Gamelan

Academic Enterprise Resource Planning

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Abstract — **Most of Indonesia's educational institutions serve a very limited number of students. This will result in financial problem in providing a good infrastructure, especially in information system. This research is to design an information system capable for enterprise resource planning for academic institution that will be applicable in most academic business process in Indonesia.**

*Keywords—***academic information system, academic operational, human resource, billing, payment, asset, questionairre, password management.**

I. Introduction

As per December 12th 2013, Indonesia has 4425 educational institution which mostly is in Higher School (51%) and Academic type (30%), which serve 17.497.413 active students [1]. From 4425 educational institution, most of them have students body less than 1000, which in return give a financial problem especially for hiring a good faculty member.

The problem arises when it comes to infrastructure, information system and access, including the employee that run the infrastructure. There will be an option for the institution, with its benefit and risk for each option:

1. Hire a dedicated employee to run the infrastructure

2. Partnership with a third party professional institution

3. Both

For hiring a dedicated employee, there will be obligation for the institution to provide salary and career path, and in exchange the risk is when the employee resign. For partnership, the benefit is the lower risk itself, while maintaining a good partner the result will be obvious, and the risk is when the partner does not have a good intention. Maintaining both employee and partnership is the average benefit and risk from previous schema.

There is another option for a low budget institution to provide a decent infrastructure, especially for the information system, which is to ask for government help to provide a flexible information system infrastructure that capable to accommodate any possible business process.

II. System Design

A. Requirements

The main requirement for this research is how to design an information system that has the capability to accommodate most possible academic business process. To do this, we need to make sure that all business process in academic institution can be supported, and we need a best practice framework. This research will use TMForum TAM (Telecommunication Application Map) [2] as a base framework to make sure that all business process will be accommodated, with a small change in point of view.
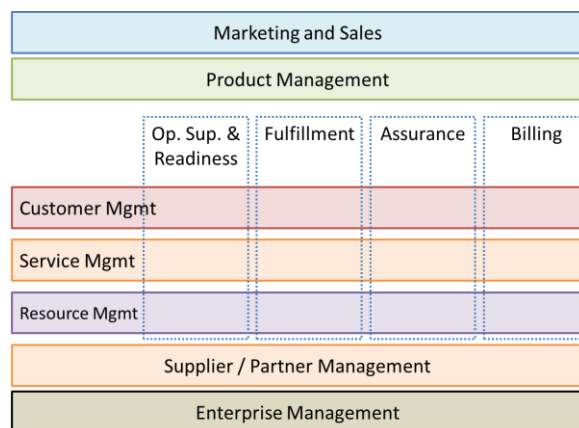

Figure 1: Telecommunication Application Map

In TAM, there are 7 layers, including:

1. Marketing and Sales

2. Product Management

3. Customer Management

4. Service Management

5. Resource Management

6. Partner Management

7. Enterprise Management

While in ERP (Enterprise Resource Planning) point of view, there are 7 modules, including:

1. Financial Accounting

2. Management Accounting

3. Human Resource

4. Manufacturing

5. Supply Chain Management

6. Project Management

7. Customer Relationship Management

From here we can create the requirement for the application:

1. Marketing and Sales

2. Resource Management

3. Asset Management

4. Customer (Student) Management

5. Human Resource

6. Financial Accounting (Billing, Collection, and General Ledger)

B. *Design*

From above requirements, we design the architecture to include a master data as the foundation and collaboration to accommodate interaction between modules.

Figure 2: High Level Architectural Design

There will be several data group in our system, including:

1. Master data organization

2. Master data customer (student, staff, and lecturer)

3. Master data resource (room, peripheral)

4. Master data product (course, service)

5. Transactional sales (product proposition)

6. Transactional delivery (scheduling, quality assurance, and customer feedback)

7. Transactional quality assessment (competency, assessment, and training need analysis)

8. Transactional financial assessment (billing, collection, general ledger)

9. Transactional project management office

10. Collaboration (notification, legal letter, questionnaire)

Master data organization defines the organization structure along with each of its job specification (competency needed to fulfill the job description) to ensure a perfect match between employee and his/her competency.

Master data customer defines each of the customer type's profile and also their personal achievement.

Master data resource defines and manages all resources needed for product delivery fulfillment and also to assure that its utilization is in optimum level.

Master data product defines all services that can be offered to every customer based on their profile (needs, passion, talents, and competency).

Transactional sales manages all purchase in every product or services for every customer based on their profile (needs, passion, talents, and competency) and to assure that each of the purchase will be delivered in timely manner.

Transactional delivery manages all resources needed for product delivery fulfillment and also to assure that its utilization is in optimum level.

Transactional quality assessment manages all resources to assure that they provide the best possible services.

Transactional financial assessment manages all financial perspective, from rating and discounting, billing, invoicing, collection, to general ledger.

Transactional Project Management Office manages all supply chain management, from user proposal to supply delivery.

All of these functionalities will be combined and named as Gamelan, a pentatonic traditional musical tool.

