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Management Report for Marketing in Higher Education Based On Data Warehouse and Data Mining

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Abstract

Elements of globalization in the world of education has expanded and developed, and made an Higher Education institutions market has been developed as a global phenomenon, so that Higher Education institutions aware to show their existence in global and high competition. The objective of this study was to apply data warehouse and data mining techniques that can be used by universities to obtain relevant information about their current condition, and to track the institution's development, which is required by the management to monitor organization performance in marketing area, and to support information in decision making process. The research method began with the collection of data and information, analyzes the current condition in marketing area, design the data warehouse model and mining the data. The obtained results were the data warehouse model and evaluation model using data mining technique to support the management in marketing decision-making process.

Keywords*: data warehouse, data mining, marketing, higher education institution*

1. Introduction

In recent years, there has been a paradigm shift in the governance of education systems around the world, the new marketing policies and market type mechanisms have been introduced in several countries, previously characterized by high levels of government control [10]. In most countries, the existing marketing education process has been viewed as a "compromise between academic autonomy, privatization, and state control" [14]. Issues and implications of the global marketing education and privatization of education have also been discussed in a number of key issues, and there are increasing competitions between national and international institutions [4].

Current research on customer's behavior and student's choice in the education market, although not widespread, but have been stimulating the needs of institutions to anticipate long-term implications and to understand the key factors involved in the student's choices [5]. Efforts made by governments to improve the quality of education through the encouragement of market forces are based on the assumption that the student or prospective student as an informed consumer can make rational choices in selecting educational institutions [2]. Data mining techniques capabilities provided effective improving tools for predicting student performance. It showed how useful data warehouse and data mining can be used in the higher education institution to predict the final performance of student.

Problems that often occur are that the educational institutions are less sensitive. They also less focus on what the driving factor in determining the customer's choices, but more focus to attract customers to the institution themselves. Increasing the marketing budget is not automatically increase the communication, distribution and service channels to support marketing to improve the image of the institution, target sales and market volume [11]. Furthermore, it does not ensure the effectiveness of marketing implementation to customers and institutions if done in the inappropriate time, place and media. With high

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demands, the marketing department should also be responsible not only to conduct effective operational activities, but also to establish efficient ones, in which both could become the indicator of productivity in successful marketing process [12]. When marketing itself, an educational institution would be very concerned with the process in the decision making taken by the management and the information sought by the students as potential customers [7]. The decision taken by the management is not solely the result of personal creativity, but also needs to be built based on the insight of data around them. Institutions need to know the comprehensive data, current information about trends, as well as micro-macro-trends that exist within the institution [11]. From marketing initiatives there is so much valuable information that can be analyzed to develop a marketing strategy.

Nowadays, higher learning institutions encounter many problems which keep them away from achieving their quality objectives. Some of these problems stem from knowledge gap. Knowledge gap is the lack of significant knowledge at the educational main processes such as counseling, planning, registration, evaluation and marketing [3]. The objective of this study was to apply data warehouse and data mining techniques that can be used by universities to obtain relevant information about their current condition, and to track the institution's development, which is required by the management to monitor organization performance in marketing area, and to support information in decision making process. [15].

Data warehouse is a collection of integrated databases and subject-oriented and designed to support the decision-making function, where each unit of data is relevant to the events at any given time [9]. The ability of a data warehouse that can support the following actions: Running business data: data is produced by enterprise applications; Integrate business data: to improve and synchronize two or more enterprise applications, even those that do not designed to work alongside each other; and Monitor business data: determine the relationship between data, deliver it to end users as reporting tools and support decision making process [6].

Data mining can be viewed as a result of the natural evolution of information technology. The database and data management industry evolved in the development of several critical functionalities: data collection and database creation, data management (including data storage and retrieval and database transaction processing), and advanced data analysis (involving data warehousing and data mining) [8]. Data mining (knowledge discovery from data) is extraction of interesting (non-trivial, implicit, previously unknown and potentially useful) patterns or knowledge from huge amount of data. Data mining techniques are analytical tools that can be used to extract meaningful knowledge from large data sets [8].

Data mining is the process of automatically extracting useful information and relationships from immense quantities of data [13]. In its purest form, data mining doesn't involve looking for specific information. Rather than starting from a question or a hypothesis, data mining simply finds patterns that are already present in the data. Education data mining as an emerging discipline, concerned with developing methods for exploring the unique types of data that come from educational settings, and using those methods to understand student's profile, and to set their study needs. [1].

