‖ORIZON
CONSTRUCTION

Executive Summary

Student Consultant, Sheng-Lun Chen, Rempei Iwata
Community Partner, Jean-Claude Gahamanyi

I. About the Organization

Horizon Construction SA is a leading local construction company in Rwanda, executing diverse construction projects, including infrastructure, roads, housing and buildings. The company, established in 2007, is a subsidiary of Horizon Group.

The mission statement of Horizon Construction is:

To form long-term relationships of value with our clients and partners by using quality construction and engineering solutions and employing the best resources and latest techniques.

Currently, Horizon Construction has 120 permanent employees. For temporary employees, the company hires based on demand of projects. From 2010 to 2012, the company had completed 25 projects, and it currently has 5 projects in progress. In 2012, its revenue is 8 billion RWF, and the net profit is 0.5 billion RWF.

II. Improvement of Equipment Management

Equipment management is an important task in Engineering Equipment Department. EED deploys equipment based on Project Managers' application, and records the utilization data to calculate revenues the department generates. However, EED did not have an effective system for equipment deployment and revenue calculation. Therefore, the company had difficulty to get clear equipment utilization rate and accurate revenue.

To raise the efficiency of equipment deployment and of monthly revenue reporting, we designed an Equipment Management System which provides the following functions:

- A calendar which shows detailed and visual equipment deployment, including equipment in use, out of use, and in repair.

- Tow easy-to-use user interfaces to schedule a new deployment and to change an existing deployment.

- A date-changeable table which shows deployment of equipment on project.

- Automation of producing Monthly Report which shows revenue statistic.

- A table of equipment which helps Damas manage workable and scrapped equipment.

- A table of project which helps Damas manage the information of ongoing and ended projects.

III. Standardization of Project Management

The monthly report from the Project Manager and the Site Engineer to the General Manager is important part that controls quality of project management in the company. The issue about the monthly report is that the format of the reports is different from each the Project Manager and the Site Engineer. Due to these inconsistent formats, they spend much time to create the report, make calculation mistakes and have difficulty to effectively find out a project status. However, each Project Manager and Site Manager have strong points in their monthly reports.

To share individual's strong point and improvements, standardization of project management by unifying the monthly reports contributes to improvement of quality of the project management of the company. Therefore, the scope of work of this task is to make the process of monthly reporting more efficient by using the unified format of the company.

This consultation built the Unified Monthly Report Format (UMRF) that is able to

- Include all strong points and necessary information from gathered past reports, to

- Reduce mistakes about calculations, and workload of data input by minimizing the number of data that a user needs to input, to

- Automatically create the next month report to reduce inconsistency and workload, and to

- Create an effective summary page to grasp a status of a project by introducing project schedule and resource budget information.

Although the UMRF can offer the company the foundation of keeping and improving project management quality, the company needs a systematic framework to continuously keep and improve the quality of project management. Therefore, this consultation proposes that the company should assign a staff as a Quality Controller of Project Management. This Quality Controller leads to continuously improve the UMRF and to revise the manual by gathering best practices. The consultation also expects that the top management of the company strongly encourage all Project Manager and Site Engineer to utilize the UMRF.

Consulting Partner
Jean-Claude Gahamanyi
jcgahamanyi@horizonconstruction.rw

Horizon Construction SA
PO. Box 6969 Kigali Rwanda
http://www.horizonconstruction.rw

About the Consultant
Sheng-Lun Chen
shengluc@andrew.cmu.edu
Sheng-Lun is a 2nd year student in School of Information Systems and Management of H. John Heinz III College. He took part in the Technology Consulting in the Global Community internship over the summer.

Rempei Iwata
riwata@andrew.cmu.edu
Rempei is a 2nd year student in the School of Information Systems and Management. He is also an employee of The Bank of Tokyo-Mitsubishi UFJ in Japan. His responsibility is to plan the new online banking service.

||ORIZON CONSTRUCTION

Final Consulting Report

Student Consultant, Sheng-Lun Chen, Rempei Iwata
Community Partner, Jean-Claude Gahamanyi

I. About the Organization

Organization

Horizon Construction SA is a leading local construction company in Rwanda, executing diverse construction projects, including infrastructure, roads, housing and buildings. The company, established in 2007, is a subsidiary of Horizon Group. The company was an engineer regiment in the Rwanda Army. Therefore, the major shareholder of the company is the Ministry of Defense.

The mission statement of Horizon Construction is:

> *To form long-term relationships of value with our clients and partners by using quality construction and engineering solutions and employing the best resources and latest techniques.*

Currently, Horizon Construction has 120 permanent employees. For temporary employees, the company hires based on demand of projects. From 2010 to 2012, the company had completed 25 projects, and it currently has 5 projects in progress. In 2012, its revenue is 8 billion RWF, and the net profit is 0.5 billion RWF.

The company has local competitors and foreign competitors. Among their competitors, Horizon Construction is ranked in third place. The main local competitors include NPD Contraco and Real Contractors, both of which are owned by Rwandese Patriotic Front, the current ruling political party of Rwanda. The combination of these two companies is ranked in second place. The main foreign competitors include CCECC and Strabag International, ROKO construction. CCECC is from China and is ranked in first place. Strabag and ROKO both are from E.U., the former is ranked in fourth place.

Horizon Construction has a good IT foundation. Every employee in the general office has a personal computer. The company has its own SAP server, Email server and Local Area Network. The company has used SAP Business One to integrate their business processes.

Facilities

The general office is located at Gikondo Industrial Park, 4 km (2.5 miles) to the southeast of the center of Kigali. Horizon Construction plans to move to the Free Trade Zone in the near future, located 15 km (10 miles) from the general office.

In this location there are Finance Department warehouses, an Engineering Equipment Department parking lot, and a workshop. There are seven warehouses, and one of them is the central warehouse with a computer installed with SAP and Internet access. In the parking lot, there are 92 trucks/machines/vehicles. Some of them are in the workshop for repair.

There is a server room managed by IT department. The room is not on the site of the general office. There is a SAP server and an Email server in it. Even though the power supply is unstable in Rwanda, computers do not have Uninterruptible Power Supply (UPS). When the power supply is off, the company loses the Internet connection. Only the two servers are equipped with UPS.

The Production Department has 2 plants, an asphalt plant that is 15 km (10 miles) away from the general office, and a gravel plant that is 150 km (100 miles) away from the general office.

