An introduction to the Jacquard research project
"Next Generation Auditing: Data-Assurance as a Service"

Building a Domain-Specific Language to capture concepts and methods of the Owner-Ordered Audit Tradition

Philip Elsas
ComputationalAuditing.com

Rutgers, Newark, USA

November 5-6, 2010
Introduction

• **Since 2003: Company - Canada, Netherlands**
  Offering software and consultancy services to innovate audit practices and audit software firms

• **1988-2003: Deloittie.**
  with ‘97-‘99 intermezzo at Bakkenist Management Consultants, sold to Deloittie.
  - Principal, chief architect & inventor of Smart Audit Support
  - Smart Audit Support: since 1994 key in Deloitte’s worldwide audit practice. Currently integrated in ‘The Deloitte Audit’
  - System blueprint in chapter 5 of ...

• **1990-1996: PhD Computational Auditing**
  - PhD in Mathematics & Computing Science on Financial Auditing
  - In parallel to Smart Audit project, 30% part-time, *Vrije Universiteit*
  - Directly after appearance awarded with the biennial Alfred Coini Prize for the best publication in Auditing

The Dutch Tax Office used Computational Auditing in 2001-2003 as frame of reference to compare Big 4 planning and decision-support models & systems to investigate how to improve audit productivity (57 page report); considers Smart Audit Support ‘leader of the pack’

ComputationalAuditing.com
Agenda

Building a Domain-Specific Language (DSL) to capture concepts and methods of the Owner-Ordered Audit Tradition

- Audit Domain Challenge
- Owner-Ordered Audit Approach
- Jacquard project
  "Next Generation Auditing: Data-Assurance as a Service"

Netherlands ranks in population as US state no. 5, between Florida & Illinois
Netherlands ranks in GDP as US state no. 4, between New York & Florida
Today’s audit challenge No.1

International Federation of Accountants (IFAC), “Financial Reporting Supply Chain”

“Shareholders should more actively pursue their ownership responsibilities” & “Align managerial behavior with the interests of the owners”, Jane Diplock, 2010

“Shareholders have little to say in the USA” & “Push legislators for statutory duty of care to investors, and get over the Caparo ruling (UK)”, David Webb, 2010

European Commission, “Corporate governance in financial institutions and remuneration policies”, green paper, June 2010, § 3.5 “The role of shareholders”

“... lead to the abstraction, or even disappearance, of the concept of ownership normally associated with holding shares” & footnote 18

General questions 3 & 5: “How to practically improve shareholder control of financial institutions, if still realistic?” & Necessary reinforcements for the external auditor

Gaspar et al. “Shareholder Investment Horizon and the Market for Corporate Control”

diagnosis
remediation
Today’s audit challenge No.2

International Federation of Accountants (IFAC), “Financial Reporting Supply Chain”

“Moving forward, national accountancy organizations should be charged with inventorying, bottom up, systemic disconnects that are difficult to voice for individual audit firms fearful of offending clients, and synthesizing them in an anonymous fashion.”, Jules Muis, Washington, DC, 2010

See Royal NIVRA project “Sharing Knowledge” (“Kennis Delen”), NIVRA.nl

See: “Preparing for an Audit Mandate to Contribute to Systemic Risk Anticipation”, ‘de Accountant’ & accountant.nl, 2009, with follow-up in 2010

“My concern is that they are making themselves irrelevant.” Steven Thomas about auditors, based on the E&Y - Lehman case, 2010

Rick Bookstaber’s Congressional testimonies on:
- Hedge Funds, 2009
- Derivatives, 2009
- Systemic Risk, 2008 & 2007

with requested comment on financial reform, June 2010

diagnosis

remediation
“Thus, the most important factor is society’s needs, and the related factor that interacts with it is the ability of auditing methods to meet society’s needs. However, society’s needs are not fixed and change over time. Also, auditing methods can change and improve over time.”

