TECHNOLOGY CONSULTING IN THE GLOBAL COMMUNITY

Final Consulting Report
Palau Ministry of Education
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Carnegie Mellon University



Palau Ministry of Education Executive Summary

Student Consultant, Jimmy Zeng Community Partner, Dale Jenkins

I. About the Organization

The Ministry of Education is one of the nine ministries of the Executive Branch of the National Government of the Republic of Palau. The ministry is responsible for the education of Paluan children ages 6 through 17* through the creation and operation of public schools and the development of a national curriculum. Their mission statement is:

"In partnership with parents and community, [our mission] is to ensure that our children and youth preserve Palauan culture and become contributing citizens and productive workers in a changing world."

II. Google Workspace Implementation

Since the departure of Edwel Ongrung, the IT lead at the MOE, the internal email servers have been slowly failing. Staff frequently report issues such as emails not being received and spam email accounts. Additionally, the internal emails lack up to date encryption protocols, leading them to be marked as spam when communicating with common email services, like Google or Yahoo. The creation of a Google Organization, with official accounts for all students and staff gave them access to modern gmail features, as well as a plethora of other G Suite apps. The major outcomes of this goal include:

- Purchased a new domain, palauschools.org.
- ❖ Applied for and received a Google Workspace for Education Fundamentals license for 2500 users, allowing free usage of Google services and collaboration features indefinitely.
- Created @palauschools.org accounts for 500 students and staff.
- ❖ Enabled core Google features such as Gmail, Drive, Docs, and Groups.

In the coming months, the system aims to cover all students and staff. But already the system is handling over 50 emails sent and 500 emails received on a daily basis, with a delivery rate of over 99% for internal emails.

Because of the lack of a proper IT team, sustainability was a key challenge for this project. Keizy Shiro, a test data analyst and Charmaine Bitlaol, an English specialist who also oversees distribution of student mobile devices, were chosen as system admins and received the necessary training. Additionally, they were provided with a 21-page documentation covering common admin issues, such as adding new users and resetting passwords.

In the future, the MOE is recommended to expand its IT team and assign a dedicated system admin for the Google Workspace system. The ministry should also look into maximizing the use of Google Workspace by configuring and implementing other features like Google Classrooms.

III. Mobile Device Management via Google Workspace

Ever since the 1990s, the MOE has aimed at improving students' educational experience through educational technology. Currently, this takes the form of 2000 Samsung Galaxy tablets of various models, as well as 500 chromebooks distributed to all students. However, as of now students have little reason to interact with their technology outside of Apps used by necessity such as Zoom. To combat this issue, Minister Jenkins has selected modern educational software such as Renaissance Accelerated Reader and BeAble Life-Ready Literacy for the students. Yet even with these modern applications, our devices require several upgrades to refine the student experience. Particularly, the ability to 1) deploy applications remotely, 2) track school devices remotely, and 3) restrict access to non-educational apps and school-inappropriate content.

To reach these goals, my project configured Mobile Device Management features as part of the Google Workspace system. Outcomes of the implementation include:

- Created a permitted app list for student-owned devices.
- Restricted school-inappropriate via web filtering on Youtube and browser.
- ❖ Created a device inventory to view all devices with a student account.

With these configurations in place, once all students receive their Google accounts and log in on their school devices, mobile device management will be enforced. The metrics of our success will be the percentage of time students now spend on educational apps while using their devices, which we aim to be over 90% once the system is fully operational. We should also aim to gather qualitative data by interviewing students about their new technology experience.

As a recommendation, the MOE is urged to keep a close eye on the metrics to determine if the system is working sufficiently. If the results are not satisfactory, the MOE is encouraged to seek out other, more robust MDM solutions than Google Workspace, which has relatively fewer features.

IV. Additional Recommendations

In previous years, Edwel acted as the consulting partner for the MOE. This is the first year Minister Jenkins has worked with a student consultant. As a result, the project ran into several speed bumps due to unfamiliarity with the program, such as the consultant not being paid on time. The MOE is suggested to speak to Edwel about best practices for navigating the TCinGC program in order to streamline the experience and allow consultants to work more efficiently, generating maximum value for the MOE.

Consulting Partner

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Palau Ministry of Education P.O. Box 189 Koror, Palau 96940 http://www.palaumoe.net **About the Consultant**

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Jimmy is a senior in Information Systems with an additional major in Computer Science. He is pursuing a career in consulting next Fall.