Business Domain

Horizon Construction, Ltd. has two main businesses. The first one is the construction of roads and infrastructure, which generates 30% of the company's revenue. It includes the construction of dikes, asphalt and concrete roads, and water supply systems. The second line of business is the construction of housing and buildings, which contributes to 65% of revenue. It includes banks, libraries and schools. There is a small part of revenue comes from selling materials, such as pipes or concrete. But it only makes less than 5%.
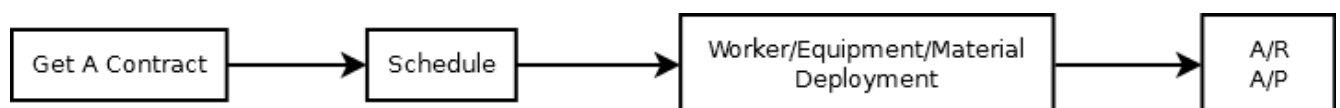

Fig. 1 Main four processes

So far, more than 30 projects such as roads, a dike in the Southern Province, a library in Kigali, the first residential estates in Kigali and the border post that is the model post in Rwanda have been executed successfully.

There are mainly four processes in Horizon Construction Ltd from getting a contract through completing a construction (Fig. 1). The Design & Quantity Survey Department finds a prospective tender and sends it to the General Manager. If the General Manager approves it, a Project Manager will take over and make a schedule for it and apply for worker/equipment/material. After the schedule is done, a site engineer, who is belonged to the Project Manager, will investigate the site. The Engineering Equipment Department will arrange the deployment of equipment, including vehicles, trucks and machines. The Store Manager, which belongs to the Finance Department, will provide the materials. If there is a shortage on a material, the Store Manager will report to the Procurement Department, which is responsible for purchasing. The Production Department provides cement for all construction. During and at the end of the project, Finance Department manages the cash flow, payment, and collection.

The Finance Department (including the Store Manager), the Production Department and the Procurement Department use SAP Business One for most of their data record. The rest of departments use Word and Excel. Besides, most information of the Engineering Equipment Department are recorded on paper, and then manually input into computer.

Department and Staff

There are main departments: General Manager Office, Design & Quantity Survey Department, Project Manager Office of Road & Infrastructure, Project Manager Office of Housing & Building, Finance & Accounting Department, Production Department, Engineering Equipment Department, Procurement Department, Personnel & Administration Department, IT Department, Legal & Compliance Department (Fig. 2).
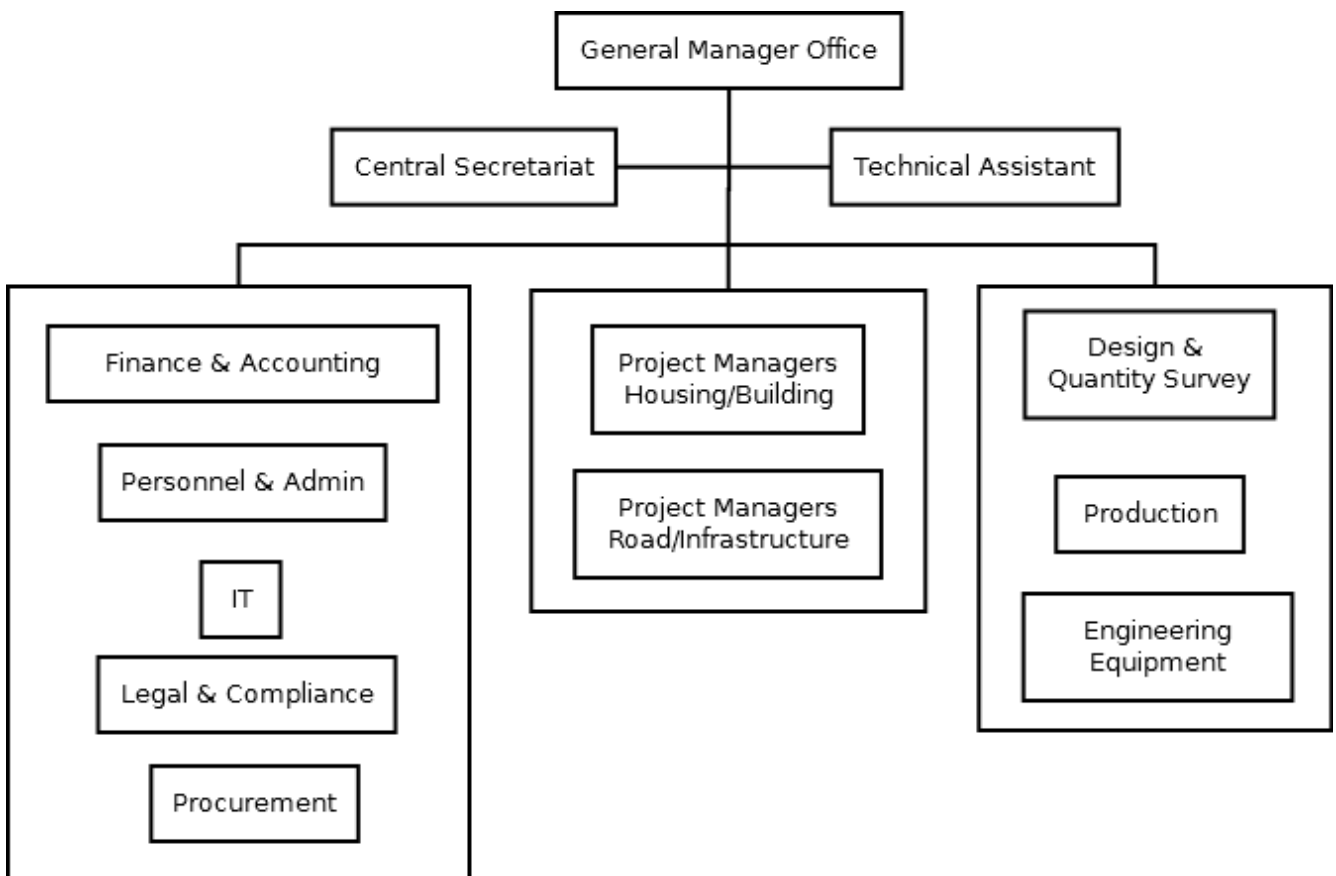
Fig. 2 Organizational structure

General Manager – Jean-Claude

Jean-Claude GAHAMANYI is the person in charge of Horizon Construction. He manages overall strategy and operations of the company.

Design & Quantity Survey Department (D & QS) – Asoph Nimiroz & Abdala Salim

The D & QS searches newspaper advertisements for prospective tenders. The department contacts to the client and gets all requirements and information of the construction project, including materials and blueprints of the building. The D & QS calculates price and adds in profit, and then reports to General Manager. General Manager decides whether to tender the project.

