Gustavo Monteiro

Automation and Cost Management Project Based on TAGs in AWS

SÃO PAULO
2025

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Final Course Project submitted to the Institute of Technology and Leadership (INTELI), to obtain a bachelor's degree in Information Systems

Advisor: Prof. Rodolfo Riyoei Goya

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2025

Cataloging in Publication
Library and Documentation Service
Institute of Technology and Leadership (INTELLI)
Data entered by the author.

Monteiro, Gustavo

Automation and Cost Management Project Based on TAGs in AWS / Monteiro; Rodolfo Riyoei Goya – São Paulo, 2025.

Nº de páginas: 18.

Trabalho de Conclusão de Curso (Graduação) – Curso de Sistemas de Informação / Instituto de Tecnologia e Liderança.

1. AWS. 2. gerenciamento de custos. 3. infraestrutura cloud 4. gerenciamento por atributos. 5. tagueamento.

Acknowledgments

Since the beginning of the academic year, back in January 2022, I knew that on the day I sat down to write these acknowledgments, I would look back and realize just how quickly time has flown, and how I managed to get where I am today, not only because of my perseverance, resilience, and willingness to accept the challenge, but also thanks to the support of my colleagues, friends, professors, and all the help I received at Inteli and in life. These acknowledgments are dedicated to all of you.

I would like to start by thanking BTG Pactual for the scholarship. This was the opportunity I am most proud to have received. It changed my life, from my freshman year of college until this final year. And it was at Inteli that I learned countless things, far exceeding my expectations. Just as I also hope to go: Beyond!

And since this journey could not have been undertaken alone, I must thank all the professors, coordinators, directors, and staff members of my college. This day has arrived thanks to you!

To Egon, whose conduct was firm and fair, the value of which I realized during the very first challenges I faced in my internships.

To Renato Penha and César Almiñana, project advisors without whom I would not have been able to explore my potential and achieve the deliverables I did.

To Maira Habimorad, Flávia Santoro, and Ana Garcia, our leaders who have conducted incredible work since the first semester, allowing me to say: I am proud to have studied at Inteli.

I also thank the dear colleagues and friends I made along the way. I want to say that I carry a memory of each one of you—in every project, hallway chat, activity, dinner, and even trips to the gym to work out.

Among many colleagues, I want to thank Kil Matheus and Felipe Gomes for their friendship and company; I participated in my first college project with you, and I am proud to follow our growth and success. To Igor Garcia and Luca Giberti, my friends and companions in the gym, on trips, and at dinners, I want to thank you for the moments we shared and the exchanges we had over these years. And to Jonas Sales, my Poké-friend, I told you this day would come.

To my Information Systems class, filled with incredible people for whom I hope and wish every success and achievement. Especially Thainá Lima, my inspiration during the hardest times, and Gabriela de Morais—I hope we can do more projects together someday!

And I only reached this day thanks to my Thesis Advisor, Rodolfo Goya. This was the longest project, yet I feel it was the one that passed the quickest. It is certainly the one I feel most proud and happy to be finishing soon! Thank you so much for every piece of guidance, as each one made a difference in my thesis and my internship!

I also cannot fail to thank Thomson Reuters, the company that was my professional starting point, involving much hard work and fulfillment, and which was

my partner in the development of this project. Especially my manager, Cláudio Bento. I am very happy with our work during this thesis and internship period, and I appreciate all the continuous learning I received during these months on the job.

And now, looking back, I want to thank my mother, Denise, once again for her unconditional support. She has supported my choices since my very first day of life, and I hope to bring her much pride and many stories for us to share.

I also want to thank my partner, companion, friend, and love, Rafael Tomazela. If I made it here, it was also because of your help and support, and I am very grateful for that.

And finally, I want to thank my great friend Naíma again! Yet another thesis to enjoy and to give thanks for our friendship!

And after many events and happenings, Arceus has returned to enlighten and guide us.

“I see eternity go by in an instant, the autumns of many years from a single leaf. Thus I shall slice this maple in a flash, and ask a question of the ages.”

