



Data Matters:

Making The Most of Data

WESTERN INTERGOVERNMENTAL AUDIT FORUM MEETING

September 5, 2018

Nelson, Kat, and Ron

Nelson

City & County of San Francisco
Supervising Auditor in
IT & Systems Audit team

Recent data worked with:

- Purchase card transactions for continuous auditing
- Procure to pay data for continuous auditing
- Continuity of operations plans

Kat

City & County of San Francisco
Supervising Auditor in
Construction & Performance Audit team

Recent data worked with:

- Below market-rate rental unit pricing, marketing, and tenant
- City employee payroll
- Construction project budget, expenditures, and schedule
- IT helpdesk
- Qualitative and quantitative survey data
- Best practice and academic research articles
- Program application

Ron

Arizona Auditor General
Data Analysis and Strategic Applications
Team Manager

Recent data worked with:

- State agencies
- School districts
- Universities
- Counties

Outline

❖ What is Data Analytics?

- Data analytics defined
- General methodology
- Project-based analytics versus continuous auditing

❖ Getting Data

- Identifying needed data and available data
- Data extraction and data types
- Quickly assessing the quality of available data
- Bridging the gap between your data need and what is available

❖ Data Analytics Tools

What is Data Analytics?

PROCESS

of *inspecting, cleaning, transforming, & modeling* data to **gain insight**, *discover meaningful relationships*, inform conclusions, and support decision-making.

Analytics can provide clues to help you go from **condition** to **root cause**



Diving in to Data Analytics

Prepare

Support and buy-in from leadership

Collaboration with the owners of data

Start small with a pilot project

Benefit

Perform, evaluate results, resolve

Increase coverage, quality, and impact

Strengthen skills of auditors

Invest

Methodology must be effective & sustainable

Acquiring tools

Learning curve

Typical Data Analytics Methodology

Plan

- Clear Objectives; Obtain Buy-In; Reasonable Targets

Acquire & Understand

- Initial Data Samples; Obtain Owner Insights; Verify Data Quality; Choose The Best Analysis Tool

Analyze

- Develop Hypothesis; Prepare Summary; Adjust Scope As Needed

Validate

- Translate & Discuss Results; Adjust Testing As Needed; Obtain Clear Feedback

Report

- Formally Present Findings; Provide Complete Transparency; Agree On Recurring Impact; Define Action Plan; Implement Sustainable Solution



Continuous Controls Auditing

Continuous auditing ranges from continuous control assessment to continuous risk assessment – all activities on the control-risk continuum.

--The IIA, GTAG 3: Continuous Auditing: Implications for Assurance, Monitoring, and Risk Assessment

Purpose

Manage activities ranging from continuous control assessment to continuous risk assessment.

Automated Tools

Using automated tools is one of the methods of continuous auditing.

Frequency

Auditing frequency includes Daily, Weekly, Monthly, etc.

Repeatable Process

Be consistent with a repeatable process to ensure quality and accuracy of the data.

Continuous Monitoring – Purchasing Cards



Invalid cardholder
(no matching employee or terminated employee)



Declined and disputed transactions



Ghost card activities

Duplicate cardholders
(by employee ID or address)



Potential duplicate reimbursements
(gas with mileage or P-Card with an AP purchase)



Even/small dollar amount transactions



Spending limits on transactions
(lavish hotel stays, dinners, etc.)



Duplicate purchases
(same merchant same amount)



Weekend and holiday transactions

Suspicious keyword in the transaction description



New cardholder watch list



Split purchases



Suspicious merchant classification codes

More Continuous Audit Examples



General Ledger

- Unauthorized journal entry (JE)
- JEs by unauthorized users
- Duplicate JEs (same account/amount, same JE number/amount)
- Split JEs (single JE/multiple accounts, multiple JEs/single account)
- Segregation of duties (park vs. post, post vs. create account)
- Dormant accounts
- Even dollar JEs
- Suspicious keyword in JE description
- Duplicate GL accounts based on the account description



Payroll

- Duplicate employees (same bank account or address)
- Pay ceases when employee separated
- Exempt hours worked vs. standard hours
- Non-exempt hours worked vs. expected hours
- Hours worked vs. hours paid
- Employee start date after paycheck date
- Terminations within 14 days of hire
- Invalid pay rates (actual/calculated vs. master file)
- Excessive gross pay
- 401k annual contribution limit, catch-up contribution limit and catch-up
- Age limit
- Job record deletions (data corrections not using effective date)
- Overtime limit exceeded
- Leave accrual caps exceeded



Purchase to Pay

- Split requisitions and POs
- Stale requisitions and POs
- Segregation of duties
- PO date after invoice date
- Invoice number sequence not continuous
- Goods received quantity vs. invoice quantity
- Fraud of employee posing as vendor by match name and address
- Duplicate vendors (by name, address, bank account number)
- Duplicate purchases (same vendor with either same invoice number or same amount and near date, same GL account)