For IT tools, the department uses Microsoft Words and Excel.

Project Managers of Road & Infrastructure – Celestin Gahigana & Kabano

Project Managers of Housing & Building – Regis

Once the company wins a project from a public bid, the project managers (PMs) will take over and start planning construction schedules. Each PM has several site engineers who are assigned to project sites. The site engineers plan the construction schedule and supervise the construction progress of the site, and report to the PM. PM is also responsible for application of materials and equipment.

For IT tools, the departments use Microsoft Project, Words and Excel.

Engineering Equipment Department (EED) – Damas, Frank

EED arranges the deployment of all vehicles, machines, and trucks. The site managers apply equipment they need to this department. After checking availability of equipment, Damas will approve to use it. The department is also responsible for equipment maintenance, fuel supply, and utilization of equipment.

For IT tools, the department uses Microsoft Words and Excel.

Finance & Accounting Department

The department has four main tasks: Account Receivable (A/R), Account Payable (A/P), Treasury, and Petty Cash. A/R is to collect money from customers. A/P is to pay money to suppliers. Treasury is to manage cash in every bank account which belongs to the company and to make budgets annually. Petty Cash is the small but necessary expenses for the company operation. There are extra tasks such as: 1. Producing Internal Reports for supervisors such as Cash Flow prediction, 2. Producing Financial Statement for external stakeholders such as Ministry of Defense.

The department has a sub-sector: Store Management. It is responsible for inventory and stock in warehouses.

For IT tools, the department and its sub-sector use SAP Business One, Microsoft Words and Excel.

Procurement Department

The Procurement Department is responsible for purchasing materials. Once the store manager reports a shortage on a material, the department would hold a public tender. There is an Internal Bid Committee (IBC) which consists of Procurement Department, Project Managers, and Finance Department. The IBC will make a decision, and the Procurement Department will deliver a purchase order.

Besides, Procurement Department is also responsible for the rental of engineering equipment if there is a shortage of equipment in EED.

For IT tools, the department uses SAP Business One, Microsoft Words and Excel.

Production Department

The department is not on the site of the general office. The department has a plant which produces the asphalt required by Project Managers.

For IT tools, the department uses SAP Business One, Microsoft Words and Excel.

Personnel & Administration Department

The department is responsible for human resource management and employee payroll. The department is also responsible for the payroll of temporary employees, such as drivers, equipment operators.

For IT tools, the department uses SAP Business One, Microsoft Words and Excel.

IT Department– Foscon, Fred

The IT department manages the Internet, SAP system, and E-mail system. The IT people maintain the systems both remotely and physically depend on the situation. In the following Technology Management there is a detailed description about IT department.

For IT tools, the department uses SAP Business One, Microsoft Words and Excel.

Legal & Compliance Department

The Legal & Compliance department is responsible for all issues related to law, including contract proposal, contract breach and law suit.

For IT tools, the department uses Microsoft Words and Excel.

Technology Infrastructure

In the general office of the company, almost all employees have a PC that can access Internet with wire or wireless (Fig. 3). The OS is Windows XP or Windows 7.

Horizon Group that is a parent company of Horizon Construction has 2 servers for SAP and E-mail in a server room, which is not at the location of the general office of Horizon Construction. For the SAP server, the OS is Window Server 2008, and for E-mail server is Linux based (Red Hat distribution).

The Internet service is provided by Altech Stream, with a bandwidth of 512Kbps upload/512Kbps download. The bandwidth is share by Horizon Logistic, another subsidiary of Horizon Group on the same site as Horizon Construction. The fee is 1,000,000 RWF per month.

Office Name	# of PCs	# of Printers	Internet Access
General Manager Office	2	2	Wire/Wireless
Design & QS	2	2	Wire/Wireless
Finance (including store manager & cashier)	12	4	Wire/Wireless
Personnel & Admin	2	1	Wire/Wireless
Project Manager – Housing & Building	1	1	Wire/Wireless
Project Manager – Road & Infrastructure	3	2	Wire/Wireless
Engineering Equipment	2	2	Wire/Wireless
Procurement	3	1	Wire/Wireless
Production	4	3	Modems
Legal & Compliance	1	1	Wire

Fig. 3 Details of PCs

Technology Management

The IT department is responsible for the technology management. It is responsible for problem solving, reporting problems, fixing problems, administrating LAN, maintaining equipment, etc. The department closely collaborates with the IT manager of Horizon Group.

Data in the SAP server are backed up every day automatically from one drive to another drive in the same hard disk. This method of back-up has a certain risk. If the hard disk is broken down or stolen, or if there is an office fire or a natural disaster, all the data will be gone.

Technology Planning

Horizon Group bought SAP from ABC Rwanda (ABC-R), a Rwanda registered IT company. ABC-R creates solutions for all Horizon subsidiaries, including Horizon Construction. Before SAP was implemented in a department, ABC-R had several meetings with the department staff, gathering their requisition for SAP, and then created a solution.

Currently, ABC-R is preparing to implement Project Management Model for Design & Quantity Survey Department and Project Managers. Two months ago, in April 2013, ABC-R had a meeting with the two departments. A record of the meeting is in ABC-R's hand. In Horizon Construction, no one has the record.

Internal Communication

There are 3 ways of internal communication in Horizon Construction: SAP, Email and paper. SAP is used for the communication among Store Management, Finance Department, Procurement Department, Personnel & Admin Department and Production Department. Email and paper are used for the communication between different departments.

External Communication

Email, paper, and phone are the 3 ways of external communication between Horizon Construction and its customers, suppliers, and subcontractors.

Information Management

There are six types of information critical to Horizon Construction: prospective tender, project schedules, materials & inventory, production schedules, deployment of engineering equipment, personnel payroll, and finance information. Information about materials & inventory, production, personnel payroll, and finance is managed electronically via SAP Business One. For the rest, information is managed electronically via Excel and Word.

The only information system now is the SAP Business One. It has been implemented by ABC Rwanda since November 2011. In Finance Department and Personnel & Administration Department, staff is very satisfied with SAP Business One. It helps there manage data efficiently and generate reports conveniently. Currently, all Microsoft SQL Server databases are only connected to SAP Business One. No other databases are used now.

Business Systems

Horizon Construction introduced SAP Business One in 2011, beginning with the Finance Department. Five out of ten departments currently use SAP: Personnel & Administration, Procurement, Finance, Production, and IT. Currently, SAP Business One manages business processes accurately and effectively. Offices are satisfied with it.

