DATA ANALYTICS AND PROCESS MINING IN INTERNAL AUDIT

St. Louis Institute of Internal Auditors (IIA)

April 23, 2020
INTRODUCTIONS AND HOUSEKEEPING

Housekeeping:

- Remember to participate in the polling questions throughout the presentation – required to earn CPE credits (2 CPEs for this 100-minute session)
OVERVIEW OF TODAY’S PRESENTATION

- Describe the vision for **data analytics** within Next Generation Internal Audit
- Understand the **top priorities and challenges** faced by internal audit in implementing data analytics
- Introduce emerging **process mining** technology changing the audit process
- Provide live demonstration of **Celonis** process mining tool
DATA ANALYTICS IN INTERNAL AUDIT
DATA ANALYTICS – SENSING TO VALUE CREATION

Developing a **repeatable** decision-making process that **leverages data** through **logical reasoning** and **analytical methods** to turn insights into **tangible business outcomes**

**Increase Efficiency and Effectiveness**

**Increase Breadth and Depth of Coverage**

**Continuous Monitoring, Real-time Response**

**Discover Unknown Unknowns**
NEXT GENERATION INTERNAL AUDIT

Competencies, qualities and components to effect change

- Machine Learning (ML)
- Artificial Intelligence (AI)
- Process Mining
- Robotic Process Automation (RPA)
- Advanced Analytics
- Continuous Auditing
- IA Strategic Vision
- Organizational Structure
- Resource & Talent Management
- Aligned Assurance
- Dynamic Risk Assessment
- High Impact Reporting
- Agile Audit Approach

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WHAT DOES NEXT GENERATION IA LOOK LIKE?
Emerging Business Issues REQUIRE Innovative Approaches

<table>
<thead>
<tr>
<th>Next Generation Internal Audit</th>
<th>Emerging Business Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Governance</strong></td>
<td><strong>ETHICS</strong></td>
</tr>
<tr>
<td>■ Prospective Strategy</td>
<td><strong>INTEGRITY</strong></td>
</tr>
<tr>
<td>■ Aligned Enterprise Assurance</td>
<td><strong>RISK</strong></td>
</tr>
<tr>
<td>■ Streamlined Structure</td>
<td><strong>STRATEGY</strong></td>
</tr>
<tr>
<td>■ Aligned &amp; Evolving Skills</td>
<td><strong>TRANSFORMATION</strong></td>
</tr>
<tr>
<td>■ Applied Technical Acumen</td>
<td></td>
</tr>
<tr>
<td>■ Flexible Resourcing</td>
<td></td>
</tr>
</tbody>
</table>

| **Methodology**               | **CONDUCT DATA**        |
| ■ Dynamic Risk Assessment     | **EMERGING COMPLIANCE** |
| ■ Real-time Risk View         | **AI ROBOTS**           |
| ■ Analytics Driven            | **QUALITY ML**          |
| ■ Agile & Scalable Execution  | **CLOUD CULTURE**       |
| ■ Engaged Stakeholders        | **EXTERNAL DIGITAL**    |
| ■ Simplified and High Impact Reporting |             |

| **Enabling Technology**       | **RPA EXTERNAL**        |
| ■ Ubiquitous Data             | **QUALITY**             |
| ■ Automated Processes         | **EXTERNAL DIGITAL**    |
| ■ Advanced Analytics          | **RPA**                 |
| ■ Process Mining Insights     | **EXTERNAL DIGITAL**    |
| ■ Machine Learning            | **EXTERNAL DIGITAL**    |
| ■ Artificial Intelligence     | **EXTERNAL DIGITAL**    |

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DATA ANALYTICS POLL QUESTION #1

Does your IA department currently have a dedicated D&A function?

A. Yes
B. No
### DATA ANALYTICS POLL QUESTION #2

What is the size of the analytics function within your Internal Audit department?

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Doesn’t exist</td>
</tr>
<tr>
<td>B</td>
<td>1-2 resources</td>
</tr>
<tr>
<td>C</td>
<td>3-5 resources</td>
</tr>
<tr>
<td>D</td>
<td>6+ resources</td>
</tr>
</tbody>
</table>
DATA ANALYTICS COMPLEMENTS INTERNAL AUDIT

Analytics can benefit several aspects of a traditional internal audit – primarily by increasing risk coverage, attaining broader and more accurate testing results, utilizing fewer resources during an audit, and automating the overall testing process.

