

Continuous Monitoring and Auditing on Government Accounting Information Systems: A Project with the City of Burbank

Miklos A. Vasarhelyi

Rutgers Business School

Heejae Lee

Grand Valley State University

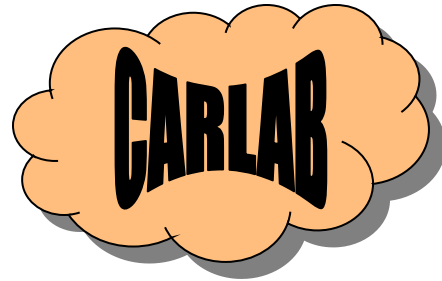


Overview

- Introduction on Carlab
 - AI Research in Carlab
 - Continuous Process Auditing
 - CA/CM Intelligent Agentic System: A DSR use case in a Brazilian State government
- Continuous Monitoring and Auditing on Government Accounting Information Systems: A Project with the City of Burbank



AI Research at the Carlab



**CarLab (Continuous Auditing and Reporting
Laboratory)**

Rutgers University



1989-2005

LITTLE INTEREST

ACCOUNTING RESEARCH DIRECTORY
The Database of Accounting Literature

Lawrence D. Brown
John C. Gardner
Editors & VantagePoint

ACCOUNTING RESEARCH
The Database of Accounting Literature

VOL. 6

VOL. 5

VOL. 4

VOL. 4

VOL. 4

Accounting

Accounting

Accounting

VantagePoint

VantagePoint

VANTAGEPOINT

VANTAGEPOINT

VantagePoint
Logan

VantagePoint
Logan

VantagePoint
Logan

VantagePoint
Logan

VantagePoint
Logan

Brown
VantagePoint

CarLab (Continuous Auditing and Reporting Laboratory) Rutgers University

Brigham Young Research Ranking in AIS

University	Last 6 Years	Last 12 Years	All Years
<u>Rutgers, The State University of New Jersey</u>	1 {10} [22]	1 {13} [43]	1 {13} [55]

Digital (free) library with over 3000 Hours of Education on YouTube

<https://www.youtube.com/@rutgersweb>

SWAM: School with a Million Courses

Tailorable education modules

<https://byoc.business.rutgers.edu/Student/demo/>

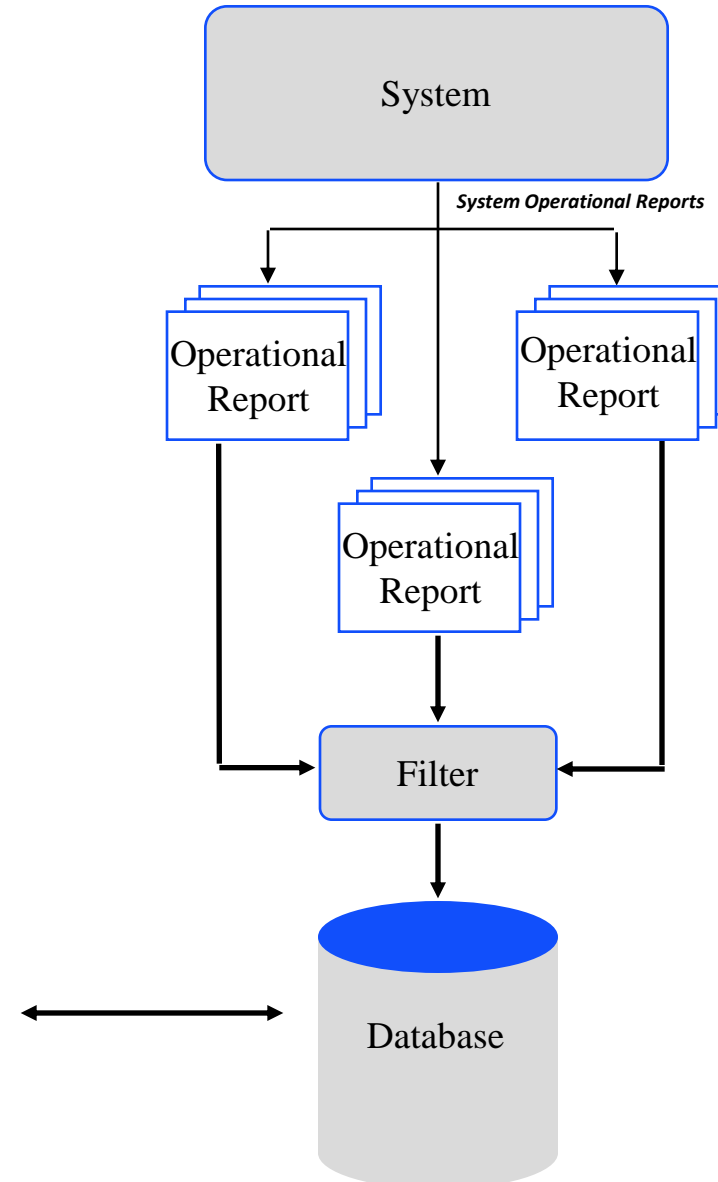
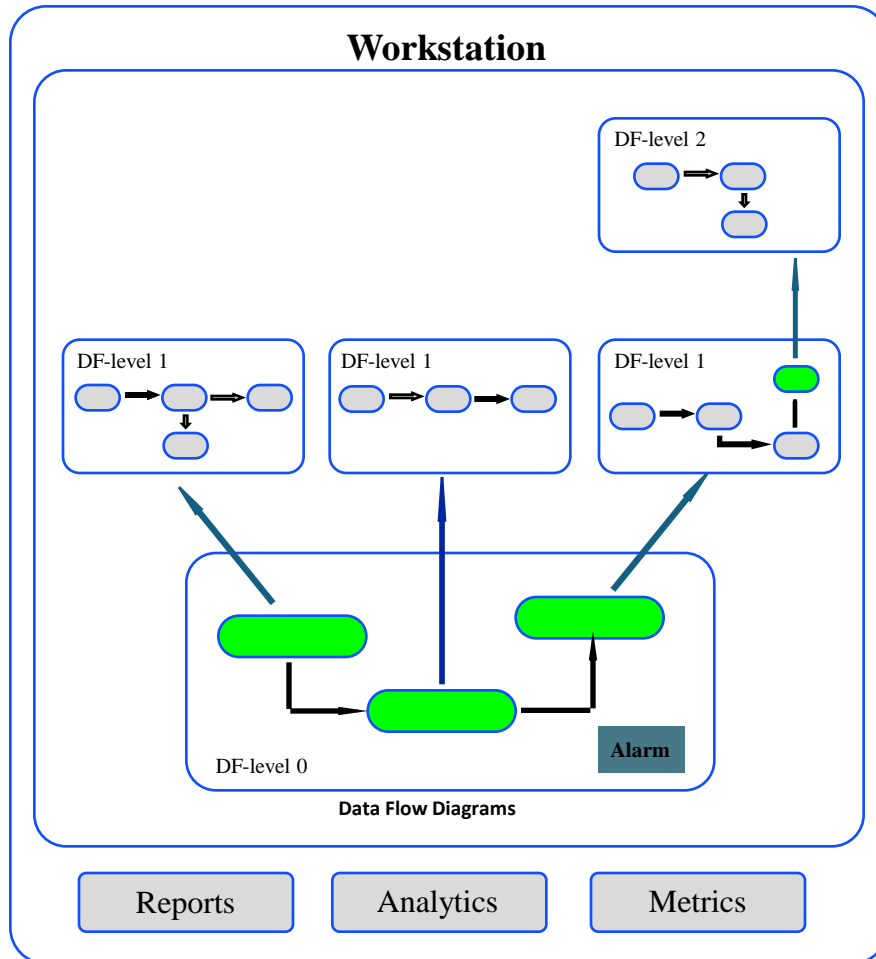
Continuous Process Auditing