Getting Data

Identifying *NEEDED* Data

❖ Incorporate consideration of data needed from the beginning of audit planning

#	Audit Objective	Researchable Question(s)	What should be and who says so? (Criteria & Source)	What could go wrong? (Risk or Negative Effect)	Information Required to Answer Question & Potential Sources
EX.	Assess the strategic planning process of the SFMTA IT function.	Does the IT strategic plan align with SFMTA departmental strategic plan?	COBIT	Waste of resources in the IT unit on projects unrelated to SFMTA mission; greater likelihood of waste and abuse	IT Strategic plan from IT Management; SFMTA strategic plan from department website
EX.	Assess adequacy of staffing levels of the SFMTA IT division.	Does the Service Management unit have enough staff to respond to help desk tickets within the time frames required by the SLA?	Service level agreement (SLA) between IT division and SFMTA operational units	Urgent IT problems not being addressed promptly, vulnerability to cyberattacks when security related requests not addressed quickly, loss of productivity	Helpdesk system data for 5 years for trend analysis; SLA

Identifying *AVAILABLE* Data

❖ Process walkthroughs

- Look for data outside of systems
 - Excel spreadsheets and Access databases
 - Physical files

❖ System walkthroughs

- Identify all systems with relevant data
- Identify the source of all data within that system
 - Is some data fed from another system?
 - What is manually inputted?
 - What is the source of manually inputted information?

Data Types & Structures

The majority of data is organized into tables.

A table can be thought of as a two dimensional matrix of data.

- Each row represents a single record.
- Each column represents a data field.

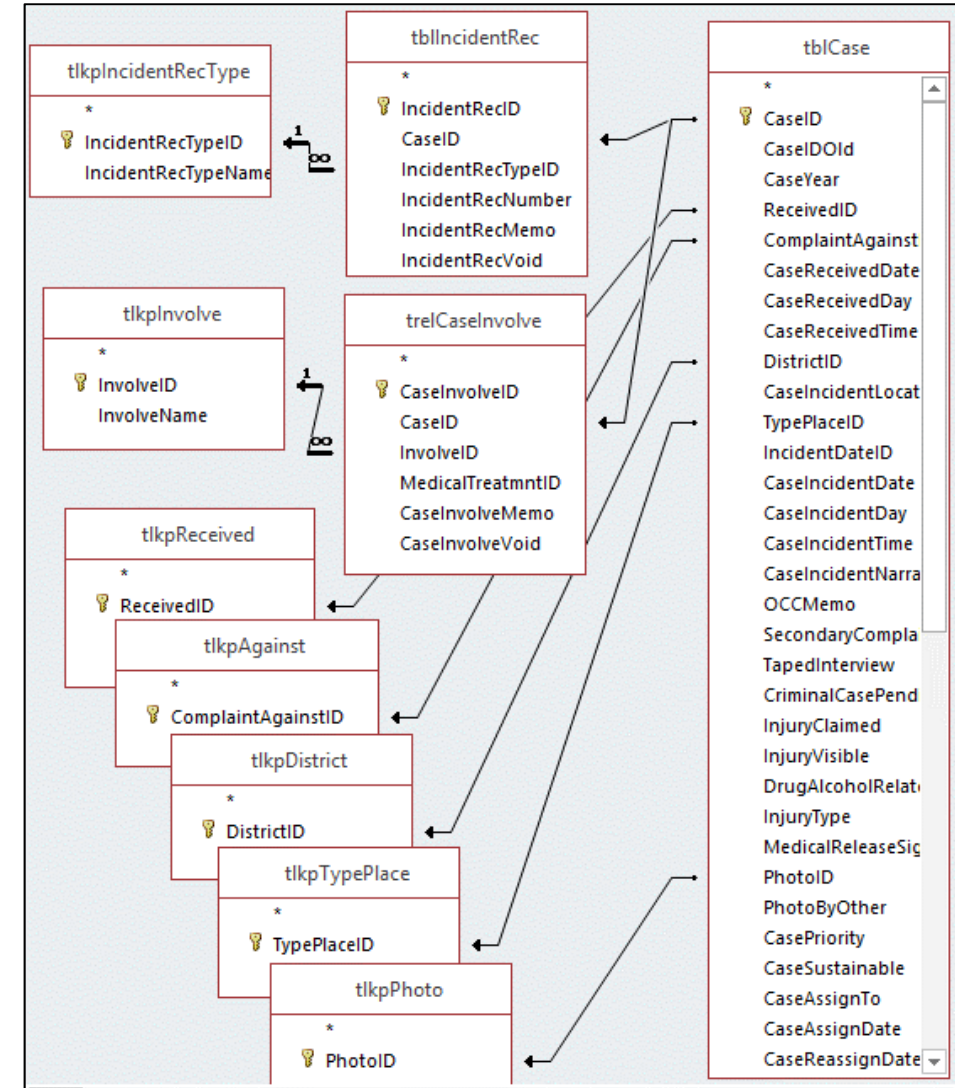
Each data column, or field, may have a different data type.