2. Research Method

The research plan runs through the following stages:

1. Analyze the business needs and the development of data warehouse model and data mining. Preparation for the model design begins with a descriptive research, to create a systematic and accurate description based on the data and information of the evaluation results, and then analyze them for the development of data warehouse model and data mining.

2. Data warehouse Model design and construction for Higher Education institution in marketing area. Development of data analysis is in the form of data warehouse model design.
3. Mining the data using data mining technique.
4. Analyze the mining result

3. Result and Analysis

Currently private universities in Indonesia are rising rapidly, and now reaching 3017 institutions; they are Academies, Institutes and University (Jakarta, Kompas, Wednesday, April 21st, 2010). There are 325 private universities in Jabodetabek - Jakarta, Bogor, Depok, Tangerang, Bekasi area (http://www.kopertis3.or.id/html/2010/09/jumlah-perguruan-tinggi-swasta-menurut-wilayah/). These conditions force private universities to compete each other to get students.

Tight competition forces the universities to have smart actions aimed to get new students. Therefore, Analytical system in marketing department can be used by universities to obtain valuable information and to support strategic decision making process.

Marketing in higher education perform several activities as follow:

a. Promotion Activities
b. Registration
c. Entrance examination
d. Re-registration
e. Payment

Marketing strategy must be aligned with the Higher Education's strategy, and marketing strategy itself is based on the important decisions that must be made based on in-depth analysis that is supported by high quality information. To support high quality information that related to marketing strategy, we need to align marketing objectives and performance indicators with data warehouse and data mining design, and the steps were: (1) Identify main marketing process, analysis needs and each data source, (2) Identify performance indicator for each main marketing activities, (3) Designing the data warehouse and data mining.

This research identified main processes on marketing department in Higher Education and their information as an indicator for each process. (1) Marketing-management process, this process analyzes information related to customer profitability, market profitability, product profitability, channel profitability, competitor tracking, budget effectively and market share. (2) Creating-profits process, this process analyzes information related to marketing effectiveness and efficiency. (3) Operational process, this process analyzes information related to customer satisfaction, response time and registration snapshot (sales). Marketing strategy supported by data as well. One of the important requirements in analysis process is a high quality data. A high quality data related to how to collect appropriate data and how to process them to produce valuable information. This research identified data sources for each main marketing process at Higher education marketing department. Table 1 shows all main marketing processes and data sources respectively.

Table 1. Data Source for Each Main Marketing Process at Higher education Marketing Department

Main Marketing Process	Analysis Needs	Data Source
Marketing-management process	Customer profitability	Internal data • Prospective and registered students
	Market Profitability	Internal data • Type of marketing activity data (for each period) • List of participants for each marketing activity (for each period) • List of students (completed all registration process) (for each period)
	Product Profitability	Internal data • List of new students for each department (for each period) External data • List of higher education organizations in Indonesia and their number of students respectively • List of industry demand related to higher education graduate • List of favorite department
	Channel Profitability	Internal Data • School of origin • Marketing channel activity • Marketing activity (on each period) • List of participant from each marketing activities (on each period) • List of student profile (on each period)
	Competitor Tracking	External Data • Competitor profile • Competitors achievement related to their promotion activities • Comparison cost of study from competitor on each department and period • Number of students from competitor on each department and period
	Budget Effectively	Internal Data • Marketing activities and cost respectively • Cost engagement from each marketing activities • External grant for each marketing activities • Total income (from all new students who completed their registration and payment)

Main Marketing Process	Analysis Needs	Data Source
	Market Share	External Data • List of Higher educations in Jabodetabek - Jakarta, Bogor, Depok, Tangerang, Bekasi area and number of active student respectively
Creating-profits process	Marketing effectiveness and efficiency	Internal Data • List of marketing type on each period • List of marketing type and person in charge (PIC) respectively • List of marketing activity and media respectively • Number of applicant on each marketing activity and target of sold respectively • List of marketing media and type of promotion on each marketing activity
Operational process	Customer Satisfaction	Internal Data • Internal and external questionnaire result on each marketing activity • Customer response on Customer service online website
	Response Time	Internal Data • Average time of exam result published • Accuracy of time for scholarship students approval • Response time to deal with each customer complaint appropriately • List of customer complaint that was executed
	Registration Snapshot (Sales)	Internal Data • Profile of registered students • Number of students on entrance exam • Number of scholarship students • Cost of scholarship program • List of entrance exam on each period, batch and department • Payment status, payment method and total amount of payment for each registered student • Number and variation of student who passes the registration process

The Second step was identifying performance indicator for each main marketing activities. Table 2 shows all marketing activities and performance indicator respectively.