Miklos A. Vasarhelyi

Fern B. Halper

1986 at AT&T Bell Labs

CPAS OVERVIEW



fer

Date: 04/01/89

Set Date

Recalculate Metrics

Recalculating With Check.

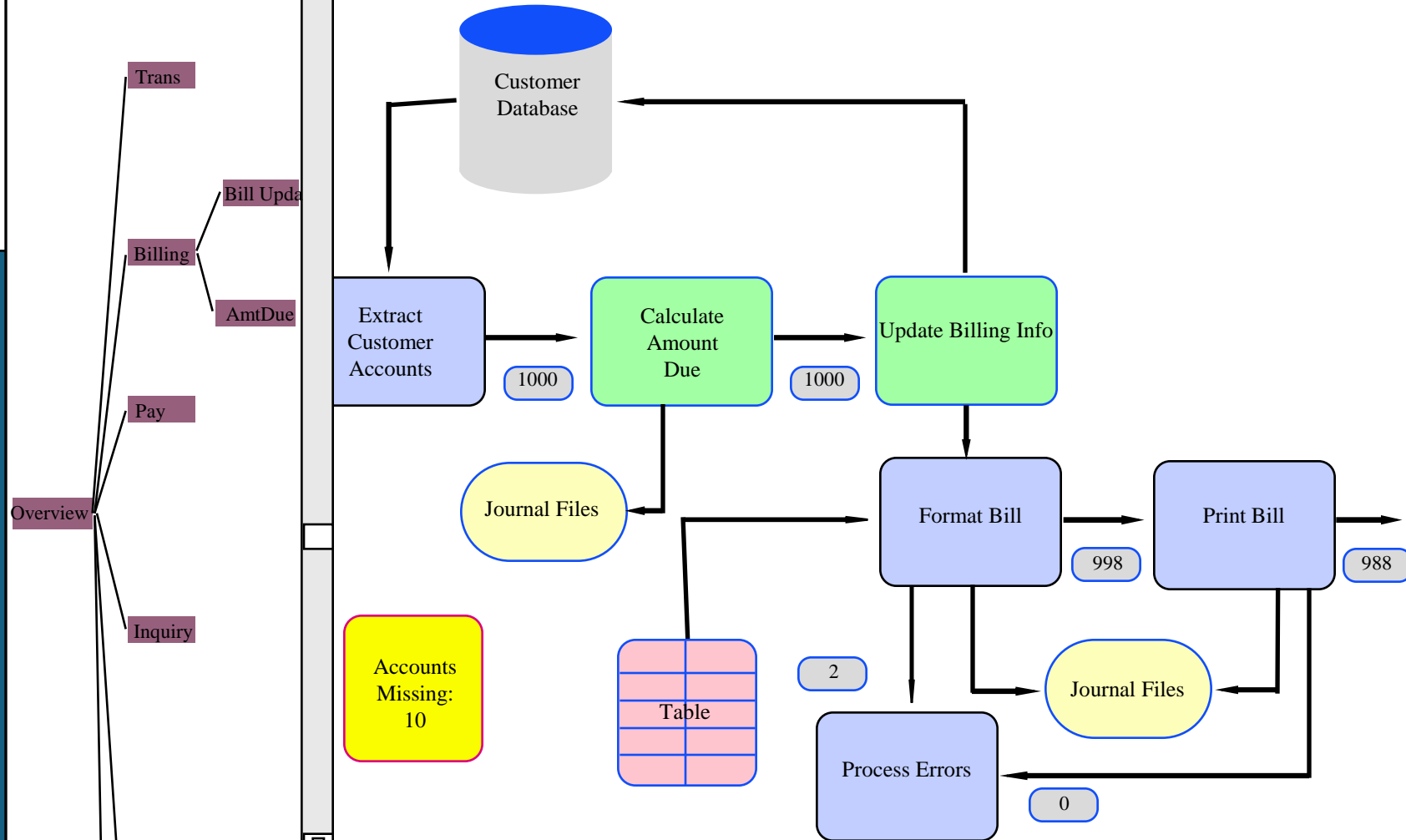
Help

Text

Quit!