<table>
<thead>
<tr>
<th>Sample Testing</th>
<th>Test Case Sourcing</th>
<th>Audit Testing</th>
<th>Result Reporting</th>
<th>Continuous Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sample</strong></td>
<td><strong>Auditee Fatigue</strong></td>
<td><strong>Manual</strong></td>
<td><strong>Manual</strong></td>
<td><strong>Manual</strong></td>
</tr>
<tr>
<td>In a traditional corporate audit, a sample selection of about 5-10% of the total population is used for testing.</td>
<td>Test case sourcing is typically provided from the client side.</td>
<td>Typical audit tests are completed manually, by cross referencing documents and data sources. This allows for greater chance of human error.</td>
<td>Reports on testing results are also manually compiled in a traditional audit.</td>
<td>The continuous monitoring of testing progress and results are done manually in a typical corporate audit.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Traditional Audit Techniques</th>
<th>D&amp;A Integrated Techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Population</strong></td>
<td><strong>Self-Service</strong></td>
</tr>
<tr>
<td>With D&amp;A capabilities, full populations can be tested. This allows for more coverage and greater insights into testing.</td>
<td>D&amp;A allows for direct access to test case sourcing, which reduces the auditee workload and automates the testing process.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Scripted</strong></th>
<th><strong>Automated</strong></th>
<th><strong>Streamlined</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytics automates several aspects of typical audit testing, reducing the margin of error and time spent on testing.</td>
<td>With D&amp;A, reporting results can be generated through a variety of analytics software suites, increasing automation and reporting accuracy.</td>
<td>Continuous monitoring can be both automated and scheduled (i.e. dashboarding) with D&amp;A methods.</td>
</tr>
</tbody>
</table>
# Analytics and the Internal Audit Process – A Framework

## Governance
- Strategic objectives
- Multi-year roadmap
- Roles & responsibilities
- Resources
- Technology

## Risk Assessment
- Key Risk Indicators
- Quantitative and qualitative inputs
- Trend analysis across business lines and geographies
- Key Risk Indicators
- Quantitative and qualitative inputs
- Trend analysis across business lines and geographies

## Audit Planning
- Coverage determination and focus points
- Identification of changes in the control environment
- Understanding of data and systems supporting a process
- Coverage determination and focus points
- Identification of changes in the control environment
- Understanding of data and systems supporting a process

## Audit Execution
- Full population testing
- Re-performance of automated controls and/or reports
- Identification of outliers for further investigation
- Code review
- Data acquisition
- Full population testing
- Re-performance of automated controls and/or reports
- Identification of outliers for further investigation
- Code review
- Data acquisition

## Audit Reporting
- Visual graphics
- Historical views
- Visual graphics
- Historical views

## Issue Validation & Monitoring
- Visualizations of current state
- Historical Analysis
- Trend Analysis & Monitoring
- Visualizations of current state
- Historical Analysis
- Trend Analysis & Monitoring

## Stakeholder Reporting
- Issue & risk trending
- Visualizations of key risks
- Project Status Monitoring & Analysis
- Issue & risk trending
- Visualizations of key risks
- Project Status Monitoring & Analysis

## Continuous Improvement
- Quality Assurance reporting
- Trending across audit teams
- Metrics on Value of Internal Audit
- Quality Assurance reporting
- Trending across audit teams
- Metrics on Value of Internal Audit

## Continuous Auditing
- Re-use data acquisitioning
- Re-use test scripts
- Re-use reporting shells
- Re-use data acquisitioning
- Re-use test scripts
- Re-use reporting shells

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### DATA ANALYTICS POLL QUESTION #3

In which area are you finding the most success in leveraging D&A in your audit processes?

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Risk Assessment (KRI’s, quantitative/qualitative analysis, trending)</td>
</tr>
<tr>
<td>B</td>
<td>Audit Planning (scoping, sampling, etc.)</td>
</tr>
<tr>
<td>C</td>
<td>Audit Execution (testing, reperformance of automated controls / reports, data acquisition, investigation of outliers, etc.)</td>
</tr>
<tr>
<td>D</td>
<td>Audit Reporting (visual graphics, historical views)</td>
</tr>
</tbody>
</table>
**DATA ANALYTICS POLL QUESTION #4**

What are the key challenges that you face today when implementing an analytics function within IA?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Data availability</td>
</tr>
<tr>
<td>B</td>
<td>Infrastructure / licensing</td>
</tr>
<tr>
<td>C</td>
<td>Skills</td>
</tr>
<tr>
<td>D</td>
<td>Cost / budget concerns</td>
</tr>
</tbody>
</table>
COMMON CONSIDERATIONS & CHALLENGES

Protiviti has identified several common challenges facing the Internal Audit teams and impacting their ability rollout analytics programs.

<table>
<thead>
<tr>
<th>1</th>
<th>Technical Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Internal Audit team doesn’t have access to some many enterprise production databases. In the current state, there is not an environment (sandbox) to utilize for data mining / exploration or development of continuous auditing projects. Limited use of desktop products such as MS Excel are used by the teams. At the enterprise level, tools may be available for data integration, transformation and analytics that may be leveraged.</td>
<td></td>
</tr>
</tbody>
</table>

| 2 | IA Data & Analytics Program Governance |
| There is not a formalized playbook that lists procedures to follow on an analytics projects. There is a need to standardize the analytics program across audits, set policies to manage data requests, demand, data quality, and finalize procedures to operationalize continuous auditing projects on future supported Internal Audit production environments. |