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I. About the Organization

Organization

The Ministry of Education is one of the nine ministries of the Executive Branch of the National Government of the Republic of Palau. The ministry is responsible for the education of Paluan children ages 6 through 17* through the creation and operation of public schools and the development of a national curriculum.

The ministry operates eighteen public elementary and high schools around the country. Elementary schools contain grades K-8, while high schools contain grades 9-12. There are also a number of private elementary and high schools operated under charter from the ministry.

The ministry is headed by a cabinet level position, the Minister of Education. The current minister is Dale Jenkins. Below the minister are two bureaus, **Curriculum and Instruction** and **Education Administration**. Each bureau is headed by a director and contains various Divisions.

The ministry holds the vision that "our students will be successful in the Palauan society and the world," and their mission statement is:

"In partnership with parents and community, [our mission] is to ensure that our children and youth preserve Palauan culture and become contributing citizens and productive workers in a changing world."

*Schools do have a 12th grade, but unlike in the US, attendance is not mandatory for students age 18 and above.

Facilities

The main office of the MOE is located west of downtown Koror. The first floor of the ministry houses the office of the Minister, conference rooms, and the server room. The second floor is dedicated to the two bureaus, curriculum and instruction on the east side and education administration on the west side. The upper floor has cubicles for staff and a central area for meetings. Bureau directors, Division chiefs, and receptionists each have their own separate offices. All common and work areas inside the ministry are air conditioned and have internet access.

The MOE also owns a secondary office inside the Palau High School complex. The employees that work there mostly belong to the Bureau of Curriculum and Instruction, including the P.E. and science curriculum specialists, as well as the scholarships office.

The ministry owns and maintains school buses for transporting the students, as well as ministry cars and vans to carry out ministry work at schools across the country. Additionally, the ministry also

owns three speed boats for visiting outlying islands like Peleliu, Angaur, or Kayangel, as well as transportation of school materials.

Programs

All programs at the MOE are linked to the creation and operation of schools. The MOE directly manages 17 elementary schools and one high school. The high school (Palau High School) is located in Koror, whereas the elementary schools are scattered throughout the 16 states. There are also 2 private elementary and 4 private high schools that run under a charter granted by the Ministry, but they are in charge of their own operations outside of triennial Ministry inspections.

Inside the schools, the MOE manages a myriad of programs from teacher training and curriculum development to student transportation and food service. The main program the MOE is interested in expanding is enriching student learning via tablet technology. This is done by distributing android tablets and chromebooks to all students ages 6-18, as well as the integration of technology into the current curriculum. Currently, the MOE owns 2000 Samsung tablets, split between the models of Tab 3, Tab 4, Tab A, and Tab S. These tablets are used by students in grades 1-3 and 8-12. As for chromebooks, the MOE currently has over 500 in inventory and is working on procuring more. They are currently used by students from grades 4-7, but the long term goal of the MOE is for every student to have a chromebook in their hands.

Staff

As aforementioned, the MOE is headed by Dale Jenkins, the current Minister of Education. Each bureau under the MOE is overseen by a director, and each division inside a bureau is led by a corresponding chief.

In total, around 430 people are employed by the MOE, including central office workers and the teaching and administrative staff at all the schools. All schools are headed by principles, and three schools also have vice principals. There are around 2100 students enrolled, with the biggest school (Koror Elementary) having 600 and the smallest school having 7.

Throughout the project, the consultant worked with 4 key members of the MOE, who contributed greatly to the research and solution. Phillip is the administrator officer of the Bureau of Curriculum and Instruction as well as the current leader of the tablet distribution program. He provided detailed information on the structure of the MOE and the current status of the tablet distribution program. The consultant also met Charmaine, the English specialist at the Bureau of Curriculum and Instruction, who simultaneously oversees the mobile device inventory and records. She gave information on the number and status of our current devices, lent the consultant sample devices for experimentation, as well as helped collect student information. Then there was director Ida Kilcullen, head of the Bureau of Curriculum and Instruction, who was not only Mr. Jenkin's second in command, but also understood the intricacies of technology. Getting her buy in was tantamount to the sustainability and future improvement of the solution. Finally is Keizy, data specialist at the Bureau of Education Administration. Keizy is a quick learner with prior experience in spreadsheets, making him a great candidate for maintaining the solution.