FlowFront Hierarchy

Billing System - Customer Billing Module



Overview

Trans

Bill Upda

Billing

AmtDue

Pay

Inquiry

Errors

Accounts Missing: 10

Table

2

Journal Files

998

988

0

Journal Files

Customer Database

Extract Customer Accounts

Calculate Amount Due

Update Billing Info

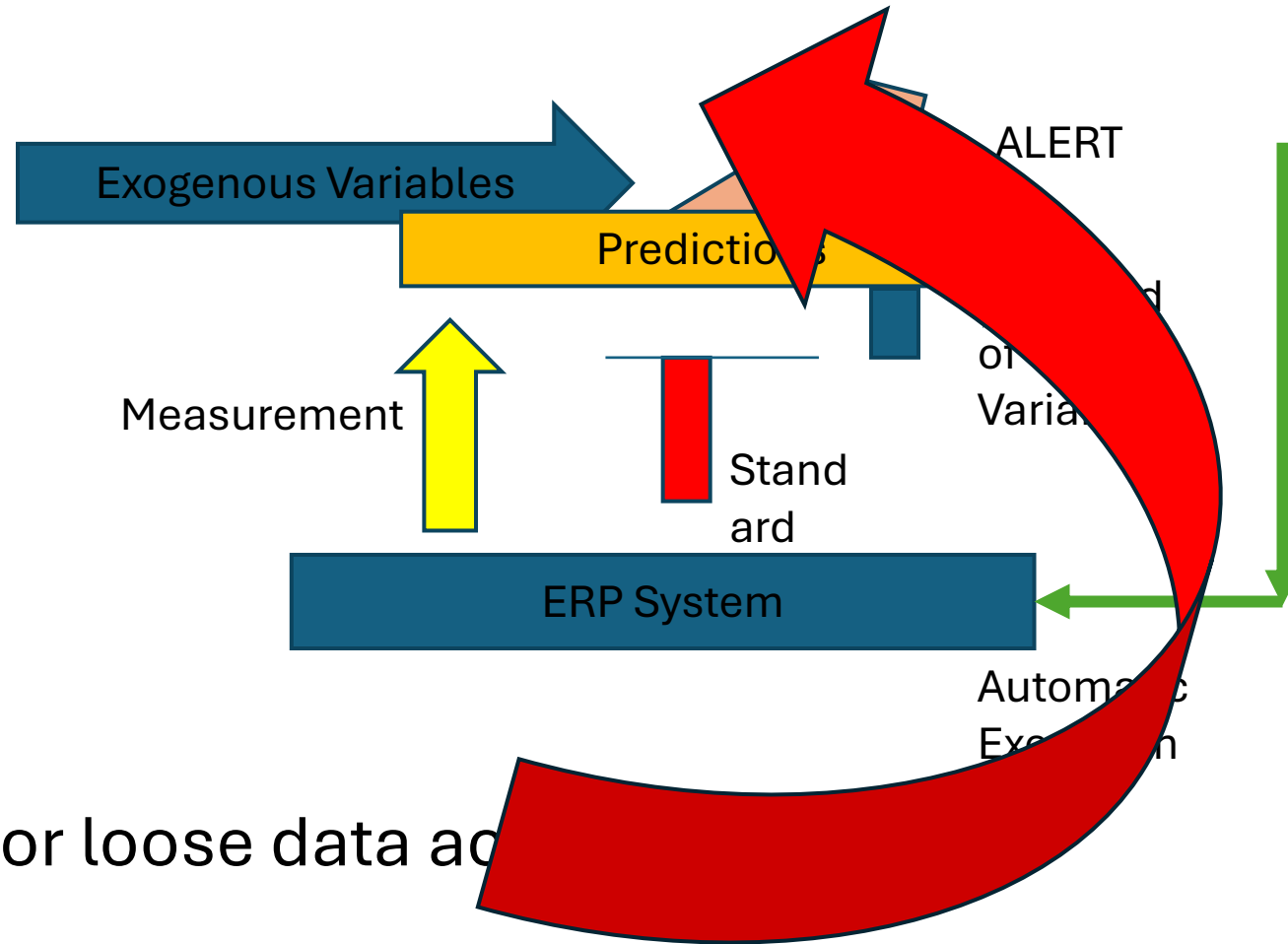
Format Bill

Print Bill

Process Errors

Elements

- Metrics
- Analytics
- Standards
 - Process
 - Variance
- Data base access or loose data access
- Exogenous variables (IoT, etc)
- AI



Link Quantitative with Qualitative with Gen AI

CarLab AI-related Projects List (selected)

- **General AI discussion**

- Using artificial intelligences in ESG assurance

- **Machine learning**

- Predict default: Going concern opinions
- Predict the discontinuity of non-profit organization
- Outlier detection and explainable artificial intelligence
- Federated continual learning in financial statement audits
- Continuous monitoring with machine learning and interactive data visualization: An application to a healthcare payroll process

- **Natural Language Processing**

- ChatGPT in audit and beyond
- Understand ESG reports: OECD project
- The effect of remote workforce on firms' cybersecurity risk disclosures and incidents
- Graph Anomaly Detection

- **Robotic Process Automation**

- RPA in audit planning, internal control evaluation, substantive procedures, and audit opinion
- Attended automation in audit

- **LLM (over 20 projects as 05/2025)**

- Extracting financial data from unstructured sources: Leveraging large language models

CarLab GFOA Projects Summary

- **Rethinking Financial Reporting (Burbank)**
 - Build a tool that watches city finances in real time to catch problems early and reduce mistakes.
- **Extracting Financial Data from ACFRs with LLMs**
 - Use AI to pull numbers out of long government financial reports automatically.
- **Automating Municipal Report Review**
 - Teach AI to help review city financial reports so humans don't have to do all the repetitive work.
- **Extracting Notes from ACFRs**
 - Use AI to pull key info from the long note sections in city financial reports to save time.