Furthermore, data types determine how data is interpreted, and also what data format is considered valid.

- For example, data can be a date, a number, or plain text.
- Invalid data in a table is often a sign of some other problem.

Each record in a table can be related to data in another table through a unique identifier, like an employee, customer, or transaction ID.

- When one table uses this identifier to reference records in another table, this is called a relational database.
- Relational databases are a very useful way to organize data.
- Many databases are built using some kind of relational database format.



Data Extraction

- ❖ **Extract strategy depends on the source types, data types and structures**
- ❖ **Internal vs. External**
- ❖ **Production vs. Staging (or Data Warehouse)**
- ❖ **Flat Files vs. Relational Database Management Systems (RDBMS)**
- ❖ **Data Stewards vs. Database Administrators (DBA)**
- ❖ **Simple rules for moving source data to the target:**
 - Ad hoc queries of the source system(s)
 - Analysis of a small sample set of source data
 - Obtain knowledge or documentation of how the source system(s) work
 - Obtain knowledge of how the target system works
 - Sufficient access to source systems
 - Requires lots of technical input and little business input



Data Extraction Readiness Check

Regardless of structure, type, or format, source data intended for extraction should be validated in terms of the following key attributes:

- ❖ Relevance: Is it relevant for its intended purpose?
- ❖ Accuracy: Is it correct and objective, and can it be validated?
- ❖ Integrity: Does it have a coherent, logical structure?
- ❖ Consistency: Is it consistent and easily to understand?
- ❖ Completeness: Does it provide all the information required?
- ❖ Validity: Is it within acceptable parameters for the organization?
- ❖ Timeliness: Is it up to date and available whenever required?
- ❖ Accessibility: Can it be easily accessed and exported to the target application?



Quickly Assess the Quality of *AVAILABLE* Data

Jump to...

System Understanding.....	1
Data.....	1
Account & Access Management.....	3
Business Continuity.....	3

System Understanding

1. System Name - [redacted]
2. System Purpose - [redacted]
3. Implementation - Was the system created or purchased?
 Created by in [redacted] [redacted]
 Purchased from in [redacted] [redacted]
4. Administration - Who is responsible for system administration and maintenance?
[redacted]

Data

When relevant, obtain *screen shots* of the system to support

Information Request

The following information should be requested from the system walkthrough (including reference links). Add to this walkthrough after reviewing the documents:

- System user manual
- System design specifications
- Data definitions
- List of system roles and definitions including areas of the system with access to and who have read/write access
- Complete list of system administrators including general administrative and the accounts role in the system
- A list of users responsible for data entry

8. What controls are built in the *system* to ensure the data is entered accurately?

- Yes No - Records have a unique identifier (system does not allow duplicates)
Data label for unique identifier: _____
- Yes Partially No - Key fields are mandatory:
- Yes Partially No - All fields only allow valid entries (text in text fields, numbers in number fields, etc.)
- Yes Partially No - Fields with restricted options use drop-down menus
- Yes Partially No - Logic checks that disallow or raise flags for unexpected values (8 digits allowed in a phone number field; 25 allowed as a supervisor district number; 1,000,000 allowed when the average value is 500, etc.)
- Yes Partially No - System flags potential duplicate entries (two purchases from the same vendor at the same cost within 1 day of each other; two applicants with the same address, etc.)
- Yes Partially No - Other: _____