Kazuha, Kaedehara

Resumo

A crescente complexidade e os custos associados aos ambientes de nuvem exigem mecanismos robustos para gestão financeira e governança. Este projeto aborda esse desafio através do desenvolvimento de uma metodologia e uma solução de software para automação e gestão de custos baseada em tags na Amazon Web Services (AWS). A metodologia proposta estabelece um padrão de etiquetagem (tagging standard) com tags mandatórias como cost-center e project-id, para viabilizar a visibilidade financeira e operacional. A solução implementada consiste em uma arquitetura serverless com AWS Lambda para coleta de dados, Amazon S3 para armazenamento, e uma API desenvolvida em FastAPI. Para superar limitações do ambiente de laboratório, um gerador de dados simulados foi criado para alimentar um dashboard interativo. Este, desenvolvido em React, permite a visualização e análise de custos e inventário de recursos. O resultado é um painel que oferece análises por centro de custo e por projeto, facilitando a identificação de tendências de gastos e a detecção de recursos não conformes com as políticas de governança. O trabalho demonstra uma solução prática e escalável que integra práticas de FinOps e DevOps, fornecendo às equipes uma ferramenta eficaz para otimizar o controle de custos e fortalecer a governança na nuvem.

Palavras-Chave: AWS; gerenciamento de custos; infraestrutura cloud; gerenciamento por atributos; tagueamento.

ABSTRACT

The growing complexity and costs associated with cloud environments demand robust mechanisms for financial management and governance. This project addresses this challenge by developing a methodology and a software solution for tag-based cost management and automation on Amazon Web Services (AWS). The proposed methodology establishes a comprehensive tagging standard with mandatory tags such as cost-center and project-id to enable financial and operational visibility. The implemented solution features a serverless architecture using AWS Lambda for data collection, Amazon S3 for storage, and an API developed with FastAPI. To overcome laboratory environment limitations, a simulated data generator was created to power an interactive dashboard. This dashboard, developed in React, allows for the visualization and analysis of resource costs and inventory. The result is a dashboard that provides analyses by cost center and project, facilitating the identification of spending trends and the detection of non-compliant resources that violate governance policies. The work demonstrates a practical and scalable solution that integrates FinOps and DevOps practices, providing teams with an effective tool to optimize cost control and strengthen cloud governance.

Key words: AWS; Cost management; Cloud infrastructure; Attribute-based management, tag.

Summary

1 Introduction

The proposed project aims to develop a methodology for implementing a cost-tagging system in AWS, applicable to all cloud-billed services. The project will be conducted in partnership with an organization, with the goal of optimizing cost control and increasing operational efficiency. The methodology will include the use of APIs for data collection and the creation of a practical implementation guide. The project will cover various stages, from setting up the development environment to training stakeholders, with a focus on cloud cost management.

During the development of the project, specific challenges related to system integration and compliance with the company's common practices will be addressed, ensuring alignment with the specific needs of the DevOps and FinOps areas.

1.1. **Partner Company Context:**

Thomson Reuters is a multinational company that provides information and technology solutions for various industries, including finance, law, tax, accounting, compliance, and media. Recognized for integrating technology with data, Thomson Reuters helps its clients make informed decisions and provides operational support. In the DevOps sector, the company focuses on enhancing collaboration and productivity through the automation of development and infrastructure processes, ensuring fast and reliable deliveries. In the FinOps sector, Thomson Reuters optimizes financial management in cloud environments by monitoring resource usage and implementing financial governance practices to align technological investments with business objectives.

1.2. **Problem Definition (Corporate Pain Point):**

The problem involves the need to create a cost tagging system in AWS that is applicable to all cloud-billed services, with the goal of optimizing cost control and increasing the operational efficiency of the organization.

The organization deals with a wide variety of services on AWS and seeks to implement tagging practices to improve cost management. Efficient integration of these practices guides strategic actions and enhances the organization's performance.

The problem consists of three main challenges:

- Development Environment Setup: Create a development and testing environment that supports the implementation of tagging practices.
- Tag Definition for Infrastructure: Develop guidelines and standards for applying tags to AWS services.
- Report Development and Data Visualization: Create dashboards or reports to present the collected data clearly.

1.3. **Proposed Solution and Expected Contribution:**

The project delivers a comprehensive system designed to automate cost management and governance within AWS through a strict "Tagging Standard." The solution is architected as a hybrid, cloud-native application comprising three main layers:

Serverless Data Collection & Storage: Utilization of AWS Lambda triggered by Amazon EventBridge to automatically collect resource and cost data on a daily schedule. This data is processed and stored in Amazon S3 buckets as JSON files, ensuring a decoupled and scalable storage mechanism.

Backend API: A RESTful API developed using FastAPI (hosted on an EC2 instance) that serves as the interface between the raw data stored in S3 and the user interface. It handles data retrieval, filtering, and secure transmission.

Frontend Visualization Dashboard: An interactive Single-Page Application (SPA) built with React and Material-UI. This dashboard consumes the API data to

present dynamic charts (using ECharts) and detailed inventory tables. It features multi-view capabilities, separating "Cost Analysis" for financial teams and "Inventory & Governance" for DevOps teams.