CA/CM Intelligent Agentic System: A DSR use case in a Brazilian State government

Maurício Vasconcellos Leão Lyrio, Universidade Federal de Santa Catarina

Miklos Vasarhelyi, Rutgers Business School

Huijue Kelly Duan, Sacred Heart University

Melissa Dardani, Rutgers Business School

Yu gu, Rutgers Business School

THE PROTOTYPE STRUCTURE



Rutgers Business School

Welcome **admin**

 Home

 PPM Intelligent Assistant

 PPM Price Validation Agent

 PPM Red Flags Monitor

 PPM Dashboards

 Logout

The prototype is structured in 4 independent modules:

1. **Intelligent Assistant:** make SQL queries on database and return in natural language the user questions;
2. **Price Validation Agent:** identifying reference prices for products and services purchased by government agencies and return suggested prices and alerts;
3. **Red flags Monitor Agent:** Performs risk analysis throughout the procurement processes database and prepares preliminary report to support audit;
4. **Dashboards:** Key indicators and general dataviz of biddings, contracts etc.

Continuous Monitoring and Auditing on
Government Accounting Information Systems: A
Project with the City of Burbank

What is Continuous Auditing and Monitoring (CA/CM)?

-
- Continuous auditing and monitoring (CA/CM) is a process that uses automated feedback to monitor an organization's transactions, controls, and IT systems in real time.
 - Implementing CA/CM can help organizations reduce errors and irregularities and improve efficiency.

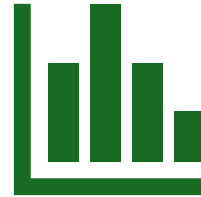
CA/CM in Government Accounting Information System

-
- In government accounting, CA/CM can positively affect accountability and compliance.
 - Develop a framework to guide how the implement CA/CM in Government Accounting Information System.
 - Case study to build the prototype of CA/CM system using monthly trial balance data

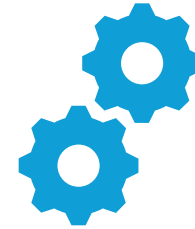
Technologies/Software Used or Can be Used



Python



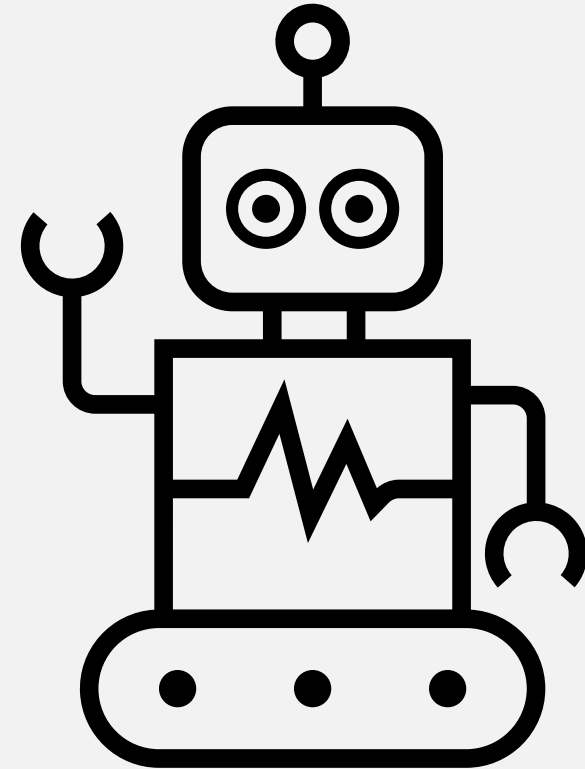
Microsoft Power BI
or Tableau



Microsoft Power
Automate or UiPath

Linking Various Agents to CA/CM system

- Various agents can be linked to CA/CM system to collect exogenous variables.
- Collecting Price Information and suggesting proper pricing, Collecting feedback from residents and measure the performance, etc.



Steps of Implementing CA/CM system

Identify Auditing/Monitoring objectives

Data Extraction

Data Preprocessing

Data Loading

Design CA/CM system

Design CA/CM Report

Implement CA/CM system

Revise CA/CM system

Identifying Auditing / Monitoring Objectives

- To develop an effective CA/CM system, it is essential to identify auditing and monitoring objectives.
- Identifying auditing and monitoring objectives can allow the management to decide:
 - Which data to be extracted
 - How to preprocess the extracted data
 - How and where to load the preprocessed data
 - How to design the CA/CM system
 - How to design the report

Examples of Auditing / Monitoring Objectives

- Mitigate the risk related to deficit in fund balance.
- Mitigate the risk of overspending compared to budget.
- Mitigate the risk of errors in month-end and year-end trial balance.
- Mitigate the risk of misstatement.



Steps of Implementing CA/CM system

Identify Auditing/Monitoring objectives

Data Extraction

Data Preprocessing

Data Loading

Design CA/CM system

Design CA/CM Report

Implement CA/CM system

Revise CA/CM system

Data Extraction

- The process of extracting and exporting data from the data source.
- The process can be done manually or automatically.
- For the case study, monthly trial balance of revenue and expense accounts of City of Burbank, CA were used.
- Data from July 2021 to June 2024 (Three fiscal year)
- Data was manually extracted to develop prototype.

Steps of Implementing CA/CM system

Identify Auditing/Monitoring objectives

Data Extraction

Data Preprocessing

Data Loading

Design CA/CM system

Design CA/CM Report

Implement CA/CM system




Revise CA/CM system

Data Preprocessing

-
- The process of cleaning, transforming, and structuring raw data into a format suitable for analysis.
 - Sometimes, the raw data exported from ERP system may not be in best format to perform data analysis.
 - Using Python code to load the raw excel file in the designated folder and automatically preprocess the raw excel file into a format can be used for analysis.
 - This process can be automatically done without or limited human intervention.