9. What *human controls* are built in to the process to ensure that data entered into the system is accurate?

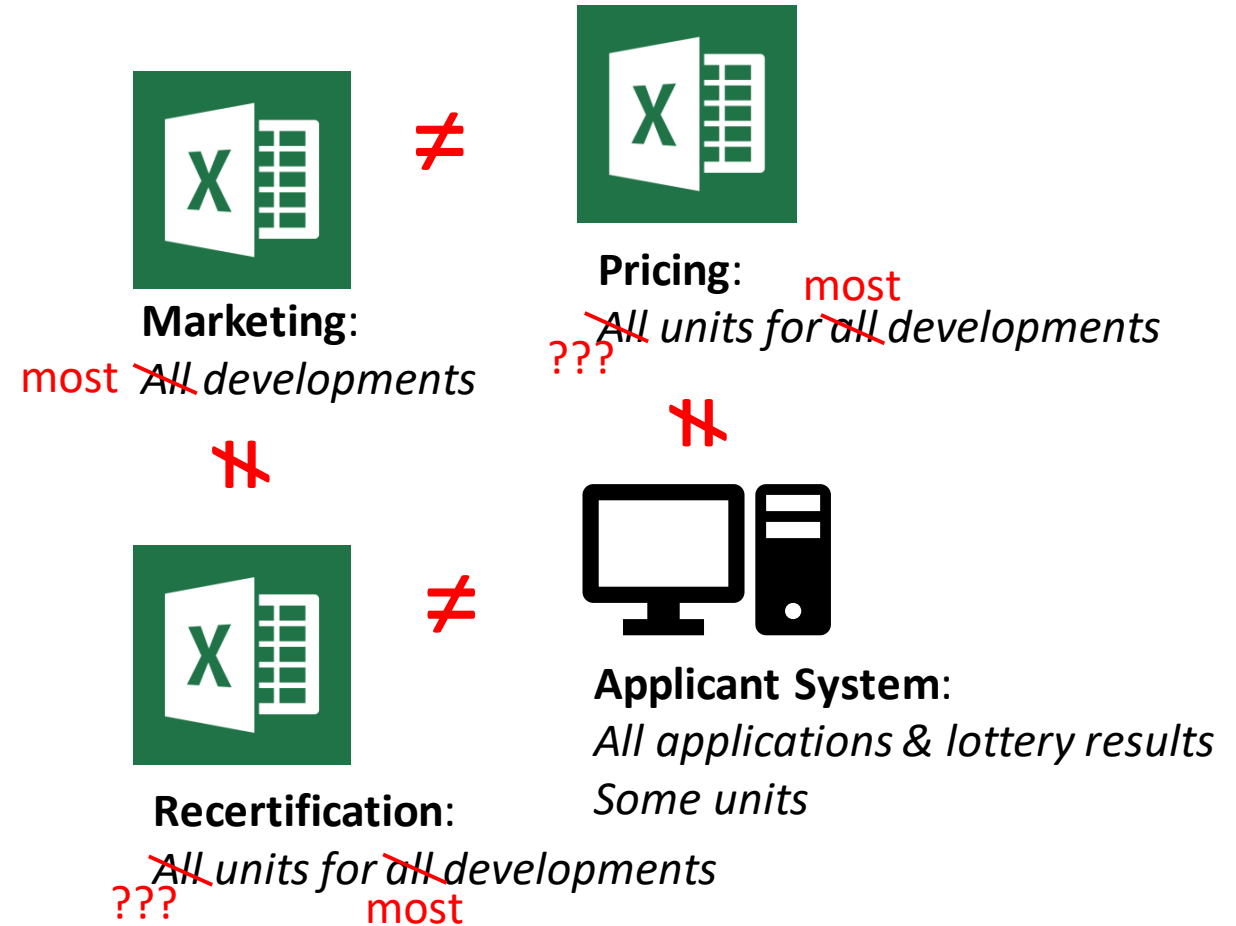
- Yes Partially No - Entries flagged by the system are reviewed by department staff

Bridging the gap between NEED and AVAILABLE

Identify the source of the gap:

- ❖ No data
- ❖ Inaccurate data
- ❖ Incomplete data
- ❖ Decentralized data
- ❖ Data in a format that inhibits analytics

Below Market-Rate Housing Rental Program



NO UNIQUE IDENTIFIERS!!!

Bridging the gap between NEED and AVAILABLE

Identify the source of the gap:

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- ❖ Decentralized data
- ❖ Data in a format that inhibits analytics

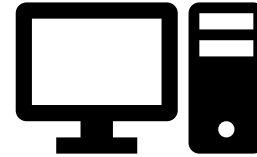
Determine what it would take to get around the gap:

- ❖ Is there another source for the data or combination of sources?
- ❖ Can the existing data be used with more limited scope?
- ❖ Can incomplete data be made complete?
- ❖ Can inaccurate data be corrected?
- ❖ Can the data be created?

Assess the value of the effort of getting around the gap.

Below Market-Rate Housing Rental Program

Housing Office



Applicant System

Planning Department



Proposed Developments:
All developments



Marketing

Building Inspection



Buildings Completed:
All developments, all units



Pricing



Recertification



Data Analytics Tools

Picking the Right Tools

Design/ Implementation

- Single user vs. multiple users
- Desktop vs. server
- Data vs. visualizations
- Securing data

Expertise/ Training

- In-House expertise
- Online training
- Consulting

Cost

- License fees / Maintenance
- Specialized hardware

Analytic Arsenal



- ❖ **Spreadsheets** (Microsoft Excel)
- ❖ **Desktop Databases** (Microsoft Access)
- ❖ **Audit Software** (ACL)
- ❖ **Server Databases**
(SQL Server, including Reporting Services)
- ❖ **Visualizations** (Microsoft Power BI)
- ❖ **Qualitative Analysis** (Atlas.ti)

Spreadsheets

(Microsoft Excel)



- Easy to use
- Create simple lists
- Conditional Formatting
- Run calculations and statistical comparisons
- Pivot tables
- Charts
- Macro scripting (VBA)

