techniques that are available to them to address audit risks.

We need our professionals to be able to identify risks (frame out their questions) and to think about what data would be useful in addressing those risks (answer those questions).

Our auditors can leverage the skills of specialists in capturing and transforming that data. Our auditors need to think about how they could analyze that data and to visualize the data in order to provide the information or evidence necessary to reach their conclusion,

We have standard tools and data engineers to help build custom solutions.

Mike Leonardson (EY Leader of Analytics)

# CONCLUSIONS

# Key Questions

Where in the audit of historical financial statements are these methods to be used?

How to create an experimentation period where supervised analytics projects are performed in real engagements?

How to deal with the economic limitations of using data analytic methods in audits?

How can human and device competencies be created?

How will data analytics impact regulators' approaches and auditing standards?

## Observation

It should be clear that the art of leveraging technology and data analytics will further enhance the quality of the audit and achieve better protection of the public interest.

Audit regulation has the power to accelerate the rate of adoption of analytics and this is a great opportunity for standard setting.

## **Public Good – Actions to consider**

- 1) Adopt the audit data standard to create an easy interconnectivity of audit technology
- 2) Create an experimentation period of dual or multiple audit standards
- 3) Reengineer and re-imagine the structures of accounting and audit education
- 4) Collaborate among the monitoring and standard setters to accelerate and improve accounting and audit standards

**Thanks!!**

**Contact me at**

**[miklosv@rutgers.edu](mailto:miklosv@rutgers.edu)**

**Visit**

**<http://raw.rutgers.edu>**

# EXTRA SLIDES



## Resource:

# Audit Data Analytics free on YouTube from the Rutgers Curriculum

### 1. Introduction to Audit Analytics:

<https://www.youtube.com/playlist?list=PLauepKFT6DK8nsUG3EXi6lYVX0CPHUnqi>

### 2. Special Topics in Audit Analytics:

<https://www.youtube.com/playlist?list=PLauepKFT6DK-PpuseJtSMlly-YBhaV4TH>

### 3. Information Risk Management:

[https://www.youtube.com/playlist?list=PLauepKFT6DK8uxePhPCoHjDf8\\_DlhRtGS](https://www.youtube.com/playlist?list=PLauepKFT6DK8uxePhPCoHjDf8_DlhRtGS)

### 4. Tutorials for Risk Management:

<https://www.youtube.com/playlist?list=PLauepKFT6DK9Grq8J67NMyGpYh1AsBb-->

For more information please visit:

<http://raw.rutgers.edu/accounting-courses.html>