| 3 | Data & Analytics Program Templates and Documentation |
| The Internal Audit team does not retain robust documentation during an analytics project. Business requirements, technical requirements, data process, transformation rules, and other details are not be documented in a consistent manner. There is an opportunity to develop an “analytics playbook” for both analytics engagement in planned audit support (i.e., discreet audits) and new capabilities such as Risk Assessments and Continuous Auditing / Monitoring. |

| 4 | Resource Constraints and Continued Training |
| There are no resources within Internal Audit who are dedicated and assigned to data & analytics projects. There are some capabilities within a small team (working group) and others with limited experience in analytics. Internal training documentation should be developed to assist additional team members during projects. Additional training options (internal or external) should be considered to train the resources on required skills as needed as the program grows. |

| 5 | Segregation of Duties |
| Without established protocols to push data or access to pull data, the Internal Audit team spends a lot of time sourcing and collecting data for their audit needs when trying to apply analytics. This is sometimes serviced through IT and other times through the Business. IA doesn’t have access rights to query most production data. There is no access to an enterprise data dictionary that can increase understanding of available data and minimize the effort in collecting appropriate data necessary for analytics. |
THE ROAD TO ANALYTICS AND AUDIT INTEGRATION

Traditional Audit Steps

1. Confirm audit objectives & scope
2. Identify potential analytics
3. Extract, transform, and load data
4. Analyze data; compare, profile, visualize
5. Brainstorm with audit team and develop testing hypothesis
6. Audit commences
7. Test key hypothesis
8. Communicate results

Integrated Analytics Steps

1. Confirm audit objectives & scope
2. Identify potential analytics
3. Extract, transform, and load data
4. Analyze data; compare, profile, visualize
5. Brainstorm with audit team and develop testing hypothesis
6. Audit commences
7. Test key hypothesis
8. Communicate results

Key collaboration step

Continuous Issue Validation & Monitoring

Continuous Auditing

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SUCCESSFUL DATA ANALYTICS

For success, factor in process changes, have the right resources, and obtain the right data

Building Blocks of Data Analysis

- Are people with the right skill set available or can they be trained?
- What tools do we need?
- Is an adequate tool already available?
- How will the audit process be changed to effectively incorporate analytics?
- What is the most efficient way to obtain and prepare the correct data?

MINDSET

DATA & TOOLSET

SKILLSET

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WHERE TO START…

Top Down or Bottom Up?

From the top… What business questions are you trying to answer? What business insights are you trying to derive?

From the bottom… What data exists? Where is it, and in what forms? How accessible is it?

Both! To be successful and move beyond routine, point-analytics you need to have answers to the top-down and bottom-up questions.
**BUILDING BLOCK: PEOPLE**

Are people with the right skill set available or can they be trained?

<table>
<thead>
<tr>
<th>Considerations</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Do we need new skill sets?</td>
<td>• Availability of skilled resources</td>
</tr>
<tr>
<td>• How will we train individuals?</td>
<td>• Time required for training</td>
</tr>
<tr>
<td>• Will analytics be performed by a dedicated individual?</td>
<td>• Time required to maintain the analytical queries and tools</td>
</tr>
<tr>
<td>• Do we need to engage other departments?</td>
<td></td>
</tr>
</tbody>
</table>
## BUILDING BLOCK: TECHNOLOGY

**What tool requires minimal support? Is an adequate tool already available?**

<table>
<thead>
<tr>
<th>Considerations</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>• What capabilities are needed?</td>
<td>• Selecting a tool</td>
</tr>
<tr>
<td>• How can we most effectively collaborate with IT?</td>
<td>• Obtaining support from IT</td>
</tr>
<tr>
<td>• Is there a business analytics tool already supported by IT?</td>
<td>• Integrating the tool with databases and systems</td>
</tr>
<tr>
<td>• What kind of technical support is available?</td>
<td>• Training</td>
</tr>
<tr>
<td>• Is the tool scalable and will it fit the long-term analytics strategy?</td>
<td>• Initial and ongoing costs</td>
</tr>
</tbody>
</table>
DATA ANALYTICS POLL QUESTION #5

What tools are you utilizing to implement D&A within IA? (select all that apply)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Galvanize</td>
</tr>
<tr>
<td>B</td>
<td>R/Python</td>
</tr>
<tr>
<td>C</td>
<td>Tableau</td>
</tr>
<tr>
<td>D</td>
<td>Power BI</td>
</tr>
<tr>
<td>E</td>
<td>Others</td>
</tr>
</tbody>
</table>
# Building Block: Process

## How will the audit process be changed to effectively incorporate analytics?

<table>
<thead>
<tr>
<th>Considerations</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>• How will analytics change our approach and work program?</td>
<td>• Obtaining an agreement and consensus on changing the audit process</td>
</tr>
<tr>
<td>• What kinds of audits can be improved by using analytics?</td>
<td>• Attempting to do too much at once</td>
</tr>
<tr>
<td>• What steps need to be taken to ensure success?</td>
<td>• Measuring and communicating success</td>
</tr>
<tr>
<td>• How can a repeatable process be designed?</td>
<td></td>
</tr>
</tbody>
</table>
# BUILDING BLOCK: DATA

What is the most efficient way to obtain and prepare the correct data?

