Executive Summary

Student Consultants, Jeevika Ghosh and Pavan Gollapalli
Community Partner, Edwel Ongrung

`

I. About the Organization

The Palau Ministry of Education (MOE) is responsible for managing, operating, and promoting the public elementary and secondary school system and implementing the national educational curricula.
 Its mission is as follows:

> *The mission of the Republic of Palau's Ministry of Education, in partnership with parents and community, is to ensure that our children and youth preserve Palauan culture and become contributing citizens and productive workers in a changing world.*

The vision is similarly straightforward:

> *Our students will be successful in the Palauan society and the world.*

II. Expenditure Tracking System

The Ministry wanted to make changes to its budgeting processes in order to increase accountability and gain transparency into how its money was being spent. The main problem the MOE faced was that there was no way to accurately measure how its discretionary budget was being used to purchase items for classrooms. Focus groups conducted in 2016 revealed that teachers and other staff members would request items but would not even receive updates on the status of their request, never mind the items themselves. This issue limited classroom activities and prohibited teachers and staff from reaching their full potential.

After the 2016 focus groups, the MOE developed a paper-based system for capturing staff requests for items and tracking their progress into classrooms. Our goal was to transition this system to a web-based application, allowing users to request items and follow the MOE's processes while eliminating the need to track records and conduct analysis on paper. No existing

system was able to meet the MOE's needs for two reasons. Firstly, the paper processes the MOE developed were also dependent on Ministry of Finance regulations for accountability purposes and so needed to exactly match the required paperwork. Furthermore, most currently available budgeting or inventory management applications lacked customizability and required subscription fees that the MOE was unwilling to pay.

Here's a quick summary of our outcomes:

- The MOE database from last year's project was restructured to better reflect the centrality of assets and the forms that modify the presence and status of those assets.
- A Ruby on Rails application was developed to implement all four modules of the MOE's process (requisitioning, receiving, distribution, and inventory management), tested with users, and deployed on the MOE intranet.
- Weekly training sessions were conducted with Edwel so that he could maintain the application and database and add additional features after monitoring the application's performance in a production setting.

Recommendations

The four main parts of the MOE's expenditure tracking process are now implemented, but three minor auxiliary forms needed to update the status of assets in the system remain unimplemented (updating the condition of an asset, transferring an asset between MOE departments, and marking an asset for disposal). Given their relative lack of importance, these forms can wait until next summer. Additionally, we now recommend that work move forward on a reporting module in order to more effectively visualize insights from the data that will be entered into the database over this coming school year.

Consulting Partner

Edwel Ongrung
edwel@palaumoe.net
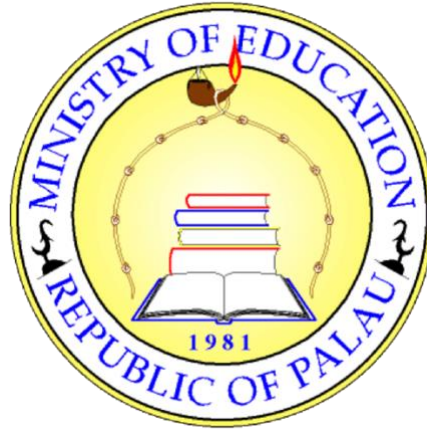
Palau Ministry of Education
Koror, Palau

About the Consultants

Pavan Gollapalli
pavankgollapalli@gmail.com

Pavan recently graduated from the Information Systems program. He will soon begin work as a software engineer for Cisco Meraki.

Jeevika Ghosh
jghosh@andrew.cmu.edu

Jeevika is a rising junior in Information Systems.