Pros



- Limited to 1,048,576 rows and 16,000 columns
- Little to no audit trail
- Problematic as data grows
- Security
- Viruses attached through macros
- Multiple copies

Cons



Desktop Databases

(Microsoft Access)



Pros

- Readily available
- Integration
- Relational database
- Multi-user
- Larger storage capacity
- Data can be updated
- Queries
- Simple Report creation

Cons

- Limited to individuals or small groups
- Little or no audit trail
- Maintenance and corruption
- Limited Reporting/Visualization
- Multiple copies
- Database 101
- Security

Audit Software

(ACL)



ACL Analytics

- Import wide variety of data types
- Read-only data
- Robust audit/analysis functions
- Performance
- Automation
- Logging

Pros



- Lots of disk space required
- Data cannot be directly cleansed
- Cumbersome relationships and indexes
- Reporting good but limited
- Cost
- Security

Cons



Database Servers

(SQL Server)



Pros

- Capacity
- Performance
- Integration
- Dynamic data
- Views (joined datasets)
- Multi-user
- Granular security
- Transformations
- Automation

Cons

- Requires IT administration and maintenance
- Learning curve (database management, admin, design)
- GUI limited (coding needed)
- Cost
- Runs on Windows-based servers

Database Servers

(Reporting Services)



- Interactive reports allow users to select their criteria from drop-down lists
- Easy export for further analysis with multiple file formats
- Web based
- Subscriptions
- Role-based security model

Pros



- Limited data sources (SQL Server only)
- Learning curve involved

Cons



Reporting Services

Year

1 of 1 100% Find | Next

Leadership Competencies LEAP Management Report Officewide (2016)

Officewide

		Competency Ratings	Responses
LEADING CHANGE	1. Creativity & Innovation	 6.44	103
	2. External Awareness	 6.11	103
	3. Flexibility	 7.47	103
	4. Resilience	 7.33	103
	5. Strategic Thinking	 5.37	103
	6. Vision	 5.2	103
LEADING PEOPLE	7. Conflict Management	 6.55	103
	8. Leveraging Diversity	 6.73	103
	9. Developing Others	 6.87	103

Reporting Services

Total number of initial deficiencies:	20						
Number of significant deficiencies:	13						
Compliance Status	Compliant						
Our opinion on the District's compliance status is based on our review of the deficiencies cited by the District's auditors in the USFR Compliance Questionnaire, auditor's reports on internal control and compliance, auditor's opinion on the financial statements, management letter, and financial statements, (as applicable) and the District's compliance history.							
Any additional considerations:							
	Progress in correcting previously cited deficiencies						
Area (highlight area in yellow if emphasizing in MC letter)	# Prior Year Deficiencies	# Corrected	# Not Fully Corrected	# New	# Current Year Deficiencies	In the current year, the District has:	Increase Risk of Fraud (only on Noncompliance or Marginal that are "Nearly Noncompliance")
ACCOUNTING RECORDS	2	1	1	1	2	Not Improved	
AUXILIARY OPERATIONS AND EXTRACURRICULAR ACTIVITIES FEES TAX CREDIT FUNDS							
BUDGETING				1	1	Worsened	
CASH AND REVENUES	5	3	2	1	3	Not Improved	
CLASSROOM SITE FUND	1	1				Improved	
COOPERATIVE AGREEMENTS AND REGIONAL SERVICES							
CREDIT CARDS AND P-CARDS							
EXPENDITURES	1	0	1		1	Not Improved	
FINANCIAL REPORTING							
FOOD SERVICE FUND							
GENERAL LONG-TERM DEBT							

Visualization Tools

(Power BI)



Microsoft

Power BI

Pros

- Easy to get started and use
- Imports from many sources
 - Live links(fast/dynamic)
 - Imported(robust functionality)
- Interactive visualizations
- Easy to share
- Resources and community

Cons

- Printing
- Formatting limited
- If data changes, recreate.
- Table relationships limited
- Only sharable in same email domain
- Cannot mix imported and live links data
- Live links limited functionality
- Sluggishness with large data sets (1GB data import limit)