<table>
<thead>
<tr>
<th>Considerations</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>• What data is needed?</td>
<td>• Availability</td>
</tr>
<tr>
<td>• Where is the data sourced from?</td>
<td>• Accessibility</td>
</tr>
<tr>
<td>• How do we obtain and link the data?</td>
<td>• Quality</td>
</tr>
<tr>
<td>• Is the data accurate and reliable?</td>
<td>• Format</td>
</tr>
<tr>
<td>• What validation and cleansing will be required?</td>
<td>• Number of sources</td>
</tr>
<tr>
<td></td>
<td>• Security</td>
</tr>
<tr>
<td></td>
<td>• Privacy</td>
</tr>
</tbody>
</table>
We’ve identified key priority focus areas for the Analytics plan and have outlined some “stretch” goals for higher maturity capabilities and operations within the Internal Audit Analytics function.

## Internal Audit Analytics Roadmap…It’s a Journey

<table>
<thead>
<tr>
<th>Higher Maturity Opportunities</th>
<th>Advanced Analysis Capabilities</th>
<th>Full Program / Methodology Integration</th>
<th>Integrate Analysts</th>
<th>Year 2 Expand Coverage</th>
<th>Year 1 Foundation Building, Exploration, Pilot Cases and Analytics Reusability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Continuous improvement</td>
<td>Continuous analytics / audits</td>
<td>Broaden organizational use</td>
<td>Train analytics champions</td>
<td>Define objectives and strategy</td>
</tr>
<tr>
<td></td>
<td>Predictive analytics</td>
<td>Fully integrated analytics program</td>
<td>Fully embed analytics into all audits</td>
<td>Integrate ad-hoc analysis</td>
<td>Define data access model</td>
</tr>
<tr>
<td></td>
<td>Risk assessments</td>
<td>Standardized reporting packages</td>
<td>Move towards quality controls</td>
<td>Establish KPI’s</td>
<td>Identify enabling tools</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mature analytics champions</td>
<td>Formalize and normalize data ingestion</td>
<td>Identify team champions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Train staff and develop capability</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Prove value (e.g., pilots, PoCs)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Establish KPIs</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td>Establish knowledgebase / reusable scripts</td>
</tr>
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<td></td>
</tr>
</tbody>
</table>
THE (MODERN) IA TOOLKIT

Range of tools available from traditional to emerging... all with IA utility
## DA ROLES & RESPONSIBILITIES

In order to properly integrate data analytic capabilities into the traditional audit methodology of scheduled corporate audit projects, roles have been defined and fulfilled by appropriate Corporate Audit team members.

**“Auditor of the Future”: Acting as Data Champion or Audit Team member with new skill/tool sets noted below**

<table>
<thead>
<tr>
<th>Role</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Core DA Team</strong></td>
<td>Provide technical expertise on sourcing data, extracting, transforming, and loading data, administering access to data. Support audit teams end-to-end through the entire audit life cycle with data quality, analysis, reporting, and planning audit procedures. Train auditors on how to use various analytics tools and when to use them. Conduct complex data analysis routines and prepare visualizations using specialized data analytics toolsets.</td>
</tr>
<tr>
<td><strong>LOB Data Stewards</strong></td>
<td>Governance and steering body for the data analytics program. A steward will generally each represent a line of business (LOB) or audit client. Understand the value of how data analysis can enhance audit procedures. Evangelize the use of data analytics on audits. Solicit ideas and feedback from teams on how and where to apply analytics. Identify repeatable analytic opportunities. Own the responsibility for identification of audit projects that will use data analytics on their teams.</td>
</tr>
<tr>
<td><strong>Data Champions</strong></td>
<td>Subject matter experts on self-service analytics projects and audit techniques that use data analytics. Advanced knowledge of tools such as ACL and Tableau that are typically used by the audit team. Primary technical POC for audit teams during fieldwork.</td>
</tr>
<tr>
<td><strong>Audit Team</strong></td>
<td>Perform data analysis on audit engagements using tools such as Excel, ACL, and Tableau. Understand basic data analysis, data quality, and information management principals. Identify opportunities to enhance quality and efficiency on audits by introducing analytics procedures.</td>
</tr>
</tbody>
</table>
CONSIDERATIONS: STANDARDS, POLICIES, DELIVERABLES/TEMPLATES

There are many considerations in this area to reach an efficient, compliant audit analytics program. Here are a few examples that have to be defined:

<table>
<thead>
<tr>
<th>Consideration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Acquisition Standardized Process</td>
<td>Repeatable standardized process for acquiring source system data, loading into the data lake and presenting to Auditors</td>
</tr>
<tr>
<td>Standardized wrangling and profiling</td>
<td>Controls and procedures to merge acquired data, detect issues in the data loading process and also issues in the source system data that implicate testing and reporting (example: False Positives)</td>
</tr>
<tr>
<td>Data Retention</td>
<td>How long should data be archived once collected by audit? Will GDPR impact this?</td>
</tr>
<tr>
<td>Data Security</td>
<td>What members of the audit can view data (and which data) in the data lake. Who can update?</td>
</tr>
</tbody>
</table>
EXAMPLE ANALYTICS
SAMPLE T&E DASHBOARD
**SAMPLE T&E DASHBOARD**

### Employee Names

**1,880 Transactions | $373,422 Total Spend | Date Range 1/8/2015 to 12/20/2016**

<table>
<thead>
<tr>
<th>Personal Transactions</th>
<th>Spend by Merchant Category Code</th>
<th>Selected Transactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITUNES.COM/BILL ITUN CUPE</td>
<td>LODGING HOTELS</td>
<td>$164,024</td>
</tr>
<tr>
<td>MTA MVM42TH STREET NE</td>
<td>AIRLINES AND AIR CARRIERS</td>
<td>$78,919</td>
</tr>
<tr>
<td></td>
<td>EATING PLACES AND RESTAURANTS</td>
<td>$35,155</td>
</tr>
<tr>
<td></td>
<td>TAXICABS AND LIMOUSINES</td>
<td>$32,256</td>
</tr>
<tr>
<td></td>
<td>MEMBERSHIP ORGANIZATIONS NOT ELSE</td>
<td>$9,030</td>
</tr>
<tr>
<td></td>
<td>CIVIC</td>
<td>$8,517</td>
</tr>
<tr>
<td></td>
<td>SCHOOLS AND EDUCATIONAL SERVICES - N</td>
<td>$6,878</td>
</tr>
<tr>
<td></td>
<td>Cash Payment / Unmatched Transaction</td>
<td>$6,232</td>
</tr>
<tr>
<td></td>
<td>PASSENGER RAILWAYS</td>
<td>$4,612</td>
</tr>
<tr>
<td></td>
<td>GIFT</td>
<td>$4,274</td>
</tr>
</tbody>
</table>

### Out-of-Pocket Transactions

- **$5,232**
- **1%**

| Hotel | $458 |
| Hotel | $458 |
| Travel - Other | $329 |
| Lunch (travel/offsite) | $200 |
| Ground Transportation | $91 |
| Laundry/Tips | $91 |

### Weekend Transactions

- **$54,504**
- **15%**

| SAN FRANCISCO MARRIO SAN | $4,777 |
| EXECUTIVE/GIFTSHOPE B45 | $4,266 |
| LOEWS HOTELS MIAMI B MIA | $3,333 |
| SAN FRANCISCO MARRIO SAN | $2,256 |
| HOTEL SOLAMAR (2) 00 SAN | $2,199 |
| AMERICAN AIRLINES DALLA | $1,604 |
| ROCK OATEN GREGOR ROL | $1,577 |

### Gift Transactions

- **$4,828**
- **1%**

| Meeting in NY and CA | $4,266 |
| Site Visit | $316 |
| Site Visit meeting | $48 |
| Site Visit | $20 |
| Meetings | $24 |
| Conference and F2F Meetings | $22 |

### Spend by Supplier

- **$66,635**
- **$64,815**

| UNITED AIRLINES | $25,845 |
| TOC CHAUFFEURED TRANSPORT | $22,041 |
| MMR SAN FRANC MARRIOTT | $12,752 |
| AUTOGRAPH ALSOQUIN FRONT | $10,181 |
| BOCARATON RESORT WALDORF ASTORIA | $8,987 |
| UNITED ELECTRICITY | $8,517 |
| HARVARD CLUB OF NY CITY | $7,793 |
| LOEWS MIAMI BEACH HOTEL | $7,215 |
| FIS & OLIVE | $6,841 |

### Spend by Expense Category

- **$145,409**
- **$141,677**

| Hotel | $44,062 |
| Travel - Other | $42,749 |
| Airfare/Rail | $41,677 |
| Airline Fees | $36,751 |
| Conference/SeMINAR | $33,157 |
| Ground Transportation | $6,099 |
| Hotel Taxes/Other | $5,567 |
| Lunch (travel/offsite) | $4,576 |
| Laundry/Tips | $3,946 |