Example of Data Preprocessing Input and Output folders

y > Research Data > Burbank > TB Rev Exp Search TB Rev

<input type="checkbox"/> Name	Status	Date modified	Type	Size
 NextGen TB 2122	✓	12/10/2024 1:02 PM	Microsoft Excel Work...	709 KB
 NextGen TB 2324	✓	12/10/2024 1:02 PM	Microsoft Excel Work...	735 KB
 TB_NextGen	✓	1/6/2025 12:06 PM	Microsoft Excel Work...	706 KB



/ > Research Data > Burbank > TB Rev Exp processed Search TB Rev

<input type="checkbox"/> Name	Status	Date modified	Type	Size
 NextGen TB 2122	✓	2/8/2025 2:57 PM	Microsoft Excel Work...	2,850 KB
 NextGen TB 2324	✓	2/8/2025 2:57 PM	Microsoft Excel Work...	2,939 KB
 TB_NextGen	✓	2/9/2025 2:36 PM	Microsoft Excel Work...	3,001 KB

Example of Data Preprocessing Input and Output data

Fund	Cost Center	Account	Sub Account	JUL 2022 Period to Date BURBANK	JUL 2022 Period to Date ACTUALS	AUG 2022 Period to Date BURBANK	AUG 2022 Period to Date ACTUALS
001 - General Fund	ND000 - Non-Departmental	40001 - Current property taxes	1000 - Secured	-38,412,200.00	0.00	0.00	0.00



Fund	Cost Center	Account	Sub Account	Period_Date	Budget	Actual
001 - General Fund	ND000 - Non-Departmental	40001 - Current property taxes	1000 - Secured	2022-07-01 00:00:00	-38,412,200	0
001 - General Fund	ND000 - Non-Departmental	40001 - Current property taxes	1000 - Secured	2022-08-01 00:00:00	0	0

Steps of Implementing CA/CM system

Identify Auditing/Monitoring objectives

Data Extraction

Data Preprocessing

Data Loading

Design CA/CM system

Design CA/CM Report

Implement CA/CM system

Revise CA/CM system

Data Loading

-
- The process of moving data to the platform or software where the CA/CM system will be designed and implemented.
 - Data can be loaded manually or automatically to the platform or software.
 - For the case study, data files is designed to automatically loaded to the Power BI.

Example of Automating Data Loading Process

Data source settings ✕

Manage settings for data sources that you have connected to using Power BI Desktop.

Data sources in current file Global permissions

⌵

- c:\users\leehee\onedrive - gra...a\burbank\tb rev exp processed

Steps of Implementing CA/CM system

Identify Auditing/Monitoring objectives

Data Extraction

Data Preprocessing

Data Loading

Design CA/CM system

Design CA/CM Report

Implement CA/CM system

Revise CA/CM system

Design the CA/CM system

-
- Design the Continuous Auditing and Continuous Mentoring system to achieve the objectives identified.
 - In a case study, we designed CA/CM system to
 - Mitigate the risk related to deficit in fund balance.
 - Mitigate the risk of overspending compared to budget.
 - Mitigate the risk of errors in month-end and year-end trial balance.
 - Mitigate the risk of misstatement.

Design the CA/CM system – Overview

Mitigate the risk related to deficit in fund balance.

City of Burbank - Revenue Expense Accounts Overview

Present total revenue and expense and difference between two numbers for the fiscal year

\$733.22M Total Revenue	(\$672.42M) Total Expense	\$121.6M Net Change in Fund Balance	Period <input type="checkbox"/> 2021-2022 <input type="checkbox"/> 2022-2023 <input checked="" type="checkbox"/> 2023-2024
196 Count of Cost Center	267 Count of Account	37 Count of Fund	