Table 2. Marketing Activities and Successful Indicators

Marketing Activities	Successful indicators
Promotion Activities	Number of participants and number of forms sold in marketing events
Registration	Number of forms sold in direct or indirect registration process, Number of form returned by prospective students
Entrance examination	Number of students who take the entrance exam and the exam result
Re-registration	Number of prospective students who passed the entrance exam and take re-register process
Payment	Number of students who take re-registration and payment process

The Third step was designing the data warehouse and data mining. Designing the data warehouse consists of the following steps:

First: Identifying and Conforming the Facts

A fact table stores quantitative information for analysis. Table 3 shows all fact tables.

Table 3. Fact Tables

Fact Name	Description
MarketingActivityFact	To see the marketing activities and its attributes, cost, number of participants who attended the activities and number of sold forms of each activity
RegistrationFact	To see the demographic data of the registered prospective students of each period
EntranceExamFact	The number of prospective students who have been taking the entrance test include the test result and its grade.
Re-registrationFact	To see the comparison of prospective students who have been complete re-registration process, that viewed from each department and payment status, prospective students in registration category, and pass the entrance test to re-registration process.
ScholarshipFact	To see the number of students that applying scholarship program and its fee.
CompetitorProgramFact	To see the programs and their benefits that offered by the competitors
CompetitorProfileFact	To determine the potential competitor from various regions, and knowing their capacity.

Second: Identifying and Conforming the Dimensions

A dimension is a collection of reference information about a measurable event. These events are known as facts and are stored in a fact table. Table 4 contains dimension tables that designed from the user's perspective that required in data analyzing process

Table 4. Dimension Tables

Dimension Name	Description
BatchDimension	The table contains the batch of registration (in number)
GradeDimension	This table shows the test results (grade form) of the prospective students
TypeOfScolarshipDimension	The table contains the types of scholarships that offered include the description and its benefits as an investment or cost of higher education
TypeOfActivityDimension	The table records the types of marketing activities such as expo, exhibition, seminar, school visitation and other activities
DepartmentDimension	The table contains the department in the higher education
CityDimension	The table indicates the city and can be correlated with school data, and other activities
PeriodDimension	The table contains marketing year, usually associated with the academic year
PromotionProgramDimension	The table records promotion program conducted by internal and competitor, in order to make a comparison
ProvinceDimension	The table indicates the city. Such can be correlated with school, promotion activities, and other data
SchoolOfOriginDimension	The table indicates the school of origin of prospective students who has participated in marketing events
SemesterDimension	The table is useful to provide report in range semester
UniversityDimension	The table provides a competitor's profile
TimeDimension	The table contains the time divided by year, month and day.

Third: Designing a Star Schema

A star schema is diagramed by surrounding each fact with its associated dimensions. Table 5 shows all star schema mapping that will be used based on the analysis purpose.

Table 5. Star Scheme Mapping

Marketing Area	Star Scheme
Customer Profitability	CustomerProfitability star scheme
Market Profitability	MarketProfitability star scheme
Product Profitability	ProductProfitability star scheme
Channel Profitability	ChannelProfitability star scheme
Competitor Tracking	CompetitorProfile star scheme CompetitorTracking star scheme
Budget Effectively	MarketingCost star scheme
Market Share	MarketShare star scheme
The effectiveness and efficiency of marketing activities	MarketingActivity star scheme
Customer Satisfaction	CustomerSatisfaction star scheme

Response Time	TimeDelivery star scheme
Registration Snapshot (Sales)	Registration star scheme