Agenda

Building a Domain-Specific Language (DSL) to capture concepts and methods of the Owner-Ordered Audit Tradition

- Audit Domain Challenge
- Owner-Ordered Audit Approach
- Jacquard project
  "Next Generation Auditing: Data-Assurance as a Service"
1840-1930: Two Main Directions of Audit

Money inflow for owners: long-term ROI

Owner-ordered audit, to check management:
- to increase credibility that profits aren’t UNDERstated, or unstated: that no revenues are missing & expenses (e.g. bonuses) aren’t too high

Management-ordered audit, to attract new investors:
- to increase credibility that profits aren’t OVERstated: that stated profits are real, and not (partly) fake

Money inflow for management: maximize equity

Owners

Potential Owners

Management

USA

NETH&UK
1930-1990: Branching scientific approaches

Anglo-American evolutionary branch

practical-inductive

Audit policies, methods and standards follow from considering a lot of performed audits; empirical

Dutch evolutionary branch

theoretical-deductive

Audit methods evolve from client’s top-level business process, i.e. normative model

Originally only a mental process model; later, due to formalization, supported by executable process model

1840-1930 foundation
management-ordered audit: overstated profits

1840-1930 foundation
owner-ordered audit: understated profits
Supercycle: top-level business process

A rectangle represents a state, a balance sheet item

A circle represents a (trans)action, an activity, a mutation to connected states

'Soll' (To Be) & 'Ist' (As Is) modalities

Schmalenbach (1929), Limperg (1926, 1930’s), Abr. Mey (1936), Burgert (1957), Starreveld (1962, 1980’s), Frielink (1980’s), Blokdijk (1975), Veenstra (1972, p.41)

Supercycle is key concept in Owner-Ordered Audit Tradition

Supercycle is key concept in Owner-Ordered Audit Tradition
Addressing today’s challenge no.1

Today we worldwide only use a management-ordered audit method. Ignoring the proven method of the owner-ordered audit.

Why don’t we allow shareholders to substantiate their ownership responsibilities? Why not have long-term incentive structures imposed upon management via the owner-ordered audit method?

The potential risk pertaining to management picking up the bill for an integral two-way audit (the ‘paying, thus dominating’ risk), can be mitigated by continuing high-quality documentation (‘if it’s not documented, it’s not audited’), complemented by governmental reviewing.
Financial institutions are exposed to more moral hazard than ever before. Why not measure systemic risk while it’s building up? Why not introduce preventive measures to reduce built-up?

A newborn, powerful preventive measure is the Royal NIVRA’s ‘Sharing Knowledge’ project, with supportive technology. The auditor is positioned to attest whether internal controls and incentives are in place to provide data of adequate reliability. A reliability emphasizing long-term ownership interests. Anything better to neutralize management’s exposure to moral hazard than the owner-ordered audit?

Individual financial institutions might each be free of an internal systemic risk, while, as a collection, they may induce an external systemic risk. This occurs when a lot of institutions take a similar position, while the other side is not sufficiently covered. Loosely speaking: too many are on the same side of the ship, without them being able to see one another. The auditor is a pre-eminent party to make such accumulated systemic risk visible. It’s a party that is able to aggregate information into systemic risk indicators - or to certify the required reporting channel - while taking professional care of confidentiality issues.

See: ‘de Accountant’, April 2010
Golden opportunity for audit profession

Pull side
- Improve the audit profession’s relevancy to society
  - Individual audit: ownership orientation (chall. 1)
  - Contribute to systemic risk mitigation (chall. 2)

Push side
- R&D of supportive concepts and technology

Match-making between ‘pull’ & ‘push’
- Internationalize the owner-ordered audit method. This requires deep computational support. Why?
  - To minimize international, educational burden (3-years post-Master)
  - To streamline train-the-trainer, roll-out & getting ROI fast
Agenda

Building a Domain-Specific Language (DSL) to capture concepts and methods of the Owner-Ordered Audit Tradition

- Audit Domain Challenge
- Owner-Ordered Audit Approach
- Jacquard project "Next Generation Auditing: Data-Assurance as a Service"
Jacquard project:
Next Generation Auditing:
Data Assurance as a Service

- Project lead: CWI, the Dutch national Center of Mathematics & Computing Science, Paul Klint, Tijs van der Storm, Paul Griffioen + ...

- Project partners:
  - PricewaterhouseCoopers, Jacques de Swart & Mona Mashaie (13th WCAS)
  - The Dutch Tax Office, Marc van Hilvoorde (XBRL)
  - ComputationalAuditing.com, Philip Elsas

- Project result: Domain-Specific Language (DSL) in Software as a Service (SaaS) architecture, 2010-2014

- Project sketch: RascalMPL- & model-based audit support

What’s a DSL?

In software development and domain engineering, a domain-specific language (DSL) is a programming language or specification language dedicated to a particular problem domain, a particular problem representation technique, and/or a particular solution technique.