Technology Infrastructure

The existing technology at the MOE can be summarized with the table below:

Technology Category	Description
Hardware	 Mac or Apple desktops for ministry staff Macbook Air laptops for teachers 2000 Samsung Galaxy tablets Models: Tab 3, Tab 4, Tab A, Tab S Chromebooks for students grades 4-7 Models: Acer, Samsung
Internet Connection	 Undersea fiber optic cable from Guam Paid wireless access points throughout Koror offering broadband level speed (PTWaveFi) Internal wifi network inside the ministry Limited wifi network at schools, particularly ones on outlying islands Some students have no internet access at home
OS	 Android for Samsung tablets ChromeOS on chromebooks Latest iOS for apple devices
Database	 High school student information database SQL backend, Microsoft access frontend Elementary school student information database SQL backend, PHP web frontend Being replaced by Rediker student information database Payroll tracking system [defunct]
Website	 Current website is built by previous consultants in HTML, CSS, JS and PHP.
Software	 Microsoft office Renaissance Accelerated Reader BeAble career development software Online textbooks

Technology Management

Edwel Ongrung had been the head of the IT team at the MOE for the past decade. Despite his retirement, the MOE continues to rely on Edwel to solve their technology issues. While a previous CMU consultant moved much of their infrastructure to the cloud, in hopes that technology management can be outsourced, that has yet to be done and Edwel remains the sole person with the knowledge to maintain the databases and applications.

Furthermore, while the MOE had a dedicated IT team previously, multiple members have left the department. Currently, the sole IT personnel at the ministry is Balo, the computer technician. Balo can handle most physical repairs to PCs, Macbooks, and tablets. Broken devices from schools around the country are sent to him and repaired, while appliances like servers require him to travel to the school and fix it. However, software issues are not his specialty. While Edwel tried to pass on his knowledge as best as he could, Balo had difficulties understanding so much information. As a result, the MOE still relies on Edwel to repair the mail servers and the databases.

At the school level, each school has an appointed teacher to keep an eye on technical issues. These tech-savvy teachers also help the MOE with simple tasks, such as installing apps on mobile devices, or teaching students how to use a word processor. However, more complex issues are beyond them and they request the MOE for a technician to be sent.

Technology Planning

The ministry does not have a technology planning committee. A new technology is usually implemented via a proposal by a member of the MOE, and then approved by Minister Jenkins, which grants funding for the project. The department that proposed it usually implements and maintains the technology in-house afterwards. Formerly, Edwel kept a more structured technology development process, but currently all technology are proposed on an ad-hoc basis.

Communication

Most communication at the office is carried out in person on an ad-hoc basis. Staff would walk to the office of the person they want to talk to, and the latter would make time for them. If someone is out of the office, staff would call or text their personal number. All staff have emails ending with the "@palaumoe.net" extension used for official communications, but response times can be slow.

As of the conclusion of the project, all staff now use Gmail accounts with the extension "@palauschools.org".

The MOE's website (palaumoe.net) provides important information to external parties, such as students, parents, and other government officials. However, the site is outdated and many pages remain unconstructed.

Information Management

The MOE has had a long history of involvement with the TCinGC program. The most prominent outcome of the work of many consultants is the Student Information Database.

Currently, the MOE uses and maintains two student information systems, one for the high school and one for the elementary school. The high school database was developed in 2007 with the goal of generating student transcripts in mind, and uses a SQL backend with a Microsoft Access frontend. The elementary school database was upgraded in 2009 to use a SQL backend with a PHP web frontend. Thanks to the work of a previous CMU consultant, both databases are now hosted in the cloud in a Docker environment for ease of access. There also exists a database of student standardized testing scores for analysis.

However, even with these systems, data entry and analysis has been painfully slow. As such, as of this year, Minister Jenkins has purchased the Rediker Student Information System and is in the process of relocating all student information to Rediker.

To keep inventory of the tablets and chromebooks, Charmaine uses a series of 10 Excel spreadsheets that records the IDs of the devices, their specifications, and their status. She does not need to edit the spreadsheets often, only when a device is added or needs repairs. However, she would still like to see an electronic database implemented to make the process more sustainable.