II. Improvement of Equipment Management

Motivation

Equipment management is one of the important works for Horizon Construction as a construction company in terms of meeting a schedule of a project and cost containment. Equipment management in this section means assignments, repairs and maintenances of a heavy construction equipment, a dump truck, and a car. Damas manages the Engineering Equipment Department (EED) and is in charge of equipment management for the company. The workflow of equipment management excluding repairs and maintenances is illustrated in Appendix A.

The manager Damas was assigned the manager of EED in December 2012. He has implemented some improvement plans such as reporting and providing a form for equipment management since he was assigned the manager. Based on the analysis of monthly reports for 3 months, from January to March 2013 (Appendix B), Rate of Failure, the rate of period that equipment is in a workshop to repair it, has held constant at approximately 20% for 3 months. Rate of Operation, the number of days that equipment is actually deployed to a project, is from 30% to 40%. Rate of Operation except Workshop days, the rate of deployed period that is deducted repair days, is from 40% to 50%.

Since these rates are not largely changed for 3 months, we consider that the quality of equipment management does not have inconsistency. It can be said that the quality is uniform, well controlled. However, to keep the quality uniform, well controlled the manager spends much time for several reporting and recording registers.

Damas, the head of EED, has a current work flow and corresponding forms as:

1. Project Managers apply equipment they need by submitting Damas a Requisition Form.

2. Damas checks if there is available equipment and deploys equipment based on Daily Deployment Form.

3. After the equipment is returned from usage, the equipment operator records the usage information on a Utilization Form and submits it to Damas.

4. By month, Damas collects Utilization Forms and makes a Monthly Report.

Among the above four paperwork, Damas is mainly responsible for the Daily Deployment Form and Monthly Report. For each date, Damas has a Daily Deployment Form (created by MS Word), which records the number of equipment deployed and corresponding project names. If there is an application for an excavator for ten days, Damas will have to open ten Word files, repeating checking if there is available equipment. It is poorly efficient, highly time-consuming and goes wrong easily. A proper management software can easily eliminate the repeating task.

The task of Monthly Report has similar defects. In the end of each month, Damas collects the Utilization Forms, and calculates the usage of each equipment and revenue it produced. This task is done manually in Excel. There are currently 92 equipments and tens of projects in this company. The endless calculation makes this task almost impossible to be done on time. Currently the Monthly Report is already delayed for three months.

Even though Horizon Construction has SAP, but it does not have a plan to implement SAP to the work process of EED. Thus, we decide to introduce to Damas a new management system.

Scope of Work

To improve the efficiency of equipment management and to keep the efficiency in future when Horizon Construction expands its business, the process of several reporting and recording registers should be changed. Therefore, this consultation defines scope of works following.

Scope of work 1: Make the process of equipment assignment more efficient

Scope of work 2: Make the process of reporting more efficient

Outcome

Overview of Outcomes

The head of Engineering Equipment Department, Damas, now has and is capable of operating a computerized database system, Equipment Management System (EMS), which consists of the following function:

- A calendar which shows detailed and visual equipment deployment, including equipment in use, out of use, and in repair.

- Tow easy-to-use user interfaces to schedule a new deployment and to change an existing deployment.

- A date-changeable table which shows deployment of equipment on project.

- Automation of producing Monthly Report which shows revenue statistic.

- A table of equipment which helps Damas manage workable and scrapped equipment.

- A table of project which helps Damas manage the information of ongoing and ended projects.

- A cloud drive which provides safe and automatic back-up for the EMS.

Approach

Our approach was to replace the manual analysis of EED data by implementing a database application. Thus, this consultation built the application "EMS (Equipment Management Solution)" by using Microsoft Access. The EMS enabled the manager to reduce time to operate many files to assign equipment and to report.

We chose Microsoft Access because it is already installed in every computer in Horizon Construction and easily accessed. We considered some open source software, but the Internet speed is too slow and too unstable to download software. Besides, new software might cause more compatibility problems than Microsoft Access does.

Actual work plan is followings. The detail schedule is in Appendix C.

1. Create a user interface image of equipment assignment, and monthly reporting based on the current paper form and Damas' requirements

2. Gather functional requirements of EMS for equipment assignment, and monthly reporting

3. Define requirements of function and user interface

4. Build EMS application, present to Damas, and revise the application based on his feedback

5. Beta test by migrating the current data and present the test to Damas

6. Create operation manual including the method of backup

7. Training

Besides, to provide a sustainable and reliable maintenance for the EMS, we have provided solutions for several situations.

1. Unexpected Errors: We will install Dropbox cloud drive into computers of EED. Dropbox automatically produces daily back-up for each file in cloud drive. When Damas faces unexpected errors due to unexpected operations, he can easily get access to previous file. He can try again and detour the error causing operations.

2. Incompatibility of Software Upgrade: The EMS was built in Microsoft Access 2007, the edition the company uses. If Access 2007 is upgraded to Access 2010/2013, the later version will support the previous version. In additional, we tested that EMS is compatible with Access 2010.

Defined Requirements

We discussed with Damas about the information in his daily tasks, and eliminated unnecessary factors for the system. We came to a conclusion of requirement in the below form.

Task in EED	Requirements of EMS
Equipment Deployment	• EMS shows availability of all equipment on a calendar and provides a user interface to add new deployment schedules. • It visually shows clear deployment of all equipment and corresponding projects on a table.
Utilization Management & Monthly Report	• It helps Damas create Monthly Report much more efficiently. After utilization records are inputted into the system, it automatically calculates revenue of each equipment on each project, and total revenue.
Equipment Management	• All equipment, including vehicles and machines, are registered. • Once an equipment is discarded, it will not show up on deployment calendar. But the previous monthly reports related to it are not affected.
Repair Management	• Equipment in repair is also shown on the calendar. It shows Damas an accurate distribution between equipment in function and in malfunction.
Project Management	• All ongoing projects are registered and connected to the usage of equipment. • Once a project is over, it will not show up on the deployment table. But the previous monthly reports related to it are not affected.