Power BI

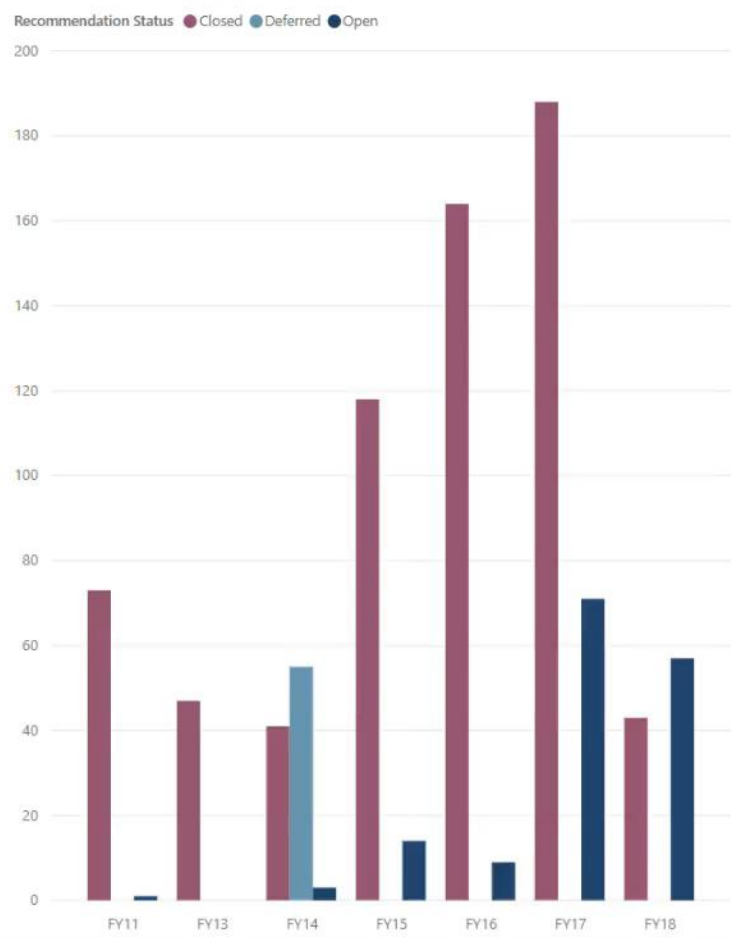
FollowUpDashboard - Power BI Desktop

File Home View Modeling Help

Cut Copy Paste Format Painter Get Data Recent Sources Enter Data Edit Queries Refresh New Page New Visual Ask A Question Buttons Image Text box From Marketplace From File Switch Theme Manage Relationships New Measure New Column New Quick Measure Publish

Clipboard External data Insert Custom visuals Themes Relationships Calculations Share

Count of Recommendation Status by Fiscal Year and Recommendation Status

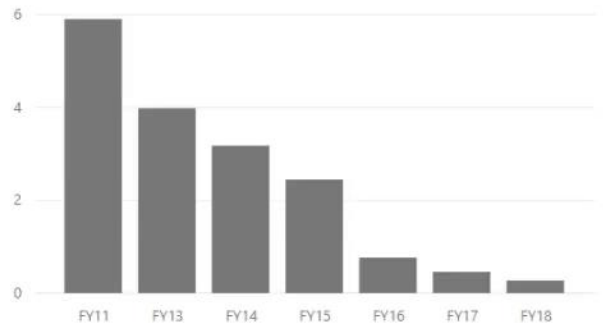


Fiscal Year: All

Department: All

Recommendations
884

Average of Length Open in Years (Closed Recommendations Only)



Closed Recommendations (does not include recommendations that are still open, or were closed when the Audit Report was published)

AuditTitle	Average of Length Open - Years
Airport Commission: Andale Mexican Restaurant and Bar Correctly Reported Its Revenue and Paid Its Rent for 2013 and 2014	0.54
Airport Commission: Books, Inc., Reported Its Revenues and Paid Rent for 2014 and 2015 per Its Lease Agreement but Did Not Provide the Required Certified Financial Reports	0.56
Airport Commission: Guava & Java Inc. Reported Its Revenues and Paid Rent for 2014 and 2015 per Its Lease but Did Not Retain Some Sales Records and Submitted a Required Annual Report Late	0.51
Airport Commission: Marilla Chocolate Company, Inc., dba California Lifestyles Reported Its Revenues and Paid Rent for May 1, 2014, Through April 30, 2016, per Its Lease Agreement but Submitted a Required Certified Annual Financial Report Late	0.60
Airport Commission: Pelican Communications, Inc., Correctly Reported Its Revenues and Paid Rent for 2013 and 2014 but Did Not Provide the Required Certified Financial Statements	0.71
Airport Commission: Rylo Management, LLC, dba Three Twins Ice Cream, Reported Its Revenues and Paid Rent for 2014 and 2015 per Its Lease Agreement but Did Not Provide the Required Certified Financial Reports	0.56
Airport Commission: The Airport Improved Its Construction Project Oversight, but Change Management and Data Reliability Procedures Must Be Strengthened	0.57
Airport Commission: Transportation Network Company Operating Permit Audit - Lyft, Inc., Complied With All Tested Transportation Requirements but Underpaid the Airport \$30,042 in Trip Fees	0.61
Airport Commission: Transportation Network Company Operating Permit Audit - Wingz Correctly Paid the Airport \$32,964 for 8,562 Vehicle Trips in April - September 2015 and Complied With Most Transportation Requirements	0.61
All Ten Selected Organizations Complied With the San Francisco Administrative Code, Chapter 12G, by Not Using City Funds for Political Activity for Fiscal Year 2013-14	1.93
Bay Area Young Positives Did Not Maintain Adequate Support for Reimbursement Requests Submitted to the Department of Public Health	1.19
Total	1.35

VISUALIZATIONS

FIELDS

Search

qryRecDeptStatus_P...