Business Systems

As part of the Palauan National Government, the MOE does not pay its employees directly. Insteal, accounting and payrolls are handled by the Ministry of Finance. Changes to an employee's pay, through hiring, raise, and firing are requested by requisition forms to the MOF.

The MOE did attempt to create an electronic requisition and payroll tracking system in 2018, which allowed requisition forms to be generated electronically while storing the information entered in a database. The system was implemented, but abandoned in 2020 due to lack of maintenance. The MOE has reverted to its former paper-based approach since.

II. Mobile Device Management via Google Workspace

Motivation

As mentioned in the technology infrastructure section, the MOE currently owns 2000 Samsung Galaxy tablets (split between four models) as well as around 500 chromebooks which are distributed to all students. However, as of now students have little reason or desire to interact with the tablets, outside of Apps that are used by necessity such as Zoom. This is due to the current Apps on these tablets being very outdated. On the oldest tablets, the Apps have not been updated since they were procured in 2015. To modernize our tablets, Minister Jenkins has purchased three modern educational Apps (Renaissance Accelerated Reader, BeAble Life-Ready Literacy, and online textbooks) for the students to use in their classes. Yet even with these modern applications, our devices require several upgrades in order to provide students with a refined and well-tuned educational experience.

From interviewing staff around the ministry, in addition to the challenge of distributing the new applications, there are several auxiliary difficulties surrounding the devices. The pain points are as described below:

- **A. Distributing applications** before the pandemic, when the MOE wanted new Apps to be downloaded, they would ship all 2000 devices to a company on-island. Workers there would manually download the Apps one by one on each device, and the entire process would take a week. Currently, said company no longer exists, and the MOE does not have the manpower to individually download each App. The MOE requires a fast, sustainable way of deploying and updating applications.
- **B.** Device tracking database currently, Charmaine is the sole person responsible for tracking all the devices. She does so through 10 Excel sheets organized by model, and manually updates the status of each device when they are broken or needs repairs. The current database is slow, prone to data loss, and ill-suited to analysis. Worse, it is missing a critical feature: the ministry has no way of confirming that devices are working properly in the field, instead, it relies on schools to self-report broken devices, which is done seldomly. Charmaine has expressed interest in a modernized database to track device status remotely.
- **C. Device usage restrictions** as of now, the MOE has no way of restricting students from downloading third-party Apps onto devices, nor a way to protect them from age-inappropriate content. The MOE requires a solution that would be able to restrict the ways a device can be used to protect students' educational experience.

As a side goal, staff also frequently reported continued difficulty using the current email servers, with the "@palaumoe.net" extension. Staff would frequently not receive emails and were subjected to spam messages, additionally, staff emails would be sent to spam when communicating with Gmail accounts due to the servers lacking up to date encryption methods.

Outcomes

Choosing Google Workspace

After the initial meeting with MOE staff, including Edwel and Minister Jenkins, and visits to several schools, I outlined the several pain points discussed in the "motivation" section. From talks with Edwel and my own research, in order to carry out remote App deployment and user restrictions like we had hoped, I determined a full Mobile Device Management platform was required. I then set to work researching how to implement an MDM service. The most economical approach was to write software in-house, but since the MOE had a tiny IT staff and no one with mobile development experience, this was not a maintainable option. There are several MDM services available on the market, the most promising one being Relution, which is a German company specializing in MDM services for educational purposes. However, after conversations with their representatives, their software cost \$6, per device, per year. For the MOE and its 2000 devices, it would have been over \$12k each year. While Minister Jenkins was not opposed to authorizing such a purchase, I felt unqualified to recommend such a purchase unless it was completely necessary. Several other MDMs were also considered, but rejected due to the same pricing issue. (see appendix A).

Having exhausted my options in existing MDM software, I turned to Professor Mertz for help, asking if he knows any MDM services for Android that are economical. Miraculously, we found that Google allowed us to apply MDM features on devices with a signed in managed Google account. However, the most impressive part is that his service would be nearly completely free. We

could apply for the Google Workspace for Education Fundamentals package, which is available to K-12 institutions globally.

But to our dismay, the application process turned out to be an arduous process spanning multiple weeks and long conversations with Google representatives. We were required to gather Accreditation Documents from our schools, as well as a signed letter from the minister authorizing the application. Yet eventually, we received our approval from Google, a license to use Google Workspace for free.