Features of EMS

EMS consists of the above requirements and the following features:

1. Equipment Deployment Calendar (including equipment in repair):

Start Date	<	7/6/2013	>	Register New Plan	Edit Existing Plan																			
Reg. #	Equipment Type	7/6	7/7	7/8	7/9	7/10	7/11	7/12	7/13	7/14	7/15	7/16	7/17	7/18	7/19	7/20	7/21	7/22	7/23	7/24	7/25	7/26	7/27	7/28	7/29	7/30
ACM1	ASPHALT CUTTING MACHINE																									
RAB803I	BACKHOE LOADER																									
RAB028C	Bitumen Sprayer Truck IVECO																									
RAB871X	Bitumen Sprayer Truck(IVECO)																									
BC1	Bulldoser Cat D7G			P	P	P																				
RAB362X	CATERPILAR - EXCAVATOR	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
RAB339X	CATERPILAR - GRADER																									
RAB337X	CATERPILAR - GRADER	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
RAB794I	CHANGLIN - BULLDOZER	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W					
RAB8051	CHANGLIN- BULL DOZER								W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W
RAC027C	CHIP SPREADER																									
CM1	CONCRETE MIXER	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
RAB795I	CONCRETE MIXER TRUCK																									
RAB171L	DAIHATSU - DELTA	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
RAB202L	DAIHATSU - DELTA																									
RAB898T	DAIHATSU - DELTA	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P						
BW120D	DOUBLE DRUM COMPACTOR	P	P	P	P	P	P	P	P	P	P	P	P													
BW138 D	DOUBLE DRUM COMPACTOR	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P

Fig. 4 Equipment Deployment Calendar

- On this calendar, Damas can easily and clearly know the deployment of all equipment and report to the General Manager with accurate data.

- The vertical axis is the list of equipment ordered by equipment type.

- The horizontal axis is the duration of calendar, which can be changed to look for further or previous deployment.

- "P" stands for "Project", meaning that the equipment is deployed to a project. "W" stands for "Workshop", meaning that it is in repair.

- Damas can schedule for new deployment plans, and can change the existing plans based on unexpected changes from construction projects.

2. Equipment Deployment on Project:

Fig. 5 Equipment Deployment on Project

Date `<` 7/29/2013 `>`

Reg. #	Equipment Type	Total	11Work Shop under repair	12East Africa Granite	13CAG	14Gicye Project	15Bisesero	16Police Acady Peace	17Kinyinya Plant	18DAIHO	19Procurement	1Ntarana Quary	20Zinla Rd Project	21Musanze Quary	22HQs	23Rusumo bridge	24ACTUS	25Free Zone	26CSK	27HIRED	2ADMIN	3RUSIZI Airport	5Bulinga	6Ubumwe Project	9Rugungu cercle
ACM1	ASPHALT CUTTING MACHINE																								
RAB803I	BACKHOE LOADER																								
RAB028C	Bitumen Sprayer Truck IVECO																								
RAB871X	Bitumen Sprayer Truck(IVECO)																								
BC1	Bulldoser Cat D7G																								
RAB362X	CATERPILAR - EXCAVATOR	1				1																			
RAB337X	CATERPILAR - GRADER	1															1								
RAB339X	CATERPILAR - GRADER																								
RAB794I	CHANGLIN - BULLDOZER																								
RAB8051	CHANGLIN- BULL DOZER	1	1																						
RAC027C	CHIP SPREADER																								
CM1	CONCRETE MIXER	1				1																			
RAB795I	CONCRETE MIXER TRUCK																								
RAB171L	DAIHATSU - DELTA	1					1																		
RAB202L	DAIHATSU - DELTA																								
RAB898T	DAIHATSU - DELTA																								
BW120D	DOUBLE DRUM COMPACTOR																								
BW138 D	DOUBLE DRUM COMPACTOR	1																					1		
RAB782I	DUMP TRUCK	1												1											
RAB785I	DUMP TRUCK																								
RAB791I	DUMP TRUCK	1									1														
RAB793I	DUMP TRUCK	1	1																						

- On this table, Damas can easily and clearly know the deployment of all equipment with accurate data.
- The date of table can be changed to can be changed to look for further or previous deployment.
- The vertical axis is the list of equipment.
- The horizontal axis is the list of project.

3. Utilization Record:

Fig. 6 Table of Utilization Record

Utilization_ID	Project_ID	Project_Name	Equipment_ID	Equipment_Type	Utilization_Date	Effective_Hour
149	9	Rugungu cercle	RAB182Z	MERCEDES-BENZ	6/29/2013	1
145	9	Rugungu cercle	RAB818I	DUMP TRUCK	6/25/2013	10
148	9	Rugungu cercle	RAB182Z	MERCEDES-BENZ	6/25/2013	2
147	9	Rugungu cercle	RAB182Z	MERCEDES-BENZ	6/23/2013	2
144	9	Rugungu cercle	RAB818I	DUMP TRUCK	6/22/2013	10
143	9	Rugungu cercle	RAB818I	DUMP TRUCK	6/21/2013	10
146	9	Rugungu cercle	RAB182Z	MERCEDES-BENZ	6/20/2013	2
142	9	Rugungu cercle	RAB818I	DUMP TRUCK	6/20/2013	10
141	17	Kinyinya Plant	RAB268Z	MERCEDES-BENZ	6/17/2013	9
64	20	Zinia Rd Project	RAB182Z	MERCEDES-BENZ	6/17/2013	10
116	9	Rugungu cercle	RAB785I	DUMP TRUCK	6/16/2013	7
121	17	Kinyinya Plant	RAB348Z	MERCEDES-BENZ	6/15/2013	9
63	20	Zinia Rd Project	RAB182Z	MERCEDES-BENZ	6/15/2013	7
140	17	Kinyinya Plant	RAB268Z	MERCEDES-BENZ	6/15/2013	7
115	9	Rugungu cercle	RAB785I	DUMP TRUCK	6/15/2013	4
128	17	Kinyinya Plant	RAB267Z	MERCEDES-BENZ	6/15/2013	8
62	20	Zinia Rd Project	RAB182Z	MERCEDES-BENZ	6/14/2013	10

Record: 1 of 292 — No Filter — Search

- All utilization information necessary for revenue statistic is shown on this table.
- Damas can add new records or change existing records.

- Damas can search for specific record by setting filters on this table.

4. Monthly Report:

Monthly Report of Equipment Utilization   5, 2013   Print

Reg. #	Equipment Type	Project Name	Unit	Days	Hours	W/S	Price	Cost
ACM1	ASPHALT CUTTING MACHINE		Day	0		0	30,000	
			Total	0		0		
RAB803I	BACKHOE LOADER		Hour	0		0	0	
			Total	0		0		
RAB028C	Bitumen Sprayer Truck IVECO	Ubumwe Project	Day	2	12	0	400,000	800,000
			Total	2	12	0		800,000
RAB871X	Bitumen Sprayer Truck(IVECO)	Ntarama Quarry	Day	5	56	0	400,000	2,000,000
			Total	5	56	0		2,000,000
BC1	Bulldoser Cat D7G		Hour	0		0	60,000	
			Total	0		0		
RAB362X	CATERPILAR - EXCAVATOR		Hour	0		0	60,000	
			Total	0		0		
RAB337X	CATERPILAR - GRADER		Hour	0		0	65,000	
			Total	0		0		
RAB339X	CATERPILAR - GRADER	Zinia Rd Project	Hour	7	40	0	65,000	2,600,000
			Total	7	40	0		2,600,000

Fig. 7 Monthly Report

- Monthly Report is produced by one button click.
- Revenue produced by equipment is automatically calculated based on the utilization records.
- Repair records are also taken into account in the report.
- Monthly total revenue is shown at the end of the report.