Final Consulting Report

Student Consultants, Jeevika Ghosh and Pavan Gollapalli
Community Partner, Edwel Ongrung

`

I. About the Organization

The Palau Ministry of Education (MOE) is responsible for managing, operating, and promoting the public elementary and secondary school system and implementing the national educational curricula. Its mission is as follows:

> *The mission of the Republic of Palau's Ministry of Education, in partnership with parents and community, is to ensure that our children and youth preserve Palauan culture and become contributing citizens and productive workers in a changing world.*

The vision is similarly straightforward:

> *Our students will be successful in the Palauan society and the world.*

Some major functions of the Ministry of Education include the following:

- School improvement processes
- Curriculum development
- Student progress assessment and reporting
- Budget preparation
- Personnel recruitment, selection and management
- Teacher and administrator training and certification
- Community and vocational development
- Adult education initiatives
- Policy analysis, evaluation, and recommendations

The Ministry is also responsible for all matters pertaining to public education in the Republic. The organization is divided into two overarching bureaus, the **Bureau of Education**

Administration and the **Bureau of Curriculum and Instruction**. The Bureau of Curriculum and Instruction has two divisions, the Division of Curriculum and Instructional Materials Development and the Division of Instructional Implementation and Teacher Training. The Bureau of Education Administration contains three divisions: the Division of Personnel Management, the Division of School Management, and the Division of Research and Evaluation, along with support services that include IT and general administration. These last two units are the departments that have reached out to work with the TC in GC program.

Facilities

The Ministry of Education is in charge of 118 buildings totaling 340,000 square feet of space. These buildings include educational facilities as well as administrative ones.

The primary MOE office is located west of downtown Koror, opposite Palau High School and next to the Supreme Court. The first floor of the office holds some conference rooms, the server room and the office of the Minister of Education. The second floor of the building is divided into two sides based on the bureaus – curriculum and administration. The upper floors have cubicles for staff and offices for department chiefs, directors and receptionists. All offices and work areas inside the Ministry are air conditioned. There are six laser printers in the office, with two printers that work and four that need maintenance. The building parking lot has had solar panels installed since 2010 which theoretically provide up to 51 kW in electricity but are relatively unreliable in practice.

There are government-provided cars for the employees to carry out MOE related work and to visit schools in different districts, when needed. The Ministry also owns three speedboats for traveling to schools on other islands like Peleliu, Angaur, or Kayangel, but two of them are currently under maintenance. There is a small maintenance department behind the Ministry that is in charge of maintaining all the cars, but boats need external servicing.

Furthermore, each school has its own computer lab with an average of 15 machines. Each student is also given a personal tablet. Some schools in more remote areas are too far to reach the MOE's intranet and have their own networks installed.

Programs

The MOE manages 17 elementary schools, one high school, and one community college. The high school and community college are located in Koror, whereas the elementary schools are scattered throughout the 16 states. There are 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 a triennial Ministry inspection.

All the programs run by the MOE aim at improving the schools and the quality of education. Some past projects and future plans include:

1.   Capturing data about teachers through observations carried out by administration from the MOE, principals, other teachers etc.

2.   Training teachers to provide techniques for improving the students' learning and then keeping track of each teacher's training.

3.   (future) Capturing minute data about the allocation of monetary resources provided to the MOE.

4.   (future) Administering several system-assessments to gauge budget performance.

In the past, students from the TC in GC program have worked on the first two projects. The ministry would like to now focus on the latter two, which deal more with the administrative and budgeting side of operations. The Ministry controls its own budget, but has tended to work with the Ministry of Finance in order to ensure all processes are correctly carried out.

Staff

The Ministry is headed by the Minister of Education, Sinton Soalablai.

Around 430 people are employed by and at the MOE, including the teaching and administrative staff at the schools. All schools have principals as heads, and three schools also have vice-principals.

The primary client partners for this engagement are:

1.   Edwel Ongrung, Administrative Services Manager - Edwel is in charge of Support Services for the Ministry. He is also the person responsible for server maintenance and managing all the technology related things going on at the MOE. We will be working with him to analyze the problem, discuss the feasibility of the solution, understand the compatibility of the solution with the existing software and hardware infrastructure.