**Home Office: Princeton**
SAMPLE T&E DASHBOARD
SAMPLE T&E DASHBOARD
### Top 40 Vendors

<table>
<thead>
<tr>
<th>Vendor Name</th>
<th>Po Amt Tit</th>
<th>Invoice Amount</th>
<th>Paid Amount</th>
<th>Discount Offered</th>
<th>Discount Taken</th>
<th>2% Discount</th>
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<tbody>
<tr>
<td>MEDIACOM WORLDWIDE INC</td>
<td>$6,423,413</td>
<td>$8,311,497</td>
<td>$8,311,497</td>
<td>$0</td>
<td>$0</td>
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<tr>
<td>IRK DONNELLEY</td>
<td>$5,766,895</td>
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<td>T ROWE PRICE RETIREMENT PL.</td>
<td>$2,167,512</td>
<td>$10,995,172</td>
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<td>MOORE COMPANIES, INC.</td>
<td>$5,667</td>
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<td>JONES LANG LASALLE AMERIC.</td>
<td>$17,784,659</td>
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<td>$0</td>
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<tr>
<td>GMAIL INC.</td>
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<td>$14,944,936</td>
<td>$14,944,936</td>
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<td>$0</td>
<td>$238,290</td>
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<tr>
<td>DAVIS GILFORD CONSTRUCTION</td>
<td>$5,350,894</td>
<td>$14,477,164</td>
<td>$14,477,164</td>
<td>$0</td>
<td>$0</td>
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<tr>
<td>DIAMOND MARKETING SOLUTIONS</td>
<td>$2,186,532</td>
<td>$14,120,595</td>
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<td>$0</td>
<td>$0</td>
<td>$286,412</td>
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<td>MERRILLC INC.</td>
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<td>PARADISE INC.</td>
<td>$9,583,126</td>
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<td>GOOGLE INC.</td>
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<td>ALPINE ACCESS INC.</td>
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<td>$9,797,843</td>
<td>$9,797,843</td>
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<td>$195,957</td>
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<tr>
<td>SHAPIRO AND DUNCAN INC.</td>
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<td>HOWKIND-WRIGHT EMPLOY.</td>
<td>$8,476,719</td>
<td>$8,326,744</td>
<td>$8,326,744</td>
<td>$169,293</td>
<td>$151,771</td>
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<td>RPS MEDIA GROUP LLC</td>
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<td>$163,205</td>
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<tr>
<td>DISTRICT OF COLUMBIA GOV.</td>
<td>$2,087,425</td>
<td>$2,841,350</td>
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<td>$0</td>
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<tr>
<td>D EXPOSITO &amp; PARTNERS LLC</td>
<td>$8,536,254</td>
<td>$7,465,010</td>
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<tr>
<td>OUTBOUND INC.</td>
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<td>$7,209,236</td>
<td>$7,209,236</td>
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<tr>
<td>CIDER INC.</td>
<td>$1,039,073</td>
<td>$1,955,623</td>
<td>$1,955,623</td>
<td>$29,522</td>
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<tr>
<td>HCC HOLDINGS LIMITED PARTNERSHIP</td>
<td>$8,240</td>
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<tr>
<td>GRAY GLOBAL GROUP</td>
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<tr>
<td>THE CONSORTIUM INC.</td>
<td>$6,869,966</td>
<td>$6,818,398</td>
<td>$6,748,620</td>
<td>$69,778</td>
<td>$69,779</td>
<td>$156,368</td>
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<tr>
<td>OTIS ELEVATOR COMPANY</td>
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<tr>
<td>SIMPLIFIED APPROACHES LLC</td>
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<td>$5,915,002</td>
<td>$5,915,002</td>
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<tr>
<td>TENSION ENVELOPE CORPORA.</td>
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<td>SYPARTNERS LLC.</td>
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<td>TRANSCOMMON WORLDWIDE N. INTERNATIONAL BUSINESS M.</td>
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<td>$5,590,771</td>
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<td>GAG OUTSOURCERS INC.</td>
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<td>DIAMOND GRAPHICS INC.</td>
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<td>SQUARE 49 LLC.</td>
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<td>ELECTRONIC FAVORITE STREET LLC</td>
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<td>ACUCENT SOLUTIONS INC.</td>
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<td>FACEBOOK INC.</td>
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<td>A T &amp; T</td>
<td>$6,175,000</td>
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<td>$0</td>
<td>$80,051</td>
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</table>

**Use Slider to Choose the Number of Top Vendors**

- **Total Amount Paid**: $10,294,257
- **Total Discount Offered**: $297,093
- **Total Discount Taken**: $272,997
- **Total Potential Discount**: $10,211,345