System Configuration and Content

Due to the time it took to have the package approved, the configuration of the system was done parallel to the approval process, which was made possible by using the 30-day free trial of the package. The first outcome was the purchasing of a new domain, palauschools.org, to organize the new Google accounts. Subsequently, I set to import all students and staff into the system, which was made possible with aid from Charmaine and Keizy, who prepared the information in spreadsheets. The process is ongoing, currently we have over 500 accounts created with more on the way.

Configuration of the system was done through the web interface at admin.google.com. I requested one of each of our tablet models, Tab 3, 4, A, and S, from Charmaine to produce a demo, to be presented to the MOE. With the demo tablets, I turned on most G Suite features, such as Google Drive and Google classroom, and configured corresponding privacy and sharing settings. I implemented an allowed app list for managed devices, an inventory showing all current devices, and restricted age-inappropriate content on Youtube and Google. The efficacy of my configuration can be determined by the percentage of time the students spend on educational apps. Because the system is not fully deployed for all students, we do not have statistics currently, but I believe the percentage will rise to >90% over time.

Unfortunately, late in development, I discovered that there was no remote application deployment via our Education Fundamentals package, which was confirmed by a Google agent. As described by the agent, this feature is available for some paid versions of Google Workspace, but due to the pricing concerns I mentioned before, this was also not feasible. Remote application deployment would allow apps to be automatically downloaded and updated on managed devices whenever they are connected to the internet. Without it, students would still need to manually install apps from the app list whenever they need it. Through discussions with the staff at MOE, we determined that because our students are tech-savvy enough, this would thankfully not pose a great issue.

Sustainability Considerations

Because of the state of the IT team at the MOE, sustainability was a key consideration of this project. In early interviews with the staff, I paid attention to those with the requisite tech knowledge, such as Charmaine and Keizy, to maintain the project. In the final weeks of the project, I trained both of them on moderating the Google Workspace system, including adding new users, resetting user passwords, and enabling Google services. Additionally, I prepared a 21-page documentation article diagnosing common problems encountered while managing the system.

Finally, I showed both of them how to reach Google's support service for any outstanding questions they may have.

In addition to finding staff to maintain the project, I also wanted to get buy-in from the management level to find someone with the resources to oversee future development of the project, even if Keizy and Charmaine would leave the organization. This is when I began to work with director Ida Kilcullen, from the Bureau of Curriculum and Instruction. I discovered that director Ida had plans of implementing Google Classroom to replace the current Zoom system for remote learning. Since Google Classroom is one of the features available in Google Workspace, I described to her my plans of setting up Google Workspace and gave her access to the system. Because her goals are now intertwined with my project, it ensures that the system will not fall into disrepair as long as the students are using Google Classroom.

Recommendations

Learning and Improving Google Workspace

Google Workspace is a complex platform with thousands of functionalities. My work in the summer merely touched upon some of these features for the MDM service. In order to make the most of Google Workspace, IT staff at the MOE must continue to learn about the platform and make improvements to the system on their own. They must investigate features like Google Meets, Google Classroom, and Google Groups.

By tapping into these features, the MOE benefits by making more efficient use of the resources at hand. So much time this summer has already been invested in approving and implementing the Google Workspace system, augmenting the system with other functionalities, is both cheaper and quicker than seeking those features in a new software.

The best resources to learn more about Google Workspace are through Google's builtin documentation. Information on how to use each service as a common user can be found at Google User Support (support.google.com/a/users), while information on their implementation and configuration can be found at Google Workspace Admin Support (support.google.com/a).

Determine if Google Workspace is Enough

While Google Workspace is powerful, in my outcomes section I also detailed its rather limited MDM features, especially on the older Tab 3 and Tab 4 devices. The current system lacks the ability to remotely deploy applications, one of the major pain points originally it was supposed to solve. Due to my short time at the MOE, I was unable to see the system through full deployment. Thus, I urge the MOE to keep a careful eye on the status of the pain points post-deployment, based on the metrics described in outcomes.

Careful monitoring of the metrics will keep the project efficient and productive, preventing it from straying from the original pain points it intends to solve. If at some point the MDM features of Google Workspace become insufficient for the organization's needs, the MOE will know it's time to seek out a more robust MDM solution.