2.   Saburo Remoket, Receiving and Distribution - Saburo is responsible for interfacing with vendors and logging the status of purchased items as they are received and successfully distributed to the teachers and students in need. We will be working with him and Edwel to test our receiving and distribution system, verifying whether the forms we create and implement conform to the processes developed by the Ministry.

3.   Adeline Ngirakesau, Inventory Custodian - Adeline follows the Republic of Palau Property Management Manual (established by Executive Order 418 for all government ministries) to maintain and keep track of inventory. We will be working with her to ensure that the inventory tracking and verification process she follows is accurately converted to an online form, along with providing her useful metrics on asset status that she can provide to MOE management.

For any proposed system, the initial beneficiaries will be the system users (Denicia Mariur for budgeting, Bonnie Imeong for requisitioning, Saburo Remoket for receiving/distribution, and Adeline Ngirakesau for inventory). These people are all able to use online systems, which is evident through their regular use of spreadsheets and resources such as the Ministry intranet and email. Therefore, using a simple application with online forms would not be challenging for them. The eventual targeted beneficiaries are the teachers and students who will gain transparency into the resources that are allocated to them.

Technology Infrastructure

Although there is no official operating system for the MOE, Mac OS seems to be widely used at the office. Most employees at the office have a Macbook or similar Apple computer.

The elementary schools have about 2000 Android tablets, 200 iOS tablets, and a small mix of Windows, Mac, and Linux desktops, for the students. The high school has most of the Windows computers. Principals and other Ministry employees use Macs, with some staff using Windows and Linux.

Installation of an undersea fiber-optic cable last year has made using the internet in Palau the fastest yet. Access is now as easy as purchasing a card with an access code on it; there are wireless access points offering broadband-level speed (4 Mbps) throughout Koror that anyone can connect to after purchasing the card.

The Ministry has also greatly benefited from the new fiber optic cable and recently increased the bandwidth of their connection. The WPA2 protected **moewifi** network is accessible anywhere inside the building and is extremely fast (speed was measured at 47 Mbps down and 9 Mbps up).

Technology Management and Planning

Technology is managed across two units - one unit manages IT and support services and another unit elsewhere in the Ministry is responsible for the implementation of new technology in the curriculum. The IT unit is responsible for the technology infrastructure and providing services and technical support to MOE users. The most prominent problems that the IT support team tackles are maintenance of equipment, mainly copiers and printers and network problems throughout the school system. Edwel serves as the head of IT and has two staff members working under him, Bal Ongrung and Warren Fukuichi. Bal is the technician, Warren is responsible for the network, and Edwel is responsible for servers and backend services.

Bal mainly works on fixing hardware problems for laptops and replacing faulty parts. Warren and Edwel focus on keeping the servers up and running and fix any network problems that occur in the ministry and the schools. Together, the team is responsible for tackling IT related issues for nearly 1600 people (which includes students, teachers and MOE employees). The MOE also brings in local IT specialists to help them with various projects and for maintenance of programs and applications.

The IT unit also handles all information security for the Ministry. All the PCs use a free open source antivirus system called Avast. However, any Macbooks (or personal laptops) do not have antivirus software downloaded. In order to block harmful websites and mitigate threats from incoming and outgoing network traffic the department relies on firewalls setup on the network servers. Though this is not relevant to our project's scope, it is also an area of need for the Ministry.

Though this is a technical project, the current project does not fall under the purview of the IT unit. Rather, it falls under the Finance and Inventory units which Edwel, as the Administrative Services Manager, has a responsibility to improve. We will work directly with these units in the implementation of this project.

Communication

Most communication at the office is carried out in person, with people walking to the office of the person they want to talk to or using phones to dial each others' extensions. All files and information are shared through email. Employees have emails ending with '@palaumoe.net' that they use for official communication. For faster responses, people text each other using iMessage as most of them have Apple computers.