5. Repair Management:

Repair List

Add New Record

Repair_ID	Equipment_ID	Equipment_Type	Start_Date	End_Date
16	RAB824I	DUMP TRUCK	1/1/2013	9/18/2013
17	RAB793I	DUMP TRUCK	2/4/2013	8/30/2013
11	RAB268Z	MERCEDES-BENZ - Tr	7/17/2013	7/20/2013
21	RAC068C	TOYOTA HILUX	7/2/2013	7/26/2013
22	RAC070C	TOYOTA HILUX	4/2/2013	7/31/2013
23	RAB092M	FORD - RANGER D/C	7/2/2013	7/26/2013
19	RAB826R	TOYOTA - HILUX S/C	2/4/2013	7/26/2013
18	RAB820I	TRACKED EXCAVATO	3/4/2013	7/31/2013
12	RAB789I	MOTOR GRADER	5/8/2013	7/20/2013
13	RAB063Z	WHEEL LOADER	7/15/2013	7/23/2013

Fig. 8 Repair Management

- All repair records are shown on the table. Damas can provide a clear and detailed information about the works in workshop.
- Damas can add new repair records, or edit existing records.
- Damas can know if the repair of equipment is on schedule.

6. Equipment Management:

Fig. 9 Equipment Management

- All workable and scrapped equipment and its corresponding revenue per unit are listed on the table.

- Damas can add new equipment and edit the information of existing equipment.

- If a equipment is scrapped, it can be set to "Deleted", and it will not show up when Damas schedule a new deployment. But its utilization records will be kept in the system.

7. Project Management:

Fig. 10 Project Management

- All ongoing and ended projects are shown on the list.

- Damas can add new projects or edit existing projects.

- If a project is ended, it can be set to "Deleted", and it will not show up when Damas schedule a new deployment. But related utilization records will be kept in the system.

Documents for Operation

We provide an operation manual which shows how to apply the EMS on Damas' current work and shows methods of troubleshooting (Appendix D). Examples in the manual come from real case as below:

1. How to schedule a deployment of equipment

2. How to check deployment of equipment on projects

3. How to add a utilization record

4. How to produce a monthly report

5. How an equipment in repair

6. How to add/change/delete a project

7. How to add/change/delete an equipment

8. How to search for a specific record

9. Errors Handling

10. Data back-up and storage

Training Session

With the manual and site teaching sessions, Damas already transmitted the previous deployment data into EMS database. The Monthly Reports of previous months, from April to June, are also in process. He is capable to operate EMS independently.

Furthermore, we are planning to teach one more staff in Engineering Equipment Department who can help Damas on creating Monthly Report. Monthly Report consists of past records, having different character from Equipment Deployment. For Equipment Deployment, it takes a man with authority to make a decision. However, Monthly Report can easily be produced by anyone who is trained to be capable of entering usage records correctly.

Recommendation

The accuracy of utilization records is important. In Monthly Reports, the revenue EED earns comes from the utilization records. If a user inputs wrong utilization records, the revenue will be also incorrect. Therefore, Damas needs to make sure that the utilization records are correctly imputed. There are two ways can be used to raise the accuracy:

1. Assign a reliable staff to be in charge of inputting records:
   Inputting utilization records of a month for over a hundred equipments into EMS could takes several days. As the head of EED, Damas is very busy and hardly has the time. We suggest that Damas should assign a staff to be responsible for records inputting.

2. Collect and input the record every week:
   Currently, EED collects the Utilization Forms from the equipment once a month. However, there are some record errors in the forms come from handwriting. If EED raises the frequency of collecting the records, it is much easier to find out errors and track for the right records.

3. Promote the accuracy of record in Utilization Form filled by drivers/operators:

   Damas successfully promoted the accuracy of Utilization Form by giving bonus to drivers/operators. However, they still sometimes forget or wrongly fill the forms. It would be helpful if there is a compliment way to further raise the accuracy.

III. Standardization of Project Management

Motivation

Project management is the core task of Horizon Construction. Currently, three project managers are in charge of the projects of the company. These project managers manages several projects and have site managers who are assigned to a construction site. Since the project is typically executed at multiple sites, the Site Engineer is responsible for the management of a site. The ordinal task force structure of a project is Appendix E.

Workflow of project management of the company is illustrated in Appendix F. After Design & Quantity Survey Department acquires the project contract, the Project Manager plans project schedule, labors, materials, equipment, and subcontract based on the design documents. Based on the plan, the Project Manager requests the Procurement Department, the Personnel & Administration Department, and the Engineering Equipment Department to arrange and to purchase the resources. Once the project starts, the Project Manager reports to the General Manager monthly and in each phase of the project. These reports include progress of a construction and consumption of resources.

According to our analysis of interviews with the Project Managers and the Site Engineers, and of their reports, the company is considered to well manage the project by individual employees. However, in the organizational level, some issues are observed as the followings.

The first issue is that a format of the monthly report for the General Manager is not unified. Each Project Manager and Site Engineer uses his/her own format. Besides, he/she might have different report formats for each project because the Project Managers and the Site Engineers do not share information. This situation leads to:

- Quality of project management for each project is not consistent, to

- Calculation/Number errors in the reports are common and hard to find out, and to

- The General Manager cannot effectively find out emphasis of projects.

Based on our research of monthly reports of 8 different projects of 2 Project Managers and 2 Site Engineers, we found that following advantages in each format (Fig. 11). This research shows that experienced Project Managers add information about difference between plans and actual activities such as estimation of total budget and balance of remaining work.

We believe that a combination of these advantages and a unified format can stabilize the report quality and eliminate the previous problems.