The concept isn't new—special-purpose programming languages and all kinds of modeling/specification languages have always existed, but the term has become more popular due to the rise of domain-specific modeling.

Domain-specific modeling (DSM) is a software engineering methodology for designing and developing systems, such as computer software. It involves systematic use of a graphical domain-specific language (DSL) to represent the various facets of a system. DSM languages tend to support higher-level abstractions than general-purpose modeling languages, so they require less effort and fewer low-level details to specify a given system.

What’s supported by the DSL?

Owner-ordered auditing: dominating and integrating with management-ordered auditing

- Quantitative: **completeness** of management’s stated profits
- Qualitative: assess irreplaceable internal control to secure actions of agents
  - assess what? **long-term incentive & authorization structure**
  - how? segregation of duties serving long-term owner interest
- Supercycle: client’s top-level business process
  - from mental model to supportive process model
  - unifying quantitative and qualitative

Why, and how, the present financial crisis is driving owner-ordered auditing core concepts out of a local past and into a global future

More: 101 slide deck in Smart Auditing PhD course: www.siks.nl/SA-2010.php, Research School for Information and Knowledge Systems, SIKS.nl, Royal Dutch Academy of Arts & Sciences, KNAW.nl
Next Generation Auditing: Data-Assurance as a Service

Key Audit Phases

1. Ist supercycle mining
   Extend process mining to client’s top business process

2. Soll supercycle identification
   Identify Soll supercycle in Ist smart flowchart

3. Continuous auditing
   Confront a stream of business events to Soll, close-to-real-time; quantitative & qualitative

4. Collect, collate & aggregate deviations automatically
   Supported by Dempster-Shafer-Srivastava method

5. Publish deviation top-10 on supercycle dashboard
   Interactive interface to query the enterprise; iPhone app
Phase 1: Ist Supercycle Mining
Phase 2: Identify Soll in Ist

Identify Soll supercycle by excluding Ist flows, based on automatically identified candidate Ist flows

Apply constraints to check if remaining model is a valid Soll


Pull signal from audit practitioners & IT audit educators, e.g. “Process Mining” by Mieke Jans & CARLAB, Rutgers, 2010

Push signal from Technical University of Eindhoven, ProM, Fluxicon & Anne Rozinat

Analyzing 3232 cases, classifying casualties (red arrows):
A. Invoice receipt without prior approval (2537x)
B. Approval acquired after purchase completion (261x)
C. Purchase order established for rejected request (9x)
D. Handled order status skipping receipt (875x), etc.

Design-time workflow vs. run-time workflow
Phase 3: Continuous auditing

On-the-fly, close-to-real-time checking of spanning business equations

Confront a stream of business events to Soll

"Continuity Equations" Miklos Vasarhelyi et al. CARLAB, Rutgers, 2010

Reconcile with external evidence

Triangulation

3rd party evidence processing

Interrelate all buffer contents

Especially spanning buy side & sell side

Capture deviations and associated risks

http://www.ComputationalAuditing.com/images/Kring.swf

ComputationalAuditing.com
Phase 3, Continuous Auditing, **Quantitative:** Continuous Checking of Spanning Equations

7) \((A/R)_B + \text{Sales} + TS - (A/R)_E \rightarrow C/R\)

6) \text{COGS} + \text{Gross Profit} \rightarrow \text{Sales}

3) \((\text{Inv})_B + P - (\text{Inv})_E \rightarrow \text{COGS}\)

2) \(C/D - (A/P)_B + (A/P)_E - TP \rightarrow P\)

1) \((\text{Cash})_B + C/R - TO - (\text{Cash})_E \rightarrow C/D\)

8) \((\text{VAT})_B + TS - TP - TO \rightarrow (\text{VAT})_E\)

- Equation numbers relate to classical audit literature (Frieling et al.)
- The whole equation system is automatically generated from supercycle diagram.
- Sub-scripts ‘B’ and ‘E’ stand for Begin and End; C/R: Cash Receipts; A/R: Accounts Receivable; TS: value added Taxes received on Sales; COGS: Cost of Goods Sold; Inv: Inventory; P: Purchases during the period; A/P: Accounts Payable; TP: value added Taxes Paid on purchases during the period; C/D: Cash Disbursements; VAT: Value Added Taxes; TO: Taxes payment Outflow (with thanks to Raj Srivastava)
Continuous auditing web service intercepts
Authorization Change Request & signals:

refuse
human intervention required
OK

Segregation of Duties is key in irreplaceable internal control:
irreplaceable in the sense that there is no way for an external auditor to compensate its lacking or failing, while it is indispensable for a rationally justifiable approval

Segregation of Duties is substantiated very strongly in Owner-Ordered Audit Tradition

Answers the question:
“Free of opportunities for traceless embezzlement, without need to collude?”