IV. Additional Recommendations

Expansion of the IT Department

From my interviews with staff members, it is well-known that the IT team at the MOE is severely understaffed. Without a properly functioning IT department, staff at the MOE must endure frustratingly long waits before basic technology like printers and scanners can be repaired, during which work grinds to a halt. Clearly, this greatly harms the productivity of the MOE, and if the situation is already this dire at the central office, one can imagine how impossible it would feel for the schools and students.

In order for the MOE to carry out its mission of preparing Palauan students for a modern world, it is paramount that the IT team be expanded immediately. Due to the lack of IT personnel found on the island, I recommend that the ministry turn to Edwel for recommendations of qualified personnel. If that is not enough, I suggest the MOE consider a training program for less experienced IT staff to be trained by Edwel or Balo.

Streamline the Experience of Future Consultants

In previous years, Edwel has always been the community partner at the MOE, who arranged for the lodging, payment, and integration of student consultants. This year has been unique because it was the first year without Edwel at the office, with Minister Jenkins himself serving as the community partner. Due to this, both Minister Jenkins and I experience some difficulties adjusting to the partnership. For example, I was not paid for over 3 weeks because the MOE did not realize the consultants are paid by their respective ministries.

I hope that the struggles we experienced this year can help the MOE streamline the program in the upcoming years. By better integrating the consultant in the first weeks of the program, the MOE allows the consultant to use their full potential and receive the best return from their paid services. To facilitate this, I recommend the Minister and Phillip meet with Edwel to discuss previous TCinGC programs and what needs to be prepared for the consultant prior to arrival.

About the Consultant

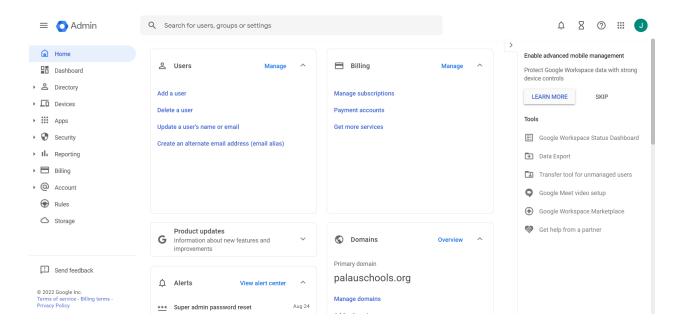
Jimmy Zeng is a senior in Information Systems with an additional major in Computer Science, with interests in algorithm design and machine learning. He is looking forward to applying the technology and interpersonal skills gained from the TCinGC program this summer to a career in tech consulting.

V. Appendices

A. Solutions Comparison Matrix

Service	Pricing	Features
Relution	6.00 euros / device yearly \$6.3 / device yearly	 Claim to fame: Targeted restriction of Apps during class Multi-user capabilities Device database (includes system info, storage, memory, even battery levels) Data dashboards App deployment, custom App store
Google Workspace for Education (Fundamentals)	Free for Educational Institutes	 Inventory Database Google accounts for all students & staff Android application deployment Manage application access to data Bundled with G Suite (Drive, Gmail, Google Classroom) Requires Android 6.0+ for advanced management, without which downloads cannot be restricted.
Miradore Free	N/A	 Inventory database with data dashboard System update management
Miradore Premium	\$12 / device yearly	 Application deployment Blacklist applications Different device profiles (elementary vs. high school) Web filtering

B. Google Workspace Admin Dashboard



Landing page of the admin dashboard, where all Google Workspace settings can be configured.

C. Google Workspace Documentation

Google Workspace For Education Quick Guide

Written by Jimmy Zeng Last updated: July 2022

Introduction

Welcome! This guide is intended to be used by Google Workspace admins for Palau schools to learn more about the Google Workspace system and solve common user and device issues.

If you are viewing this on Google Docs, you can open the Document Outline on the left with this button.

This will allow you to quickly jump between sections.

User-related Tasks

1. Adding new users

Google Workspace allows admins to add new users both one by one, and in large batches by importing spreadsheets. First, go to Directory > Users on the left bar.





The first page of the documentation. The full documentation can be found at: https://docs.google.com/document/d/1ShDY2TQxjeFkZH7KOcBkqLBQSwOjS8Y1d0e0DOCCfTE/edit?usp=sharing