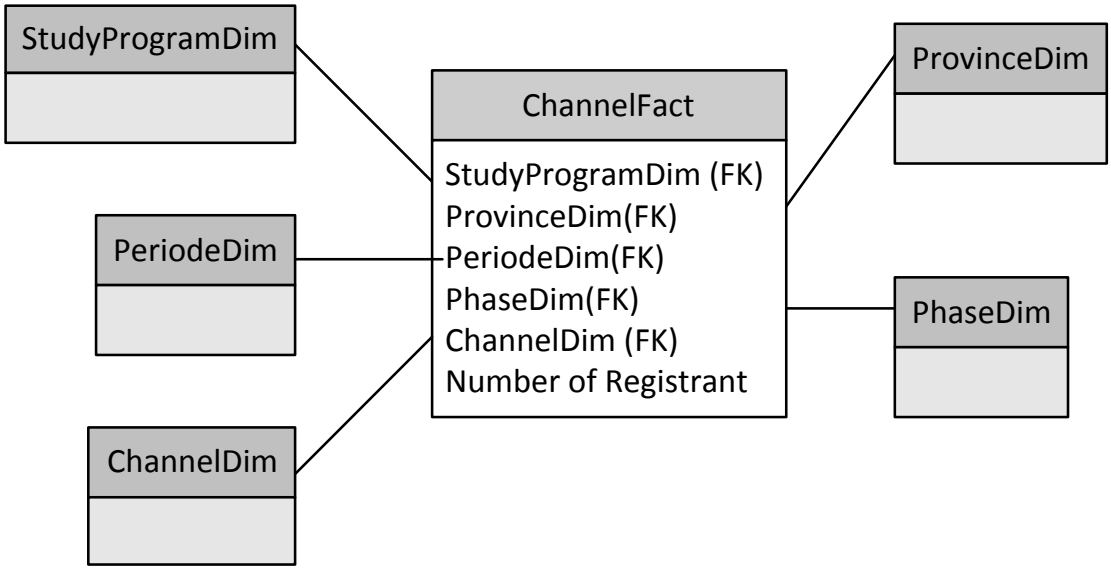

Figure 1. Starscheme for Channel Fact Table

Fourth: Designing Online Analytical Processing (OLAP)

OLAP (online analytical processing) is computer processing that enables a user to extract and view data from different points of view. Table 6 and table 7 show OLAP design for all marketing activities.

Table 6. OLAP Design (1)

Table	OLAP Customer Profitability	OLAP Market Profitability	OLAP Product Profitability	OLAP Channel Profitability	OLAP Competitor Profile	OLAP Competitor Tracking
BatchDimension	v	v	v	v	v	v
GradeDimension						
TypeOfScolarshipDimension						v
TypeOfActivityDimension				v		
DepartmentDimension	v	v	v	v	v	v
CityDimension	v	v	v	v	v	v
PeriodDimension	v	v	v	v	v	v
PromotionProgramDimension						v
ProvinceDimension	v	v	v	v	v	v
SchoolOfOriginDimension						
SemesterDimension	v	v	v		v	v
UniversityDimension	v	v	v		v	v
TimeDimension	v	v	v	v	v	v
ScholarshipFact						
ChannelFact				v		
CustomerSurveyFact			v			
IndustryNeedsFact				v		
MarketingActivityFact				v		
CompetitorFact			v		v	
MarketShareFact		v	v			
RegistrationFact	v	v				
Re-registrationFact	v	v	v			

CompetitorProgramFact						v
TimeDeliveryFact						
EntranceExamFact						

Tabel 7. OLAP Design (2)

Table	OLAP Market Share	OLAP Marketing Activity	OLAP Marketing Activity Cost	OLAP Customer Satisfaction	OLAP Time Delivery	OLAP Registration Snapshot
BatchDimension		v	v	v	v	v
GradeDimension						v
TypeOfScolarshipDimension			v			
TypeOfActivityDimension		v	v			v
DepartmentDimension	v		v			v
CityDimension	v	v	v			v
PeriodDimension	v	v	v	v	v	v
PromotionProgramDimension						
ProvinceDimension	v	v	v			v
SchoolOfOriginDimension		v				v
SemesterDimension			v			v
UniversityDimension	v		v			
TimeDimension	v	v	v	v	v	v
ScholarshipFact			v			
ChannelFact						
CustomerSurveyFact				v		
IndustryNeedsFact						
MarketingActivityFact		v	v			
CompetitorFact						
MarketShareFact	v					
RegistrationFact						v
Re-registrationFact						v
CompetitorProgramFact						
TimeDeliveryFact					v	
EntranceExamFact						v

Designing the Screen View for Information Needs

Data warehouse screen view shown in a dashboard. Dashboard is a data visualization tool that displays the current status of metrics and key performance indicators (KPIs) for an enterprise.

Screen Dashboard for Marketing Channel

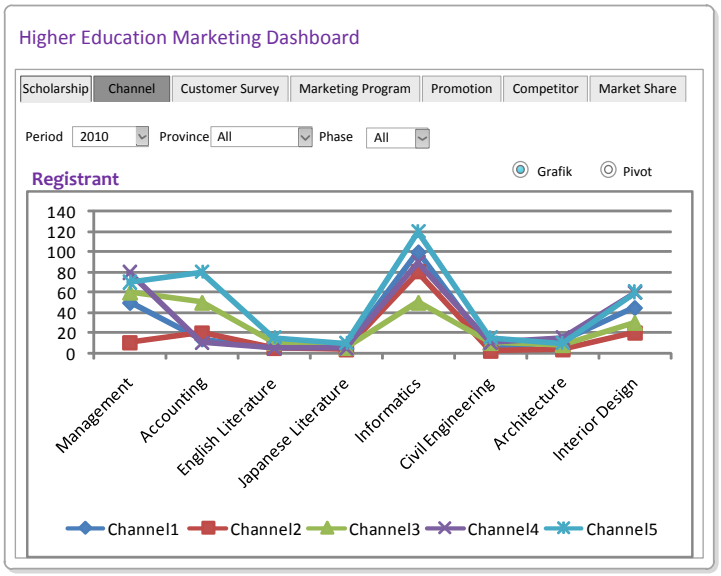

Figure 2. Screen Dashboard for Marketing Channel

Figure 2 shows the numbers of students that could be achieved by each marketing channel activity on each department, period, province and phase.