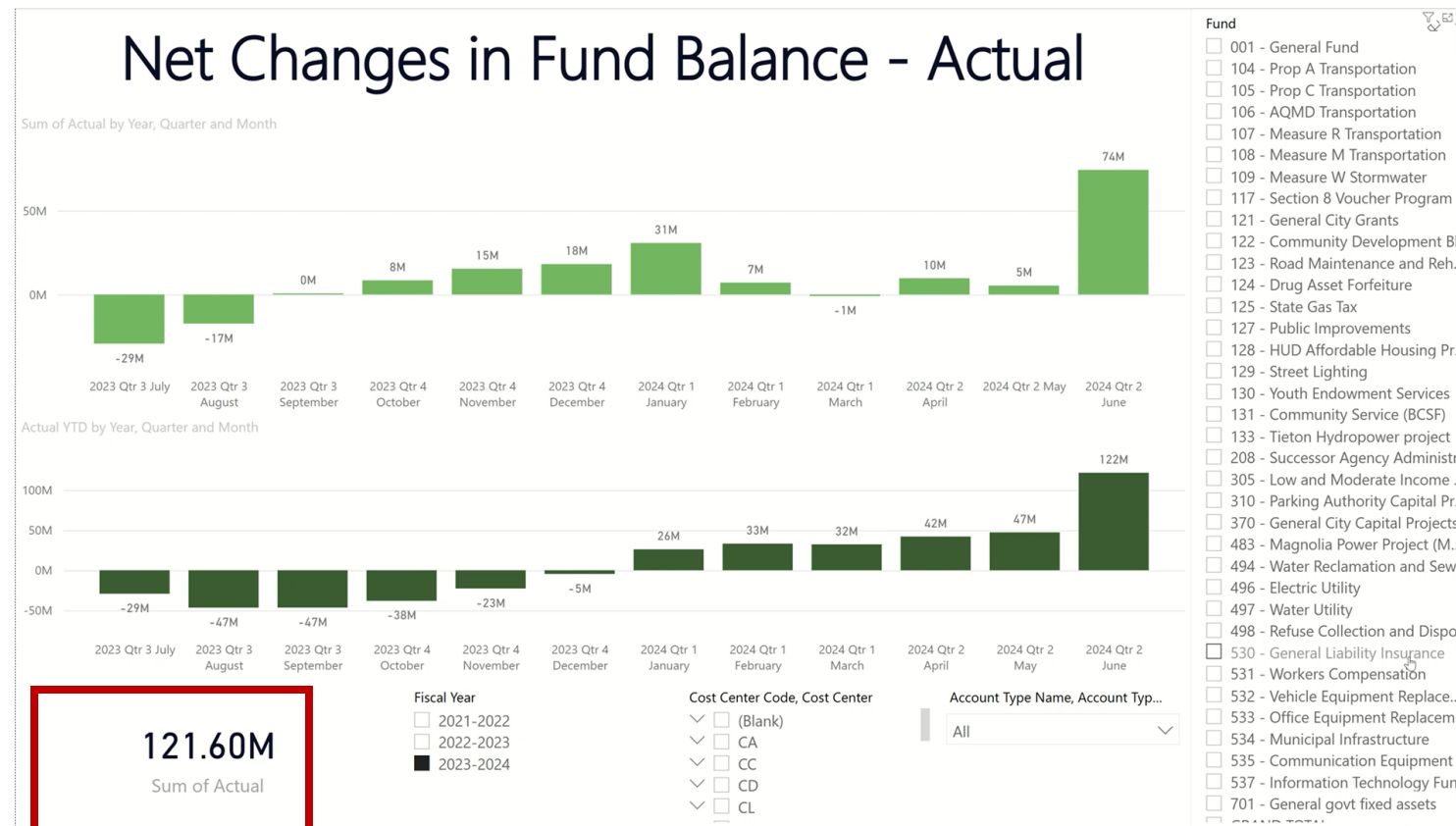


Filter Fund

Overview	YTD Bal.	Acc. Type Lv.2	Account	Fund Balance - Actual	Rev. Budget vs Actual	Rev. - Multi-Year Comp	Exp. Budget vs Actual	Exp. - Multi-Year Comp	Overspending Cost Cent...	Overspending Cost Center	Overspending Fund	CC Code Exp PY Comp	CC Exp PY Comp
----------	----------	----------------	---------	-----------------------	-----------------------	------------------------	-----------------------	------------------------	---------------------------	--------------------------	-------------------	---------------------	----------------

Trend Analysis of Net Changes in Fund Balance – Monthly, and Year-to-Date difference

Mitigate the risk related to deficit in fund balance.

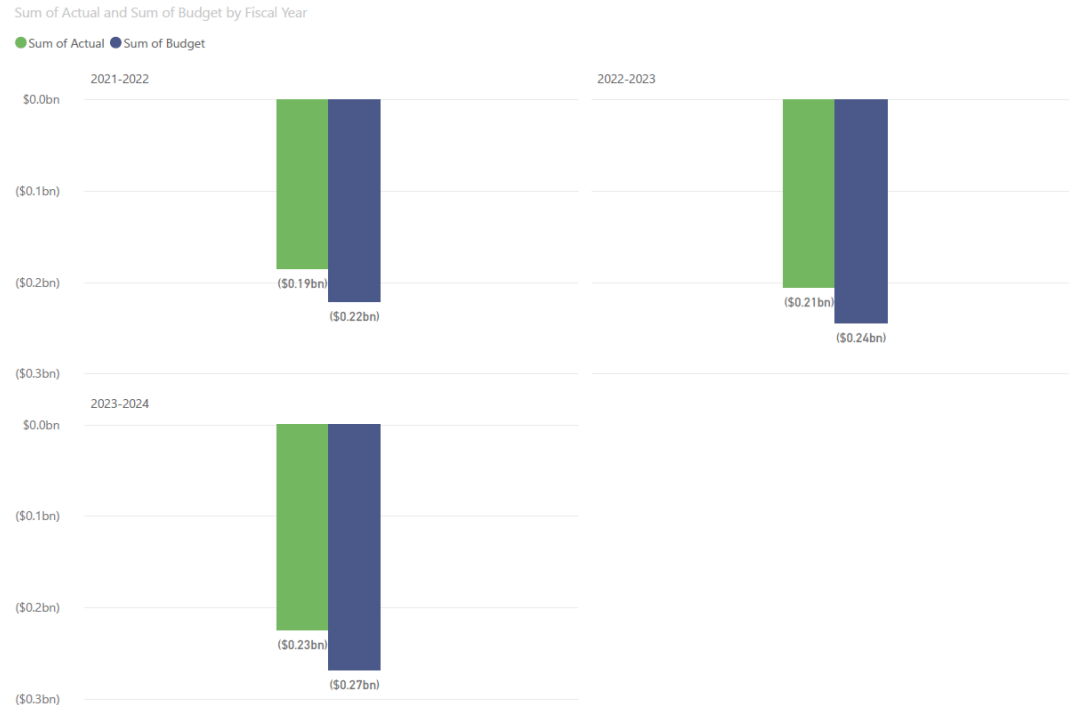


Show the total amount for selected bars

Budget vs Actual Revenue and Expenses Comparison between years

Mitigate the risk of overspending compared to budget.

Year-to-date Budget vs Actual



Filter Fiscal Year to compare

Fiscal Year

2021-2022

2022-2023

2023-2024

Fund

- 001 - General Fund
- 104 - Prop A Transportation
- 105 - Prop C Transportation
- 106 - AQMD Transportation
- 107 - Measure R Transportation
- 108 - Measure M Transportation
- 109 - Measure W Stormwater
- 117 - Section 8 Voucher Program
- 121 - General City Grants
- 122 - Community Development Block Grants
- 123 - Road Maintenance and Rehabilitation
- 124 - Drug Asset Forfeiture
- 125 - State Gas Tax
- 127 - Public Improvements

Cost Center Code, Cost Center

All

Account Type Name, Account Type Description

Expense

Revenue

Filter Fund

Filter Cost Center

Filter Revenue / Expense Accounts

Comparison Analysis for Expenses vs. Prior Year – Cost Center Level

Comparison to Prior Year on Cost Center Level (Materials, Supplies and Services & Salaries and Benefits)

Cost Center	Year	Month	Actual PY	Sum of Actual	Actual PYTD	Actual YTD	Budget PYTD	Budget YTD	Used %	PY Used %	Change in Used%
FD07A - Fire Administration	2023	March	-108,362.10	-177,478.16	-948,693.62	-1,359,683.20	-1,363,134.71	-1,451,332.55	93.69%	69.60%	24.09%
FD07A - Fire Administration	2023	April	-92,391.99	-161,940.63	-1,041,085.61	-1,521,623.83	-1,363,134.71	-1,451,332.55	104.84%	76.37%	28.47%
FD07A - Fire Administration	2023	May	-116,456.33	-173,437.32	-1,157,541.94	-1,695,061.15	-1,363,134.71	-1,451,332.55	116.79%	84.92%	31.88%
FD07A - Fire Administration	2023	June	-152,990.38	-184,457.05	-1,310,532.32	-1,879,518.20	-1,363,134.71	-1,451,332.55	129.50%	96.14%	33.36%
Total			-470,200.80	-697,313.16	-1,310,532.32	-1,879,518.20	-1,363,134.71	-1,451,332.55	129.50%	96.14%	33.36%

Alert!