Design, Implementation & Operation

“Audit Automation as the Foundation of Continuous Auditing”
Michael Alles, Alexander Kogan, Miklos Vasarhelyi & Donald Warren, 16th WCAS, 2008

Phase 4: Aggregate deviations

\[
\begin{align*}
2 \text{ Receivables} + 3 \text{ Inventories} &= \begin{cases} 
5 \text{ Assets} \quad \text{or} \\
5 \text{ Current Assets} \end{cases} \\
\end{align*}
\]

- **At least one non-current inventory**
- **All three inventories are current**

**Aggregation in XBRL:**
- Calculation linkbase
- XBRL Formula

**Articulate XBRL Assurance functionality using a dedicated website builder (plug-ins) instead of handcrafting XBRL Formula's**


**Plug-in: transferable ‘type polymorphism’ mechanism for XBRL Assurance Builder & Player**

Domain-Specific Language (DSL) for auditing: Pacioli, developed by Dutch software partner in cooperation with national research center for mathematics and computer science in the Netherlands (CWI) & University of Amsterdam
Phase 4, Aggregate deviations, **don’t stop** at individual audit: Nexus micro-macro

“Preparing for an audit mandate to contribute to systemic risk anticipation”, accountant.nl

“Automatic aggregation in auditing, with an application to systemic risk anticipation”, 19th World Continuous Auditing & Reporting Symposium, Rutgers, New Jersey, 2009

Royal NIVRA’s ‘Sharing Knowledge’ project & “Risk control and technology”, Royal NIVRA Dutch Auditing Day, Amsterdam, 2009

With supporting technology to:

1. **Receive input data streams via auditor-certified channels:** to assure data is reliable from a long-term ownership perspective

2. **Aggregate data anonymously**

3. **Present a Rosling-style big picture of Bookstaber’s systemic risk indicators, with built-in triggers for timely alerts:** to pro-actively inform financial institutions, why not via their auditors?

“Hans Rosling shows the best stats you've ever seen”

See: challenge no. 2
Phase 4, Nexus micro-macro: sustainability

The owner-ordered audit method of assessing the completeness assertion is superbly transferable from ‘completeness of revenues’ to ‘completeness of pollution’
Phase 5: Publish & address deviation top-10

Publish on interactive dashboard
Supercycle as dashboard
Drill-down on analytics
Planning & Control
Key Performance Indicators (KPI’s)
Key Control Indicators (KCI’s)
Example Key DSL operators

1. SoD operator (Segregation of Duties) + case by PwC
   Support to map & analyze a body of authorizations

2. BoM operator (Bill of Material)
   Using product spec to generate production process spec

3. PFDF expressions (Process Flow Determining Factors)
   Proven method to integrate product-specific supercycles

4. Continuous Spanning Equations & Reconciliation Checks
   Extending proven equational method to continuous app

5. XBRL operators
   Polymorphism mechanisms for type & tag coercions
Using data to prevent fraud that data won’t reveal
Illustration based on a case study

Jacques de Swart - PwC
Paul Griffioen - CWI
Philip Elsas - ComputationalAuditing.com

October 2010
1. Case description
2. Starreveld’s supercycle
   - General Ledger representation
   - Authorisation representation
3. Illegitimate actions
4. Petri nets and Fourier-Motzkin algorithm
5. 12 canonical scenarios for potential fraud that data won’t reveal
6. Follow-up
7. Data request from multi-national PwC client
8. Conclusion
Case description


A heating system maintenance company runs six processes:
1. Sales
2. Procurement (including subcontracting)
3. Labour allocation
4. Maintenance visits
5. Accounts Receivable to Cash cycle
6. Accounts Payable to Cash cycle

A $600 sale involves five annual maintenance contracts and requires 10 units of supplies, 5 units of tools and transport, 5 units of subcontractors and 15 units of labour, having fixed unit costs of $6, $10, $8 and $20, respectively, thus yielding $600 - $60 - $50 - $40 - $300 = $150
Starreveld’s supercycle – General Ledger (GL) representation