C. *Information Technology (IT) Governance*

In several years many academic institution has manage to accommodate IT Governance in their curriculum, including: IT Audit System, IT Risk Management, etc. In this system, we establish several key points to accommodate IT Governance:

1. Password Management

2. RACI matrix (Responsible, Accountable, Consulted, Informed)

3. Audit trail

4. Data Integrity through Approval System for data with high importance

Password Management defines password restriction, password expiration, and password confidentiality.

RACI matrix accommodates Segregation of Duties to ensure data integrity.

Audit trail defines each of logging method to ensure audit process.

Approval System ensures data integrity where there will be a need for configurable approver for high risk data. Data classification is split into 3 levels:

1. High: data can only be CRUD-ed by Data Owner and must be validated through approval mechanism by the authority

2. Medium: data can only be CRUD-ed by Data Owner

3. Low: data can be Read by all

Where CRUD stands for: Create, Read, Update, Delete.

III. Implementation

The first and intriguing step of implementation phase is to choose the correct framework which will be used to build the system. And when we talk about framework, it is not just a library functions, but a framework where the developer will only care about the functionality, not the user interface. Then we decide to build our own framework, which can accommodate several key points of IT Governance and also provide ease and fast solution delivery.

This core framework has already made available at Google Code [3] with GNU GPL v3 since July 2013. The design of the framework is by separating each module by folders:

1. API, application module for integration purposes, such as looking up master data by consumer applications
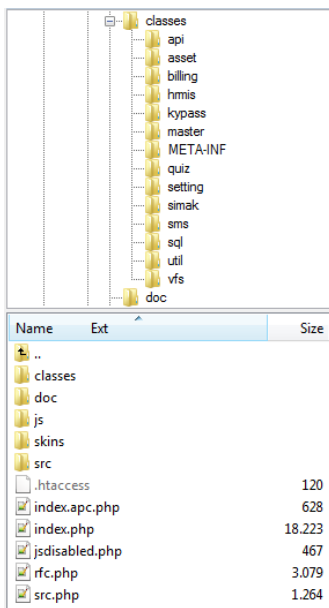
2. Asset, application module for asset management

3. Billing, application module for billing calculation and payment collection

4. HRMIS (Human Resource Management Information System, application module for managing human resource competency

5. KYPASS (Keep Your Password Safe and Secure), application module for managing password

6. Master, application module to manage master data

Figure 3: Core Framework Design

7. Quiz, application module to manage online questionnaire

8. SIMAK, application module to manage academic operational

9. SMS, application module to manage broadcast message to a specific group

The core framework itself only consists of 1 file, which is "index.php", with the help of 2 folders, "js" and "skins". The "index.php" will interpret the parameter given through php.mod_rewrite and dispatch them to the designated class.

Each module has its own Home which can be used to show the user's dashboard using graph or tables for every module where the user has the privilege to access.
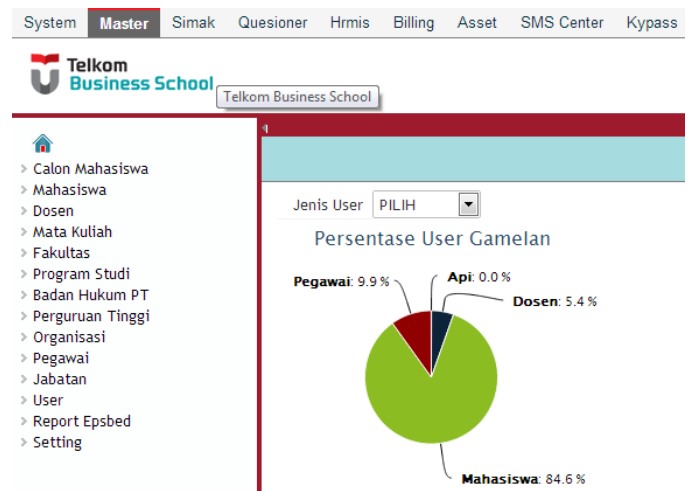

Figure 4: Module encapsulation

Every folder (module) has its own configuration, so it is possible to establish load balancing to distribute load especially by distributing the database into several machines. This is also ensuring the system integrity since there are no shared library between modules and no integration except through API (Application Programming Interface).

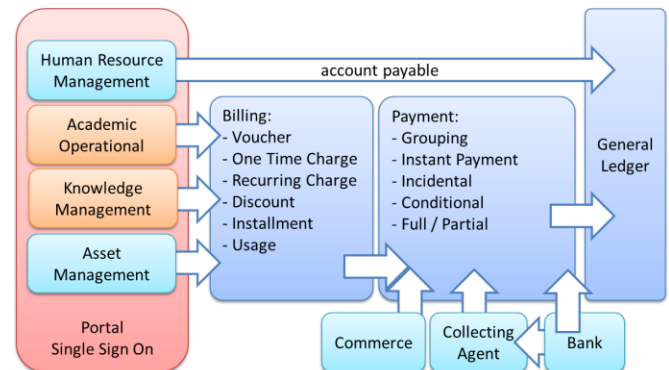Module works with each other through specific scenario:

Figure 5: Modules interworking

1. All frontend applications (academic operational, knowledge management, asset management) can generate transaction to billing module

2. Billing will pre-process the transaction to become invoice which will be sent to payment collection, where the customer will be able to make a payment through a preferable payment method

3. All payment (account receivable) will be collected with account payable to be sent to General Ledger

RACI is implemented using this scenario:

Table 1: RACI implementation

		User A	User B
Group Class 1	Menu 1	authorized without parameter	authorized with parameter
	Menu 2		
	Menu 3		
Group Class 2	Menu 1	not authorized	authorized with parameter
	Menu 4		

A. *Master Data*

Master data contain all basic, important and shared data between all functionality in Gamelan to ensure data integrity for reporting purposes. Master data, through authentication and authorization, will provide all information contained to every system that needs the information for their transactions.

Figure 6: Master data concept

Master data contain information:

1. Customer, including students (candidate, active, and alumni), lecturer, supporting staff, industry, parents, community

2. Product, including course (regular, special, bundling) and service

3. Organization, including organization structure, job identification (with its job description and job specification, respectively), and the employee in charge

4. User, including password management and role assignment (RACI matrix)

B. *Academic Operational*

Academic operational is the heart of this system, and the most challenging part is how to create a system that must be applicable to most business process in any academic institution. This problem is solved in this system by using parameterized configuration on all business process, for example:

1. Grading system, to accommodate a different style of grades, for example: A B C or A B+ B B- C+ C

2. Term system, to accommodate a different style of term, for example: semester, quarterly, or modular

3. Registration process sequence, to accommodate a different style of registration sequence, for example: pay first then start to choose course or choose course first then pay

4. Registration schedule, to accommodate a different style of registration schedule, for example: students of 2011 is scheduled right after the students of 2012

Figure 7: Parameterized configuration to support flexibility

5. Course fee, to accommodate a different style of course fee, for example: fee for a course has a different price if the course has been taken more than one

6. Course registration rule, to accommodate a different rule of course registration, for example: student already taken a specific course and drop it, is not allowed to retaken the course again in the same term

7. Legal Letter, to accommodate a different style of legal letter, for example: academic transcript

8. Student activity, to accommodate a different rule of soft skill measurement

C. *Billing – Collection*

Billing accepts any transaction from front end (sales) application using API that accepts 5 parameters:

1. Product ID, define what is the product to be charged (and also define which front end sent the transaction)

2. Customer ID, define who will be charged for using the product

3. Tariff, define the legal tariff for the product

4. Discount, define the discount given by any authority in front end application

5. Price, define the real charge for the customer, calculated by front end application from "Tariff – Discount" for integrity check purposes

Based on the given transaction, billing has the ability to calculate some common features to produce invoice:

1. Transaction Group, to accommodate grouping several transactions charged to 1 customer

2. Voucher, to accommodate a one-time voucher to deduct the price for a specific purpose given by designated authority

3. Discount, to accommodate a regular discount given with a specific reason based on specific rule

4. Installment, to accommodate an installment by-request to help students with limited financial

5. Rating, to accommodate pricing calculation from a source that cannot provide tariff and price

Billing gives the invoice to Payment Collection that has the ability to:

1. Invoice Group, to accommodate grouping several invoice under the same bill-to party

2. Instant Payment, to accommodate invoice creation with non-registered customer, along with Payment Code Generator, to accommodate a direct interaction with this type of customer

Payment can be done using commerce portal, bank (teller, ATM, e-banking), or collecting agent. When the customer paid, the status can be flagged to be "PAID", which can be invoke by front end application through API. All of these payments will be delivered as Account Receivable to General Ledger.

D. Human Resource Management

The main purpose of Human Resource Management is to put people on the right place. To achieve this purpose, several functions must be included in HRMIS:

1. Recruitment Management, to accommodate applicant tracking

2. Competency Management, to accommodate inventory and measurement (assessment) of skill (competency) for each individual employee and student, and in turn create training need analysis and career plan

3. Employee Service, to accommodate operational services for the employee, such as leave, attendance, business trip, and payroll

4. Performance Management, to accommodate performance assignment and achievement measurement for every units

Especially for payroll services, it will be delivered as Account Payable to General Ledger.

E. Asset Management

The main purpose of Asset Management is to ensure that all infrastructures are in need-by-service based and in working conditions. To achieve this purpose, several functions must be included in Asset Management:

1. Inventory, to store information for all infrastructures for future references and value analysis

2. Project Management Office, to accommodate project owner interaction to submit and monitor the process

3. Partnership, to store partner information involved in project management office

IV. Conclusion

A developing country such as Indonesia needs a hard and solid basic platform, especially in education. With 17.497.413 active students, all academic institution needs to focus on the process to ensure excellent output. So it is time for the government or other party to provide the infrastructure to support the process, including an excellent and flexible information system.

Gamelan is proposed to meet the requirements of many working business processes in many academic institutions, by using parameterized configuration to ensure flexibility. In the hope that most academic institution will gain benefits from the best practice business process.

Acknowledgment

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