**Map of Vendors**

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AUDIT MANAGEMENT

Avg. Number of Audit Findings vs Actual Hours by Risk Category

by Key Enterprise Risks

# Findings
Status  Priority
Open - Past Due  High  Medium  Low
Open - Current  High  Medium  Low

# Closed Findings
Status  Priority
Closed  High  Medium  Low
## Audit Plan to Risk Mapping

<table>
<thead>
<tr>
<th>Project</th>
<th>Financial</th>
<th>Legal / Compliance</th>
<th>Operational</th>
<th>Strategic</th>
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<tbody>
<tr>
<td>Action Plan Follow-Up</td>
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<tr>
<td>AP DA &amp; Continuous Monitoring</td>
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<tr>
<td>Architecture &amp; Constructive Process Design</td>
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<tr>
<td>Business Continuity Management</td>
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<tr>
<td>Call Center GCR</td>
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<tr>
<td>Construction Audit - Project #1</td>
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<tr>
<td>Construction Audit - Project #2</td>
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<tr>
<td>Corporate System / Process Realignment</td>
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<tr>
<td>Customer Data Flow &amp; Management Review</td>
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<tr>
<td>Financial SOX Compliance</td>
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<tr>
<td>Fraud / Anti-Compliance Risk Assessment</td>
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<tr>
<td>Gaming Audit Governance</td>
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<tr>
<td>Hotel / Resort Audits</td>
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<tr>
<td>Hotel / Resort DA &amp; Continuous Monitoring</td>
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<tr>
<td>Hotel Complex &amp; Business Assurance</td>
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<tr>
<td>IFRS Readiness</td>
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<tr>
<td>Investigations / Special Projects</td>
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<tr>
<td>IT Policy Review</td>
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<td>IT Service Provider GCR - Vendor 1</td>
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<td>IT Service Provider GCR - Vendor 2</td>
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<td>Marketing Partnerships - Inventory &amp; Risk</td>
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<tr>
<td>Pre-Implementation Review - Fin. System</td>
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<td>Pre-Implementation Review - Fin. System</td>
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<td>Pre-Year Carryforward Audits</td>
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<td>Regional Office GCR</td>
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<td>SSAE 16, SOX Testing &amp; Advisory</td>
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<td>ISKO Reporting &amp; Continuous Monitoring</td>
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<tr>
<td>Technology Innovation - Security Assessment</td>
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<tr>
<td>Time Share / Loyalty Program Points Incentive</td>
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<td>Underwriting Policy Compliance</td>
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<tr>
<td>Vendor Management &amp; Risk Assessment</td>
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</tbody>
</table>
Data Analytics in Internal Audit

QUESTIONS?

Rish Dua
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Phone: 312.476.6060

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St. Louis Office, Associate Director
Phone: 816.294.2850

Mark Boheim
Email: mark.boheim@protiviti.com
St. Louis Office, Associate Director
Phone: 314.570.3245
PROCESS MINING

The Push Toward Advanced Analytics
STOP INEFFICIENCIES

Run your business in a more efficient way, and spot deviations which may represent non-compliance to policy or process...

How things should be
“business as designed”
simple, standardized, fast

How things really are
“Day-to-day” reality
complex, inefficient, slow
QUESTIONS FOR EXECUTIVES AND AUDITORS

When choosing a process optimization approach, some useful questions to ask are…

- How do we detect and resolve harmful bottlenecks, costly inefficiencies and compliance issues?
- How fast do we get insight into our processes?
- Have process owners paid close attention to whether the organization’s control environment is functioning effectively?
- Do we know the root causes well enough to tackle the issues successfully?
WHAT IS PROCESS MINING?

Process Mining uses AI and machine learning to extract existing data from an organization’s systems to visually reconstruct how processes actually perform. The data shows what is actually happening and creates a complete process map.

Process mining is a process management technique that supports the analysis of business processes.

Process mining can analyze your process from an end-to-end perspective.

You do not need to have a process map to analyze the process flow – Process Mining uses historical data from your IT systems.

Your IT system currently records all steps of your process in execution. With process mining, you get a process map based on that data.

This way, your real process and actual business rules can be discovered automatically.
HOW DOES PROCESS MINING WORK?

Think of process mining as an x-ray machine for your processes, using the data captured by systems to show you what is actually happening, how transactions are actually being processed.

Activity
- Invoice
- Volume
- Purchase Order
- FX rate
- Vendor
- Postings
- Costs
- Contracts
- Etc.

Key Data Elements
- Activity
- Activity ID
- Time Stamp

Process Map

IT-based work
Every task supported by IT systems like SAP

Digital Footprints
Process Mining reconstructs digital workflow traces

Full Transparency
Actual process flows are visualized in near real time
THE REAL PROCESS…

See the happy paths
See the core process flow.

Explore deviations
Reveal less common paths and activities. ID non-compliance, and inefficiency.

Get the full picture
Data coverage of 100%. Full process transparency.
### PROCESS MINING POLL QUESTION #1

Are you utilizing process mining within Internal Audit? (a. Currently using, b. On our roadmap, c. No current plans to use)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>Currently using</td>
</tr>
<tr>
<td>B</td>
<td>On our roadmap</td>
</tr>
<tr>
<td>C</td>
<td>No current plans to use</td>
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</tbody>
</table>
WHY PROCESS MINING FOR INTERNAL AUDIT?

Process mining tools can fundamentally change the way that we analyze processes and perform audits.

- **Automate the walkthrough process** – replace interviews with advanced analytics and review process based on 100% populations.

- **Data tells us what is actually happening** – automatically identify process variants and complexities, identifying areas that do not comply with intended process design.

- **Support risk assessment activities** – identify “hot spot” areas, drive audit focus

- **Make findings more impactful** by quantifying the impact of non-conformance and benefits of adherence to consistent process.
### FIVE KEY BUSINESS BENEFITS OF PROCESS MINING

**Higher quality, with more accurate and valuable results**

**Reduce cost and variation, become more lean**

Find more effective ways to reduce enterprise wide costs without compromising internal controls.