Screen Dashboard for Customer Survey

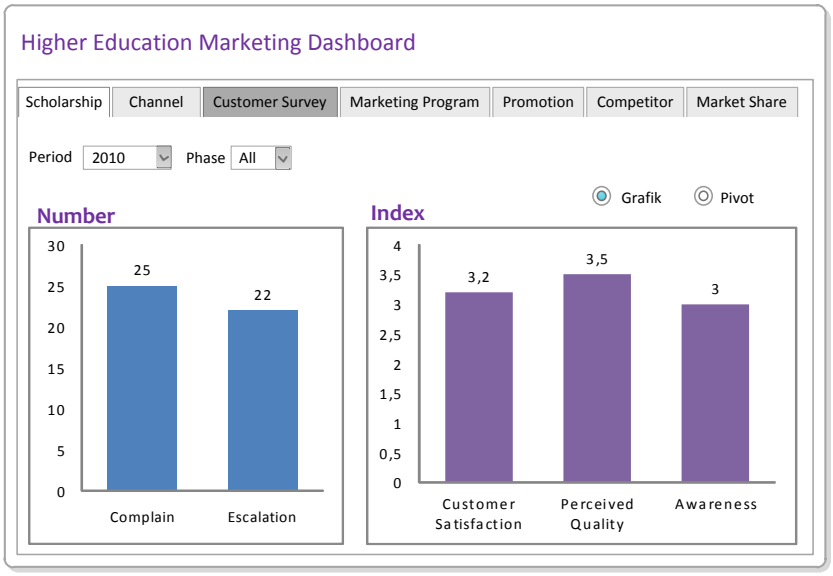

Figure 3. Screen dashboard for customer survey

Figure 3 shows the customer satisfactions and complaints for marketing activities on each period and phase.

Screen Dashboard for Marketing Program

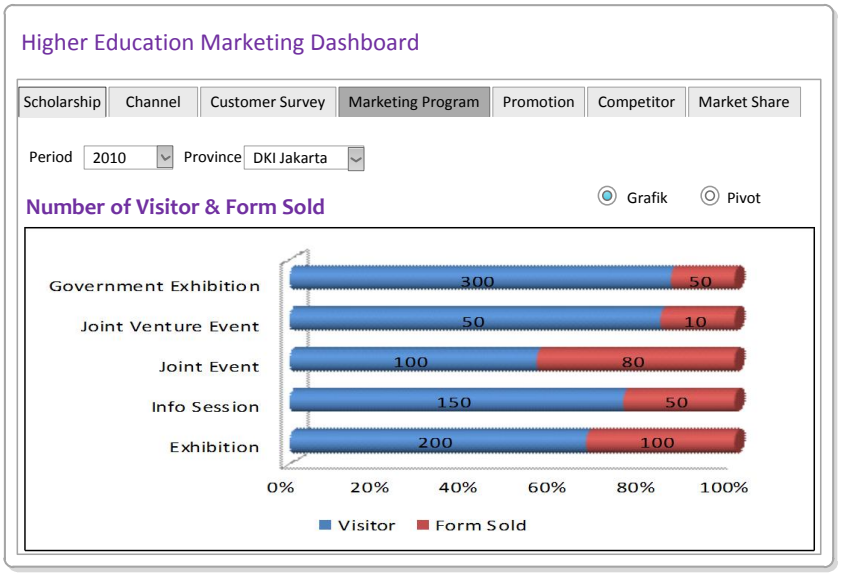

Figure 4. Screen Dashboard for Marketing Program

Figure 4 shows the number of visitors and the number of forms sold for marketing programs on each period and province.

4. Conclusion

High competition requires the university to act quickly and smart to get new students. Looking at high level of competition, diversity of data and demands to win the competition, university need to use data model and analytical tool to obtain valuable information for strategic decision support in higher education to face the competition. There are many steps which can be used to ensure the development of data warehouse and data mining for higher education institutions in marketing area.

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