The management uses reports to summarize the results of the year and each quarter. There is one main annual report called the Annual Performance Report (APR) and four quarterly reports which are issued from every unit of the MOE. The Annual Performance Report has summarized information about budget allocation, expenditure breakdown, vision and mission of the ministry, information about personnel along with medium and long term goals. Every year the Management Action Plan (MAP) is created based on the data and targets met from the previous year's reports.

The MOE's website continues to provide information for external parties it also hosts an intranet server containing educational content for internal use along with some past reports and documents.

Information Management

It recently became a priority for the Ministry to better understand and track these processes. Spreadsheets and log books have been in use at the Ministry since the 1980s, so they became the de facto method of tracking expenditures as the MOE looked for a technological replacement. Attempts were made to use the Excel logbooks to figure out and provide evidence of teachers getting materials they needed, but it was prohibitively difficult to conduct and report summative evaluations for reports such as the APR or MAP.

Last year's consultant, Ameeshi, began the first step of the technological transition by working with Edwel to create a proof of concept system to handle the process of requisitioning items using PHP with a MySQL backend and a Javascript frontend.

Business Systems

As briefly mentioned in the Programs section, the Ministry of Finance (MOF) has tended to manage the process around budgeting and spending money. The MOE has slowly started moving away from the MOF umbrella and has designed a few of its processes up to this point, but most of them are still relatively fluid due to their newness.

Once the MOE's budget is allocated by the Legislature, all expenditure requests follow a specific process. Items are requested by different units and must be approved before a purchase order is issued and a vendor is selected. After the vendor fulfills the order, the items are picked up by Saburo and verified before he distributes them to their recipients. Inventory management used to have no formal system in place; after repeated failed inventory tests that forced the Ministry to pay multiple audit exemptions costing $45,000 each, the MOE hired an inventory custodian. This official, Adeline, maintains a master list of all assets within the MOE. Twice each year, she receives inventory lists from each unit (department and school) within the Ministry and verifies their status against her master list. If any items are damaged or were not delivered, she makes a note of this before exporting a list of all fixed assets (costing more than $5000) that she has her

bureau's directors sign before forwarding it to the Palau Procurement Office for record keeping. This entire process is conducted by hand, resulting in a list of a few hundred assets that has to be manually verified twice every year. No greater analysis is done on these records, but they are constantly maintained by Adeline.

Expenditure Tracking System

Motivation

In 2006, the Palau government passed RPPL 6-11 specifying that all government ministries had to implement performance based budgeting, which is an approach to budgeting where results are prioritized over money spent. This allows ministries to hold themselves accountable for how public funds are allocated and spent. The Ministry of Finance has understandably led the way in designing a performance based budgeting system and business processes to support the new system, but recently has started pushing other ministries to develop their own budget processes and create a more decentralized, flexible budgeting structure in the government.

Palau re-elected its president, Tommy Remengesau Jr., in 2016. As part of his campaign platform, the president mandated the use of technology in increasing efficiency of all parts of the government. Around this time, the government also signed onto the UNESCO Sustainable Goals 2030 agenda, with the MOE specifically adopting Sustainable Development Goal (SDG) 4.

The Ministry has a yearly Management Action Plan to create and track progress on its goals, and with these three overarching objectives it became much more important to find a streamlined online system that accurately reflected all the different processes and provided detailed reports to better evaluate and compare teacher and school performance as a result of Ministry spending.

The MOE's goal now is to create and capture a workflow to approve, purchase, and log items that are delivered to teachers. Additionally, the results of this workflow have to be reportable so that the Ministry can evaluate its progress according to the goals it has laid out in its Management Action Plan.

Last summer, Edwel and Ameeshi worked together on a proof of concept application to model the requisitioning process that employees went through in order to approve an item for purchase by the Ministry. However, after reviewing the code after a year's usage and taking into account the requirements of the other modules it was decided that a fresh start was preferred to building on the old code.