**Reduce processing time**

Reduce the amount of time spent on routine transaction processing, focusing more on value-add business analysis.

**Improve quality and stability**

By comparing processes beyond KPIs, and maintain stability when non-routine situations arise.

**Be in control and know what is going on**

Give ongoing assurance that the organization is in full compliance with complex regulatory requirements and internal controls and policies.

**Deeper and faster insights**

Provide more insightful, timely information for decision-making in an environment where the volume of data is vast and ever changing.
## Process Mining Use Cases

<table>
<thead>
<tr>
<th>Use Cases</th>
<th>Process Mining Use Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digitalization</td>
<td><strong>Operational Excellence</strong></td>
</tr>
<tr>
<td>Process Documentation</td>
<td>• Process excellence is key for best-in-class performance of any customer</td>
</tr>
<tr>
<td></td>
<td>• Celonis Process Mining enables projects with full transparency of all processes to quantify inefficiencies</td>
</tr>
<tr>
<td></td>
<td>• Continuous tracking and monitoring ensures long-term impact</td>
</tr>
<tr>
<td>One ERP Harmonization</td>
<td><strong>Internal Audit</strong></td>
</tr>
<tr>
<td></td>
<td>• Point by point manual audit of processes risks undetected compliance and fraud issues</td>
</tr>
<tr>
<td></td>
<td>• Celonis Process Mining identifies i.a. missing approvals, duplicate payments and maverick buying</td>
</tr>
<tr>
<td></td>
<td>• Celonis ensures and monitors segregation of duties and IKS controls</td>
</tr>
<tr>
<td>Post-Merger Integration</td>
<td><strong>Shared Services</strong></td>
</tr>
<tr>
<td></td>
<td>• SSOs have high transaction volumes and are typically very cost sensitive</td>
</tr>
<tr>
<td></td>
<td>• They are an ideal target for process standardization and optimization</td>
</tr>
<tr>
<td></td>
<td>• With Celonis Process Mining, SSOs continuously monitor global process conformance and efficiency</td>
</tr>
<tr>
<td>S4 Hana Migration</td>
<td><strong>S4 Hana Migration</strong></td>
</tr>
<tr>
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<td>• The transition to a S4 HANA system requires profound knowledge of processes and user behavior</td>
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<td>• Celonis Process Mining highlights differences and gaps among systems</td>
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<td>• This ensures the optimal blueprint for the new ERP system rollout and reduces migration efforts</td>
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<tr>
<td>Robotic Process Automation</td>
<td><strong>Robotic Process Automation</strong></td>
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<td></td>
<td>• RPA is capable of reducing process costs and increasing competitiveness</td>
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<td>• Celonis Process Mining helps to identify weak points in the processes that should be addressed with RPA</td>
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<td>• Celonis allows to monitor RPA projects and verifies their cost savings and ROI</td>
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<tr>
<td>Business Process Due Diligence</td>
<td><strong>Business Process Due Diligence</strong></td>
</tr>
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<td></td>
<td>• Know your client’s characteristics is essential prior to moving processes to outsourced environments</td>
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<tr>
<td></td>
<td>• Quality and depth of the due diligence phase is significantly increased, providing fact-based decision criteria that help with sizing and committing towards the client</td>
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**Process Areas:**
- Procurement
- Sales
- Accounting
- Logistics
- Production
- IT Service
- Finance
- HR
- Quality
### PROCESS MINING POLL QUESTION #2

Are you aware of process mining's use elsewhere in your organization?

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<tbody>
<tr>
<td>A</td>
<td>Yes</td>
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<tr>
<td>B</td>
<td>No</td>
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**PROCESS MINING POLL QUESTION #3**

Where do you see the main benefits of process mining in your organization?

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<tr>
<td>A</td>
<td>Finance</td>
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<td>B</td>
<td>Operations</td>
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<td>C</td>
<td>IT</td>
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<tr>
<td>D</td>
<td>Sales &amp; Marketing</td>
</tr>
<tr>
<td>E</td>
<td>Other</td>
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RECAP
OUR VISION FOR NEXT-GENERATION INTERNAL AUDITING

- Machine Learning (ML)
- Artificial Intelligence (AI)
- Process Mining
- Robotic Process Automation (RPA)
- Advanced Analytics
- Continuous Monitoring

IA Strategic Vision
Organizational Structure
Resource & Talent Management
Aligned Assurance
Dynamic Risk Assessment
High-Impact Reporting
Agile Audit Approach
Internal audit functions will soon look and operate very differently than they do today. As the current pace of innovation accelerates, the current challenges internal audit functions confront while delivering on their core mission will only intensify.

By choosing to disrupt their functions proactively rather than waiting passively to be disrupted, future-minded CAEs will boldly take their functions to new frontiers of performance.
QUESTIONS?

Process Mining

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