Strong Point \ Name	Claris (Site engineer)	Kabano (Project Manager)	Regis (Project Manager)	David (Site engineer)
Invoice Status	✓		✓	
Summary of Work Status	✓	✓		
Project Timeline	✓			✓
Estimation of Total Budget		✓		
Remarks for Unusual Figures		✓		✓
Balance of Remaining Work			✓	
Summary of Project			✓	✓

Fig. 11 Strong points of each monthly report

The second issue is that the management of a construction progress is not controlled by both time and amount. Currently the indicator of the progress is only about how amount of a work is done. But there is no indicator about until when a work should be done. The reason of this might be difficulty to administrate both amount and time by only using an Excel spread sheet for the project management.

Scope of Work

The standardization of project management can include individual's improvements and enables employees to share these improvements. This standardization contributes to improvement of quality of the project management of the company. Therefore, this consultation defines scope of work following.

Scope of work: Make the process of monthly reporting more efficient by using the unified format of the company

Outcomes

Overview of Outcomes

From past reports, discussions with the Project Mangers and the Site Engineers, and a prototype, this consultation built the Unified Monthly Report Format (UMRF). The UMRF is able to

- Include all strong points of Fig. 11 and necessary information from gathered past reports of 8 different of 2 project managers and 2 site engineers, to

- Reduce mistakes about totals and currency exchange[*], and workload of data input by minimizing the number of data that a user needs to input, to

- Automatically create the next month report to reduce inconsistency and workload, and to

- Create an effective summary page to grasp a status of a project by introducing project schedule and resource budget information.

  [*] Some resources such as foreign labors and special equipment are paid with USD. Thus, the conversion of currency is needed in the report.

Approach

This consultation planned to approach the scope of work by creating the UMRF with Microsoft Excel. Actual work plan is followings. The detail schedule is in Appendix C.

We needed to have a consensus about the unified format with the General Manager, Project Managers, and Site Engineers by using a prototype. To gather detail, practical information, we asked the General Manager to assign the Site Engineer, Clarisse, as a co-worker with us. We expect that Clarisse plays role as an evangelist of this solution after we leave here.

In the future, the company expands its business to more complicated projects. At that time, it will need to improve the unified format by itself. We expect that Clarisse who built this solution with us will be the person in charge of improvement.

Our work plan was to:

1. Gather the information and the reports about the past projects, to

2. Discuss with Project Managers and Site Engineers to classify items in the reports, to

3. Create a prototype of the UMRF including the best practices of the past projects, to

4. Discuss about the draft with General Manager, Project Managers and Site Engineers, to

5. Reach a consensus about the UMRF, to

6. Revise the prototype, to

7. Select a past project as the test project and test the UMRF, to

8. Discuss about the outcome with General Manager, Project Managers and Site Engineers, to

9. Create the manual how to create the UMRF and how to utilize the UMRF to improve project management, and to

10. Have training for end-users and training for those who are in charge of maintaining the format.

Features of UMRF

First, the UMRF is deigned to standardize monthly report formats (Fig. 12) that currently are different between the Project Managers and between the Site Engineers by including all common information among their past reports (Fig. 13). And it also has strong points of the past reports.

Fig. 12 Samples of current monthly reports

Fig. 13 Input sheet of labor information

Second, to reduce mistakes about totals and currency exchange, and workload of inputting data, the UMRF utilizes Excel formulas and automatically calculates totals and subtotals. For example, Cost of this Month in Rwanda Franc (RWF) is automatically calculated from Period of this Month, CNY, and Unit Rate (Fig. 14). And in Bill of Quantity (BOQ) subtotals of each category are also automatically calculated (Fig. 15). This feature enables the Project Managers and the Site Managers to avoid numerous repeating calculations as they currently do.

Fig. 14 Example of utilization of formulas

Fig. 15 Example of automatic subtotal

Third, the UMRF offers the function to create the next month report automatically. After using this function, the Project Managers and the Site Mangers just input information of this month when they create the next month report. In the discussion with the Project Manager, Kabano, and the Site manager, Clarisse, we found that they have difficulty to create the next month report from a previous month report. Since they sometimes mistake to copy and paste manually, the next month report become inconsistent. They need to spend much time to fix this inconsistency. This function can eliminate this mistake.

Forth, to grasp a status of a project, the UMRF provides the summary page (Fig. 16). Unlike the above 3 features about the standardization and the elimination of mistakes, this feature is to improve the project management way. This improvement is realized by introducing project schedule and resource budget information as additional entry information. Indeed almost all current monthly reports only reports on actual expenditure and actual amount of works. It is difficult to know whether this project proceeds according to a plan or not. But this summary page enables to know the project status visually.
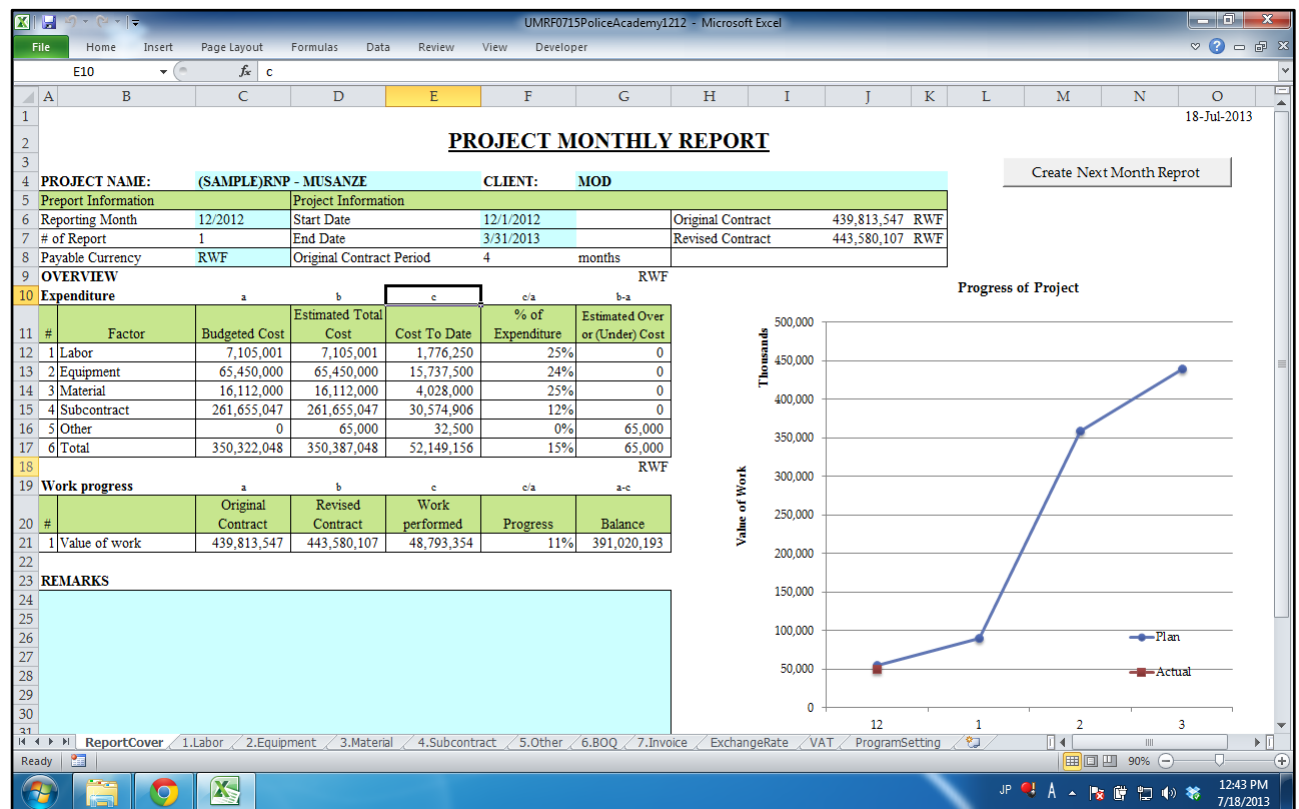