The CA/CM dashboard shows that Used % increased more than 20% from the same month prior year in March 2023.

Comparison Analysis for Expenses vs. Prior Year – Cost Center Level

Comparison to Prior Year on Cost Center Level
(Materials, Supplies and Services & Salaries and Benefits)

Cost Center	Year	Month	Actual PY	Sum of Actual	Actual PYTD	Actual YTD	Budget PYTD	Budget YTD	Used %	PY Used %	Change in Used%
PR21A - Facility Planning and Development	2023	October	-111,445.96	-383,766.06	-409,844.96	-1,330,046.63	-2,827,581.12	-3,838,173.14	34.65%	14.49%	20.16%
PR21A - Facility Planning and Development	2023	November	-105,100.35	-344,308.85	-514,945.31	-1,674,355.48	-2,827,581.12	-3,805,188.41	44.00%	18.21%	25.79%
PR21A - Facility Planning and Development	2023	December	-131,959.95	-332,495.37	-646,905.26	-2,006,850.85	-2,827,581.12	-3,805,188.41	52.74%	22.88%	29.86%
PR21A - Facility Planning and Development	2024	January	-100,552.30	-533,701.39	-747,457.56	-2,540,552.24	-2,827,581.12	-3,805,188.41	66.77%	26.43%	40.33%
PR21A - Facility Planning and Development	2024	February	-97,848.29	-346,789.48	-845,305.85	-2,887,341.72	-2,827,581.12	-3,804,635.31	75.89%	29.90%	46.00%
PR21A - Facility Planning and Development	2024	March	-166,714.73	-384,360.41	-1,013,020.57	-3,371,603.12	-2,827,581.12	-3,804,635.31	83.26%	36.70%	47.57%
PR21A - Facility Planning and Development	2024	April	-101,070.76	-462,486.66	-1,113,091.33	-3,634,178.79	-2,827,581.12	-3,754,635.31	96.79%	39.37%	57.43%
PR21A - Facility Planning and Development	2024	May	-130,576.57	-749,408.58	-1,243,667.90	-4,383,587.37	-2,827,581.12	-3,754,635.31	116.75%	43.98%	72.77%
PR21A - Facility Planning and Development	2024	June	-255,974.86	-497,912.98	-1,499,642.76	-4,881,500.35	-2,677,331.12	-3,636,372.65	134.24%	56.01%	78.23%
PR27A - Golf Course	2024	June	-53,638.00	-461,575.70	-3,881,715.19	-4,655,362.48	-3,969,921.00	-3,978,126.81	117.02%	92.74%	24.28%
PR31D - Starlight Bowl	2022	July	-17,388.37	-120,382.78	-17,388.37	-120,382.78	-454,471.00	-458,705.00	26.24%	3.83%	22.42%
PR31D - Starlight Bowl	2022	August	-15,044.92	-51,034.05	-32,433.29	-171,416.83	-454,471.00	-458,705.00	37.37%	7.14%	30.23%
PR31D - Starlight Bowl	2022	September	-22,054.43	-69,921.35	-54,487.72	-241,338.18	-472,006.10	-498,390.76	48.42%	11.54%	36.88%
PR31D - Starlight Bowl	2022	October	-17,727.51	-34,158.18	-72,215.23	-275,496.36	-472,006.10	-498,390.76	55.28%	15.30%	39.98%
PR31D - Starlight Bowl	2022	November	-18,157.33	-38,401.54	-90,372.56	-313,897.90	-472,006.10	-498,390.76	62.98%	19.15%	43.84%
PR31D - Starlight Bowl	2022	December	-18,666.85	-109,888.22	-128,545.07	-325,814.15	-472,006.10	-498,390.76	71.71%	23.88%	47.83%
PR31D - Starlight Bowl	2023	January	-18,579.94	-35,242.71	-126,809.25	-390,541.39	-472,006.10	-498,390.76	78.36%	26.87%	51.49%
PR31D - Starlight Bowl	2023	February	-19,702.42	-32,205.75	-146,511.67	-422,747.14	-472,006.10	-507,378.48	83.32%	31.04%	52.28%
PR31D - Starlight Bowl	2023	March	-28,302.75	-38,072.52	-174,814.42	-460,819.66	-472,006.10	-507,378.48	90.82%	37.04%	53.79%
PR31D - Starlight Bowl	2023	April	-24,953.64	-26,583.79	-199,768.06	-487,403.45	-472,006.10	-507,378.48	96.06%	42.32%	53.74%
PR31D - Starlight Bowl	2023	May	-42,823.03	-37,534.32	-242,591.09	-524,937.77	-472,006.10	-507,378.48	103.46%	51.40%	52.07%
PR31D - Starlight Bowl	2023	June	-82,868.14	-58,001.45	-325,459.23	-582,939.22	-472,006.10	-507,378.48	114.89%	68.95%	45.94%
PR31D - Starlight Bowl	2023	November	-38,401.54	-60,722.06	-313,897.90	-422,700.76	-498,390.76	-471,742.61	89.60%	62.98%	26.62%
					-355,298.68	-468,235.64	-498,390.76	-501,742.61	93.32%	71.29%	22.03%
					-1,262.32	-118,546.00	-280,866.00	-287,517.00	41.23%	0.45%	40.78%
					-1,577.90	-118,895.00	-280,866.00	-287,517.00	41.35%	0.56%	40.79%
					-1,893.48	-119,244.00	-280,866.00	-287,517.00	41.47%	0.67%	40.80%
					-2,209.06	-119,909.08	-280,866.00	-287,517.00	41.71%	0.79%	40.92%
					-1,335,622.05	-1,717,643.69	-1,449,104.82	-1,480,042.81	116.05%	92.17%	23.88%
					-519,346.86	-714,408.43	-1,016,420.31	-1,000,531.15	71.40%	51.10%	20.31%
					-574,677.16	-803,433.43	-1,046,430.31	-1,000,531.15	80.27%	56.10%	23.70%
					-12,207,994.38	-17,506,850.76	-13,607,375.16	-15,901,074.69	110.10%	89.72%	20.38%

- Fund
- 001 - General Fund
- 370 - General City Capital ...
- 532 - Vehicle Equipment ...
- 533 - Office Equipment R...
- 534 - Municipal Infrastruc...
- 537 - Information Technol...
- 701 - General govt fixed a...