The primary quantifiable contribution of this project is to provide 100% visibility into cloud resource allocation based on defined tags (such as cost-center and project-id) and to drastically reduce the time required to identify governance violations.

Specific measurable outcomes include:

Operational Scalability: The Total Cost of Ownership (TCO) analysis demonstrates that the architecture can monitor 25,000 resources for an estimated operational cost of only ~$7.93 per month, proving the solution is highly cost-effective for large-scale enterprise environments.

Governance Accuracy: The solution delivers a "Governance at a Glance" feature that allows for the immediate detection of non-compliant resources (instances missing mandatory tags). This transforms the compliance process from a manual, error-prone audit to an instant, real-time filtering task.

Granular Cost Allocation: The system enables the shift from aggregate billing to precise per-unit cost tracking, allowing the organization to allocate specific dollar amounts to individual projects and environments (e.g., Production vs. Development) with precision.

1.4. **Business Objectives:**

For the business partner (Thomson Reuters), the project aims to align technological operations with financial accountability, fostering a robust FinOps culture. The specific business goals include:

Optimized Cost Control: Transitioning from reactive bill payments to proactive cost management by identifying idle resources and enabling accurate "showback" or "chargeback" models to specific business units.

Enhanced Operational Efficiency: Reducing the cognitive load and manual effort for DevOps teams by automating the discovery of untagged resources, ensuring that accountability is assigned via the owner-email tag for faster incident resolution and decommissioning.

Strategic Alignment: Ensuring that cloud spending is directly traceable to business initiatives (project-id), allowing leadership to evaluate the ROI of specific technological investments and make data-driven decisions regarding infrastructure scaling.

2 Solution Development

The development of the solution was grounded in the convergence of FinOps and DevOps disciplines, addressing the specific business challenge of bridging the gap between engineering resource deployment and financial accountability..

2.1 Applied Rationale

The project is grounded in FinOps (Financial Operations) and DevOps principles. It addresses the critical need for financial accountability in the cloud by bridging the gap between engineering (deploying resources) and finance (paying the bill).

2.1.1 **Business Area Rationale:**

The solution strictly adheres to the AWS Well-Architected Framework's Cost Optimization Pillar. It implements industry-standard "Tagging Strategies" (e.g., Cost Allocation Tags) to enable showback/chargeback models, ensuring that cloud spend can be attributed to specific business units or projects

2.1.2 **Technological rationale for the solution:**

Technologically, the solution was justified by the need for a scalable, low-maintenance architecture that integrates natively with the partner's existing AWS ecosystem. A serverless-first approach using AWS Lambda and Amazon EventBridge was chosen for data collection to decouple the retrieval process from data consumption, ensuring the system could scale to monitor thousands of resources without the overhead of maintaining dedicated servers for simple cron jobs. This choice highlights a fit-for-purpose rationale where cost-effectiveness and seamless integration via Boto3 and AWS Cost Explorer APIs were prioritized over complex, third-party agents. regarding management methods, the project adopted a Lean Inception approach to define the MVP scope, utilizing a "Is/Is Not/Does/Does Not" matrix to align stakeholder expectations, while the execution followed Agile principles with bi-weekly validations and CI/CD practices for continuous delivery.

2.2 **Specification and Development**

The system was designed to meet strict functional requirements, primarily the ability to collect daily cost and usage data and verify the presence of mandatory tags across the infrastructure.

2.2.1 **Requirements and Specifications:**

Functional Requirements:

- The system must collect daily cost and usage data from AWS.
- It must verify the presence of mandatory tags (project-id, cost-center, owner-email, etc.).
- It must provide a dashboard with two views: "Cost Analysis" (for financial trends) and "Inventory & Governance" (identifying non-compliant resources).

Non-Functional Requirements:

- Security: Credentials must not be hardcoded (use of .env and IAM Roles).
- Performance: The dashboard must load 25,000 resource records efficiently using client-side memoization and local caching (S3/SQLite).
- User Specifications:
- Persona 1 (DevOps): Needs to see which instances are untagged to fix compliance issues.
- Persona 2 (FinOps): Needs to see cost evolution charts filtered by Project or Cost Center.

2.2.2 **Architecture and Technology:**

System Architecture: A hybrid cloud architecture.