Fig. 16 Summary page

Documents for Operation

This consultation created Manual of United Monthly Report Format (Appendix G). This manual indicates how to read the report as well as how to create the report because the most important point in project management is to quickly know something unusual and unplanned. And the Project Managers and the Site Engineers should consider how to deal with this situation that appears usually as delay of tasks. This manual illustrates five typical cases and explains how to deal with each case.

Training Session

By using the manual, we had training sessions with Kabano and Clarisse. For Clarisse who was assigned as co-worker of this project, we explained how to read the summary page and meaning of each item in the summary page. And we discussed with her about five typical cases in the manual to understand well the UMRF.

After training sessions, Kabano agreed to apply the UMRF to his current project to understand well. Clarisse also agreed to apply to her past project for practice.

Recommendations

Vision: Continuous Keeping and Improvement of Project Management Quality

Project management is one of the most critical business operations in Horizon Construction as a construction company. In rapidly developing Rwanda, the company that is supposed to enlarge its business needs the following vision about project management.

Continuous Keeping and Improvement of Project Management Quality

According to Toyota Motor Corp., keeping and improvement of quality is achieved by removing inconsistency, unreasonableness, and waste. The results of applying this concept to project management of the company are followings.

- **Inconsistency**: The formats of monthly reports of each Project Manager and Site Engineer are different.

- **Unreasonableness**: To create a monthly report, the Project Managers and the Site Engineers spend several days. Sometimes they spend much time to remove mistakes of calculations.

- **Waste**: There is possibility of being late to know delay of project progress due to lack of comparison between actual work and planed one.

The company has to makes sure to share ideas and efforts of individuals with the entire organization as well as encourages the Project Managers and the Site Engineers to remove above 3 things.

Goal: Build Framework of Continuous Removing of Inconsistency, Unreasonableness, and Waste about Project Management

The UMRF of this consultation contributes to removing of inconsistency, unreasonableness, and waste about project management as follows:

- **Removing of Inconsistency**: The UMRF can unify the deferent formats of monthly reports of each Project Manager and Site Engineer.

- **Removing of Unreasonableness**: The UMRF can reduce workload to create a monthly report. The Project Managers and the Site Engineers spend much effort and time to copy and paste data and to calculate totals by using calculator. For example, a Site Engineer actually spent 2 days just to find and to remove mistakes of calculations.

- **Removing of Waste**: The UMRF enables the Project Manager and the Site Engineer to know delay of a project quickly by introducing task schedule and budgeted amount of resources in the monthly report. They can also effectively control a project by comparing between a project plan and actual works by using the UMRF.

Although the UMRF can offer the company the foundation of keeping and improving project management quality, the company needs a systematic framework to continuously keep and improve the quality of project management. Therefore, this consultation proposes the framework as follows.

- The company should assign a staff as a Quality Controller of Project Management. This staff should be the Site Engineer who does not have much experience to learn broad, long-term point of view about a project management.

- The Quality Controller of Project Management should organize environment in which all Project Managers and Site Engineers manages projects by using the same UMRF and its manual. This can avoid inconsistency such that everyone uses different monthly formats.

- The Project Managers and the Site Engineers should discuss with the Quality Controller of Project Management when they have an idea to improve the UMRF and its manual. This contributes to improving project management quality by sharing the way to remove unreasonableness and waste as well as avoiding inconsistency due to revisions of the UMRF by individuals

- The Quality Controller of Project Management should revise the UMRF and its manual based on ideas of the Project Managers and the Site Engineers. This idea is not only to modify the format of the UMRF but also to add the best practice and the worst one into the manual to prevail all Project Managers and Site Engineers. This contributes to improving project management quality by sharing the way to remove unreasonableness and waste.

Risk

The Quality Controller of Project Management may not work as the proposal intends because workload of the controller increases in the short term and the controller has the difficulty to understand importance of this long-term activities. To mitigate this risk, the top management should clearly assign the controller position to a staff and make the controller write a form for management by objectives.

Like the controller, the Project Managers and the Site Engineers might not understand the benefit of the UMRF because of the lack of a long-term point of view about continuous keeping and improvement of project management quality. The top management needs to announce cooperation with the Quality Controller of Project Management and usage of the UMRF to all Project Managers and Site Managers.

Additional Impact

In the near future when the business of the company is expanded, the company needs to increase its engineers. At this time, the company can effectively, rapidly train them by using the UMRF   and the manual and can get more similar quality to existing well-experienced engineers.

Meanwhile, IT department of the company tries to implement the Project Management module, the module that MARINGO Computers GmbH offers as the module of SAP Business One. Before introducing SAP to a work of a company, standardization of works is important and necessary to succeed the implementation of SAP. The UMRF can contribute to future SAP implementation.

The systematic framework of this recommendation and continuously improving manual of the UMRF can be also preparation for an external audit.

About the Consultant

Sheng-Lun Chen

shengluc@andrew.cmu.edu

Sheng-Lun is a Master of Information Systems student at Carnegie Mellon University. He took part in the Technology Consulting in the Global Community internship over the summer and returned in the fall to start the second year study at Carnegie Mellon University.

Rempei Iwata

riwata@andrew.cmu.edu

Rempei is the 2nd year student in School of Information Systems and Management of H. John Heinz III College in Carnegie Mellon University. He is also an employee of The Bank of Tokyo-Mitsubishi UFJ in Japan. His responsibility is to plan the new online banking services.