Other government ministries are also working on similar processes, and would greatly benefit from a web-based system. Existing accounting solutions were considered, but they were ultimately discarded due to the Ministry lacking anyone with accounting expertise and because of the lack of control afforded by the solutions. As part of our exploratory research, we considered several cloud-based products that operate on a subscription service: Quickbooks, SAP S/4HANA Cloud, Sage Fixed Assets, Microsoft Dynamics 365, OurRecords, and Asset Panda. Some of these solutions are more relevant to our problem than others, with products such as Quickbooks, Sage, and MS Dynamics offering inventory management and accounting functionality, but they fail to address key use cases (such as allowing for an audit trail with the

specific forms of the MOE process) and offer far too many unrelated bells and whistles for MOE staff to comfortably use the software. Additionally, all these solutions cost money and do not allow us to host the code, which is a dealbreaker for the MOE. Some of the solutions do offer good ideas and solve what is a relatively old problem in interesting ways, and so we plan to incorporate those ideas into building an app that helps the Ministry take its first step towards managing its processes and finances through technology.

Our goal, therefore, is to build a custom expenditure tracking system that addresses the Ministry's professional limitations and provides the needed data in an efficient manner.

Outcomes

We delivered a Ruby on Rails application hosted on the MOE intranet server that replicates the look and feel of last summer's proof of concept application and implements all four modules in the expenditure process. The application has a responsive interface that also functioned on iPad Mini screens so that staff could use the application in the field when receiving items or reviewing school inventories. Three of the four modules (requisitioning, receiving, and inventory) were successfully tested in the field by users and we were able to implement feedback from those tests. The feedback ranged from user interface tweaks to implementing locking on the database in order to allow multiple people to work on inventory reviews at the same time, but all changes were made and pushed to the repository before the end of the summer. All expected outcomes discussed in the context analysis have now been met to varying degrees. Every expenditure is now entered into the system through the receiving module, making it possible to track the number of expenditures electronically. The distribution module, which created a record of when an item was delivered to the requesting teacher, was recently completed but not tested due to time constraints. As a result, we cannot reliably claim that the other two outcomes (tracking time taken to deliver an item and number of undelivered items) are completed, but the framework is in place for them to be completed. The above outcomes also do not cover the scope of the existing modules - Edwel had hoped that we complete requisitioning and receiving this summer, but we were able to complete all four modules. We hope that the distribution module will be tested in the near future and we'll be able to help debug and answer any questions over email or FaceTime.

Edwel will be the sole person in charge of maintaining the application, so we had regular meetings throughout the summer to train him in the structure and code of the application along with how to conduct maintenance and debugging through the Rails console. These instructions, along with a basic explanation of the files involved in each module, are documented in the project's README file for Edwel to reference at his leisure.

Edwel has a deep understanding of the expenditure process as he had been on the initial team that created the process, and we observed that he was able to combine that with his understanding of the application to help answer most questions that users had about the application during testing.

Recommendations

The four main parts of the MOE's expenditure tracking process are now implemented, but three minor forms needed to update the status of assets in the system remain unimplemented (updating the condition of an asset, transferring an asset between MOE departments, and marking an asset for disposal). Given their relative lack of importance, these forms can wait until next summer. Additionally, we now recommend that work move forward on a reporting module in order to more effectively visualize insights from the data that will be entered into the database over this coming school year. However, as all the item data is in the database (combined with the existing assets owned by the Ministry), it becomes possible to conduct any further analysis and export through the Rails console or custom SQL queries. Edwel is well versed in SQL from past experience so in the unlikely event that he forgets all Rails console commands, he can still interact with the database in this way.

Edwel learned a lot about the application and Ruby on Rails and we are now confident that he can debug minor issues and implement basic functionality (for example, an HTML view for turning data in the database into a printable form). However, the project ended up being more complex than intended, and any features that require extra controllers or models in the backend are better left for the next TC in GC team to implement.

Appendix A

ER Diagram, generated from the final Rails project on August 9th, 2019:

MoeExpenditureTracker domain model