- Circles denote balance sheet items
- Squares denote income statement items
- The lower half represents goods/services flows
- The upper half represents financial flows
- The left half represents internal buy side flows
- The right half represents internal sell side flows
- Value is generated at Sales & cashed in Bank

Jacquard “Next Generation Auditing” team: CWI - PricewaterhouseCoopers - ComputationalAuditing.com - Belastingdienst
Starreveld’s supercycle – Authorisation representation

Jacquard “Next Generation Auditing” team: CWI - PricewaterhouseCoopers - ComputationalAuditing.com - Belastingdienst
We call an action illegitimate if it does not belong to the Soll supercycle. From the previous slide we derive officials who can act illegitimately, and how:

<table>
<thead>
<tr>
<th>Balance sheet item</th>
<th>official</th>
<th>f</th>
<th>b</th>
<th>s</th>
<th>w</th>
<th>h</th>
<th>o</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debtors</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplies</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tools</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subcontractors</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labour</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creditors</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contracts</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Income statement item</th>
<th>official</th>
<th>f</th>
<th>b</th>
<th>s</th>
<th>w</th>
<th>h</th>
<th>o</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>ARtoCash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>SuppliesProcurement</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ToolsProcurement</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LabourAllocation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Subcontracting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APtoCash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
The supercycle can be interpreted as a Petri net.

The Fourier-Motzkin algorithm computes:

- the space spanned
- by all canonical forms
- of sequences of bookings
- both legitimate and illegitimate
- by only one official (or colluding group)
- extracting value from the company
- without leaving traces behind in the GL

For our case, the algorithm returns 12 canonical forms of potential fraud by f that extract a multiple of $150 from the company without leaving traces in GL
4 out of the 12 scenarios for potential fraud that data won’t reveal:

<table>
<thead>
<tr>
<th>Potential fraud scenarios</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sales</strong></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>ARtoCash</strong></td>
<td>600</td>
<td>450</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td><strong>Visits</strong></td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td><strong>SuppliesProcurement</strong></td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td><strong>ToolsProcurement</strong></td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td><strong>LabourAllocation</strong></td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td><strong>Subcontracting</strong></td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td><strong>APtoCash</strong></td>
<td>150</td>
<td>150</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td><strong>Illegitimate Income</strong></td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td><strong>ARtoCash</strong></td>
<td>-600</td>
<td>-450</td>
<td>-600</td>
<td>-600</td>
</tr>
<tr>
<td><strong>Visits</strong></td>
<td>-5</td>
<td>-5</td>
<td>-5</td>
<td>-10</td>
</tr>
<tr>
<td><strong>SuppliesProcurement</strong></td>
<td>-10</td>
<td>-10</td>
<td>-10</td>
<td>-20</td>
</tr>
<tr>
<td><strong>ToolsProcurement</strong></td>
<td>-5</td>
<td>-5</td>
<td>-5</td>
<td>-10</td>
</tr>
<tr>
<td><strong>Subcontracting</strong></td>
<td>-5</td>
<td>-5</td>
<td>-5</td>
<td>-10</td>
</tr>
<tr>
<td><strong>APtoCash</strong></td>
<td>-150</td>
<td>-150</td>
<td>-150</td>
<td>-300</td>
</tr>
<tr>
<td><strong>Illegitimate Balance Sheet bookins</strong></td>
<td>-150</td>
<td>-150</td>
<td>150</td>
<td>5</td>
</tr>
</tbody>
</table>

**Interpretations**

1. f keeps the profit of the last sale for himself
2. f sells against cost price to friend
3. f pays his friendly supplier twice
4. f gives his friend an additional free ride
The algorithm also yields the minimal authorisation decrease for f to exclude this potential: f should not be permitted to record sales of contracts.

Next steps in our research:

- Extend Domain Specific Language in audit context
- Collect (far) more complex cases (e.g. multi-national PwC clients)
- Establish XBRL interface to GL and authorisation data
- Refine the Fourier-Motzkin algorithm
- Integrate with other types of data analysis
Data request by multi-national PwC client:

- ISA 240 (SAS 99) tables from SAP
  - BKPF
  - BSEG
- Defining the right scope
  - Not too much, or too little data
  - Not too many users, zoom in via departments
  - Having a good balance between financial and goods/services flows
Conclusion:

Strange but true:

Data allows us to prevent fraud that data won’t reveal
Your questions, or advisory comments

PhilipElsas@ComputationalAuditing.com