- Data Layer: AWS Lambda (triggered by EventBridge) fetches data and stores it in Amazon S3 (JSON format).
- Backend: FastAPI (Python) running on an EC2 instance serves the data.
- Frontend: React application hosted on Vercel (Serverless), communicating via a proxy to avoid Mixed Content (HTTPS/HTTP) issues.

Integration: The system integrates directly into the company's IT ecosystem via IAM Roles attached to EC2 and Lambda, allowing secure, keyless access to the organization's billing and resource APIs.

2.2.3 **Development and Implementation (MVP):**

Methodology: A Lean MVP approach was adopted. The initial phase focused on a Python script (Proof of Concept) to validate API access, which evolved into a persistent API and finally a full Dashboard.

Deployment Process:

- Backend: Manual deployment to an EC2 instance running Amazon Linux 2023, managed by systemd for resilience.
- Frontend: Automated deployment via Vercel linked to a GitHub repository, ensuring that every code push triggers a live update.

2.2.4 **Testing and Technical Evaluation:**

Manual Validation: Resources were manually instantiated and tagged via CLI to verify the tagging logic (Section 9.2).

Data Simulation: Due to lab restrictions on live billing data, a Data Generator Tool (Jupyter Notebook) was created to simulate a corporate environment with 25,000 resources, distinct products, and realistic cost fluctuations (Section 12.1).

The final testing confirmed that the dashboard successfully processes large datasets, accurately filters costs by tag, and immediately flags non-compliant resources, meeting the technical requirements defined in the Lean Inception.

2.3 Assessment of Impact and Contribution to the Business

The return on investment for this solution was measured by defining corporate success metrics focused on visibility coverage and compliance rates. The primary goal was to transform opaque cloud spending into clear, actionable data.

2.3.1 **Defining Corporate Success Metrics:**

Project KPIs:

- Visibility Coverage: Percentage of resources successfully attributable to a cost center.

- Compliance Rate: Reduction in the number of "Untagged" or "Non-Compliant" resources.
- TCO of Monitoring: The cost to run the monitoring solution itself.

Measurement Methodology: The project compared the "Before" state (manual, opaque tracking) with the "After" state (automated dashboard) using a Total Cost of Ownership (TCO) analysis based on a simulated enterprise scenario of 25,000 resources.

2.3.2 **Results and Impact Analysis:**

Quantitative Analysis: The TCO analysis (Section 12.5) demonstrated that the implemented solution is highly cost-effective. Monitoring 25,000 enterprise resources costs approximately $7.93 per month using the optimized serverless architecture (Scenario B cost projection).

Qualitative Analysis:

- Agility: Replaced manual spreadsheet tracking with an automated, daily-updated dashboard.
- Decision Making: Empowered stakeholders to instantly distinguish between "Production" and "Non-Production" costs, facilitating budget decisions.
- Governance: Provided "Governance at a Glance," allowing DevOps engineers to instantly identify the owner of an unoptimized resource via the owner-email tag.

2.3.3 **Cost-Benefit Analysis:**

Estimated Costs:

- Scenario A (Implemented Hybrid): ~$29.51/month (driven largely by EC2 uptime and Data Transfer).

- Scenario B (Optimized Serverless): ~$7.46/month.

ROI Context: For an enterprise spending thousands or millions on cloud infrastructure, a monitoring tool costing ~8–30/month that prevents resource sprawl and misallocation offers an exponentially high ROI. Identifying just one unused large EC2 instance would pay for the tool's operation for a year.

2.3.4 **Critical Success Factors and Lessons Learned:**

Success Factors: The definition of a rigid Tagging Standard (Section 9.3) was crucial. Without standardized keys and values (e.g., specific project-id formats), automation would fail.

Hindrances: Access permissions within the AWS Academy Lab were a major constraint, preventing live access to Cost Explorer APIs. This necessitated the development of a Data Generator, which ultimately proved beneficial by allowing stress-testing with datasets (25k resources) larger than what the lab could physically support.

3 Conclusion

In conclusion, the project successfully achieved its objectives by delivering a functional MVP that validates the proposed methodology for tag-based cost management. The solution provides the partner company with a robust mechanism to visualize cost distribution and enforce governance policies. The immediate impact on the business is a shift from reactive bill payments to proactive resource management. For the evolution of the solution, it is recommended that the company transitions from the simulated data source to live AWS Cost Explorer API integration as soon as production IAM permissions are granted. Future enhancements should include predictive cost forecasting and automated remediation workflows using SNS notifications. Finally, to ensure long-term sustainability, the project delivers a comprehensive "Quick Start Guide" and technical documentation, facilitating a smooth knowledge transfer to the internal team.

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