- AuditTitle
- ClosedDate
- ConcurID
- DateLastResp...
- DepartmentN...
- DeptID
- Fiscal Year
- Issue Month
- Issue Year
- IssueDate
- Length Open ...
- Length Open ...
- RecID
- RecNumber
- Recommendations...
- Recommendations...

FILTERS

Page level filters

Report level filters

DRILLTHROUGH

Keep all filters

Off

Qualitative Analysis Tools

(Atlas.ti)



- Quantify qualitative data (best practice guidance literature, journal articles, interview records, audit reports, focus group and survey responses)
- Analyze a variety of media types including audio and video files
- Identify common themes across qualitative sources
- Identify statistically significant relationships between themes
- Turn anecdotal evidence into quantifiable evidence
- Excellent audit trail
- Excellent training materials and user guidance

Pros



- Limited to qualitative data so will not be used on every project
- Requires a different mindset than other data analytics so may be a greater learning curve for audit shops with primarily accounting or business backgrounds

Cons



Atlas.ti

Geo-location data

Journal articles

Think having children will make you happy?

Think again, suggests Nattavuth Powdhavee – you're experiencing a focusing illusion

Perhaps one of the most surprising findings in well-being literature is that, although children give us many things, an increase in our average day-to-day positive experiences may not be among them. This article makes an attempt to explain why.

Like many other young couples our age, my long-term girlfriend and I are thinking about starting a family of our own. Two things are currently on our to-do list. First is to get married. And second is to have two children, hopefully one boy and one girl. So far, the case for marriage looks good – there is a huge hill in happiness for both husband and wife in the year of marriage that tends to last for many years afterwards (see, for example, Lucas et al., 2003). The case for having children, on the other hand, does not look so wonderful.

Over the past few decades, social scientists like me have found consistent evidence that there is an almost zero association between having children and happiness. My analysis in the *Journal of Socio-Economics* (Powdhavee, 2008) is a recent Danish example of parents' and non-parents' reactions to the

America, numerous scholars have found some evidence that, on aggregate, parents often report statistically significant levels of happiness (Alesina et al., 2013; marital satisfaction (Furze et al., 2002) compared with non-parents. There is also evidence that the associated with parenthood are not limited to the period during which children are physically and econo- dependent. For example, Green and McLanahan (1981) found those old parents whose children have left home report the same or slightly less happiness than non-parents of similar age and sex. Thus, what these results suggest something very controversial – that children does not bring joy to our!

The focusing illusion
However, the most surprising thing the whole story is not the fact that keep finding a negative or a statistically insignificant association between children and different measures of being. For over two decades, we have to be able to explain why parents can be especially stressed as well as rewarding. McLanahan and Ad. (1989). For instance found that parents' children at home significant amount of worrying about their children and feeling efficacious as an adult something which non-parents do not have



- children: < happiness~
- effects parenting: marital satisfac
- scientific evidence~
- children: < happiness~
- children: = level of happiness~
- effects parenting: marital satisfac
- children: = level of happiness~
- research questions~
- reasons for hc: focusing illusion~
- scientific evidence~
- effects parenting: (neg) less...~
- effects parenting: (neg) more...~

Id	Name	Docume...	Density	Owner	Author	Created	Modified	Start	End	Extent
1	Buckingham Palace	London	1	Ricardo Contreras	Ricardo Contreras	4/30/2017 7:49 A...	4/30/2017 8:11 A...	n/a	n...	n/a
1	Abbey Road Studios	London	1	Ricardo Contreras	Ricardo Contreras	4/30/2017 7:49 A...	4/30/2017 8:36 A...	n/a	n...	n/a
1	Hyde Park	London	1	Ricardo Contreras	Ricardo Contreras	4/30/2017 7:50 A...	4/30/2017 8:02 A...	n/a	n...	n/a

Video files

- So many birds
- Red heads
- Red heads
- Sun is shining
- Note the feathers

Blog posts

desperately... I had a long, long list of reasons why I didn't want a child. The epiphany arrived when I finally realized that the main (perhaps only) reason why I didn't want to try was because I was scared. I was not deluded at all, I was very conscious of how easy it is for things to go wrong, during and after the pregnancy. I knew it is very difficult to care for a baby, to raise a child, to deal with a teenager. But I found that I wanted, that I needed that experience. Even though things could go wrong, and it was going to be difficult, and sometimes you end up looking at a stranger with your eyes whom you can't even like but whom you deeply love, nonetheless.