Alert!

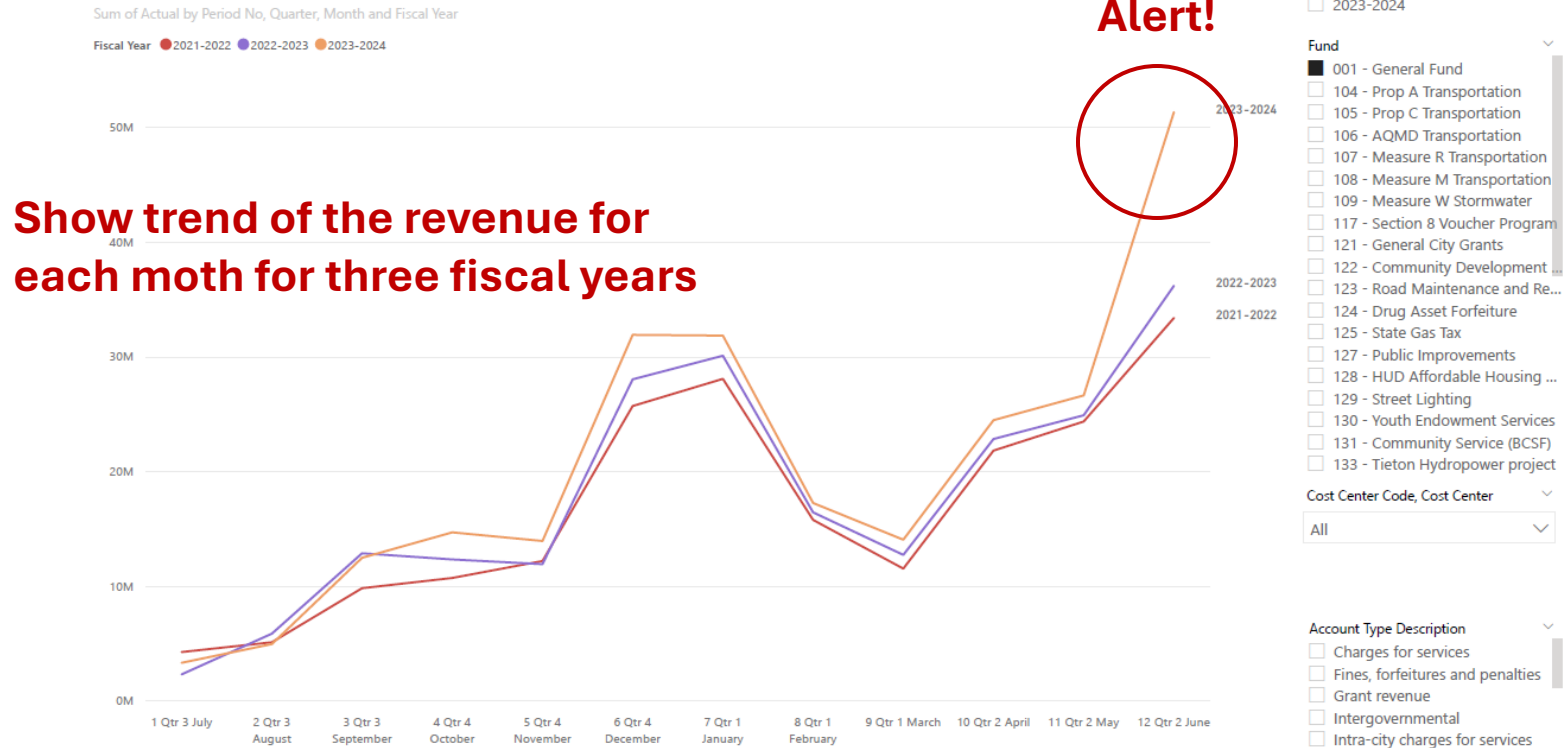
- Cost Center Code, Cost Ce...
- CA
- CC
- CD
- CL
- CM
- CP
- CT
- FD
- FN
- IT
- LB
- MS
- ND
- PD
- PR
- PS
- PW

Show the alert if % Expense Used increase more than 50% from the same period prior year

Trend Analysis of Revenues – Comparison to prior years

Mitigate the risk of errors in month-end and year-end trial balance.

Revenue - Multi Year Comparison



Steps of Implementing CA/CM system

Identify Auditing/Monitoring objectives

Data Extraction

Data Preprocessing

Data Loading

Design CA/CM system

Design CA/CM Report

Implement CA/CM system

Revise CA/CM system

Design the CA/CM Report

-
- The process of designing CA/CM Report that generated by the CA/CM system.
 - The report can be generated manually or automatically.
 - Using Robotic Process Automation to automatically send the report the designated users.

What we expect in the future



- Implement CA/CM system
- Revise CA/CM system
- Perform more case studies!

Conclusion

-
- CACM has a 40 year slow adoption history
 - Most advanced analytic methods are now called AI
 - Generative is a real revolution linking quantitative to qualitative: everything will change
 - The government sector is the ideal playpen for AI experimentation as it does not have the for-profit covenants
 - We surveyed a set of projects in Brazil and throughout the US
 - Stay out for the marvels of Gen AI – we have tens of projects

How will audit methodology change
With AI

Link to Video
Recording



Thank you for
your attention.

Any questions?