Hard work but... (30-1)~
Hard work but_fulfillment (0-0)
Hard work but_positive emotions (0-0)
Hard work but_richer life (0-0)
Hard work but_worthwhile trade-off (0-0)
perception whether children bring happiness (7...)
30 Quotations for Code HARD WORK BUT...
1:42 For over two decades, we have been able
3:11 We've been outrageously lucky. Our dau
3:15 Singer-songwriter Jonathan Colton nails
3:16 Define "happy". It's a feeling. Most of us I
3:26 I'm happy with my two boys. They're def
3:40 I am a relatively new parent myself. I und
3:48 We are lucky in that we have a daughter

Taped interviews

add name quotation
00:00:17 - 00:00:27
In Doc: interview

Codings
Comment
Tap to add a comment...

Codes
code A
code B

Atlas.ti

Journal articles Blog posts Geo-location data Taped interviews Video files
 Identify themes **Map relationships between themes** Identify co-concurrence of codes

The screenshot displays the ATLAS.ti interface for a project titled "Latin American Study - ATLAS.ti". The main window shows a matrix of relationships between codes: Children, Education, home, husband, and leisure time. The matrix cells contain counts and correlation coefficients. A callout box highlights the relationship between Education (73) and Children (87) with a correlation of 0.51, and provides the formula: $0.51 = 54 / (73 + 87 - 54)$. To the right, a Venn diagram shows the overlap between Education (73) and Children (87) is 54. The Terminology window on the right shows a network of nodes and links, with "Kabbala" highlighted. The bottom status bar indicates "665 WORDS" and "100%" zoom.

	Children	Education	home	husband	leisure time
Children		54 - 0.51	57 - 0.58	9 - 0.10	14 - 0.16
Education	54 - 0.51		51 - 0.56	4 - 0.05	6 - 0.07
home	57 - 0.58	51 - 0.56		6 - 0.08	7 - 0.09
husband					1 - 0.04
leisure time	14 - 0.16	6 - 0.07	7 - 0.09	1 - 0.04	

Education (73) @ Children (87)

Education=73
 Overlap=54
 Children=87

$0.51 = 54 / (73 + 87 - 54)$

organization

665 WORDS 100%

Data Analytics Tool Comparison

Tool	Cost	Granular Access Control	Capacity, Scalability, Performance	Data Analysis Functions	Statistical Functions	Visualizations	Ease of Use	Learning Curve	Audit Trail & Control	Server-based ¹	Interactive Output
Excel <i>(spreadsheet)</i>	Low	Low	Low	Mod	High	Mod	High	Low	Low	No	No
ACL <i>(audit software)</i>	Mod	Low	Mod	High	Low	Mod	Mod	Mod	High	No	No
Audit Exchange <i>(audit software)</i>	High	Mod	High	High	Low	Mod	Mod	Mod	High	Yes	No
TeamMate Analytics <i>(audit software)</i>	Mod	Mod	Mod	High	High	Mod	High	Low	High	No	No
Power BI <i>(visualization software)</i>	Low	Low	Mod	High	Low	High	Mod	Mod	Low	Mixed	Yes
Tableau <i>(visualization software)</i>	High	Mod	Mod	High	High	High	Mod	High	Mod	Mixed	Yes
SQL Server <i>(server database)</i>	Mod	High	High	Mod	High ²	Mod ³	Low	N/A ¹	Mod	Yes	No
Access <i>(desktop database)</i>	Low	Low	Mod	Mod	Low	Low	Mod	Mod	Low	No	No
Atlas.ti <i>(qualitative analysis)</i>	Mod	Mod	Mod	Mod	Low	Low	Mod	Mod	High	No	No

¹ Server based software requires IT staff to design and administrator

² SQL Server implements statistics using R statistical package

³ SQL Server Reporting Services is used for reporting visualizations

Conclusion

Fundamentals

Support

Collaboration

Pilot

Process

Perform

Investigate

Resolve

Invest

Tools

Expertise

Time

Nelson Ho

Supervising IT Auditor

City and County of San Francisco

nelson.ho@sfgov.org

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Bonus Content

Microsoft Excel – What you didn't know it could do

- ❖ Create relationships between tables like a relational database (Relationships)
- ❖ Import data from multiple tables in a relational database with greater ease than queries in Access (Power Pivot)
- ❖ Model changes and see output without altering the existing data (What-If Analysis)
- ❖ Automatically see forecasted values based on historical data trends (Forecast Sheet)
- ❖ Create and save perspectives to view different elements of the data
- ❖ Create hierarchies for splicing data such as year → quarter → month → day or country → state → congressional district (Power Pivot)
- ❖ Automatically identify invalid or illogical data fields (Data Validation)
- ❖ Collaborative editing (Office365)
- ❖ Statistics including regression, correlation, covariance, anova, and t-test (Data Analysis Toolkit Add-in)