

# Customer and Stakeholder Perspective using Analytical Hierarchy Process Method for Evaluation Performance of Higher Education

Satria Abadi\*<sup>1</sup>, Setyawan Widarto<sup>2</sup>, Nur Syufizah Ahmad Shukor<sup>3</sup>

<sup>1</sup>*Department of Information System, Sekolah Tinggi Manajemen Informatika dan Komputer (STMIK) Pringsewu, Wismarini Lampung-Indonesia*

\*<sup>1</sup>*satria2601@gmail.com*

<sup>2,3</sup>*Department of Computing, Faculty of Communication, Visual Art and Computing (FCVAC) Universiti Selangor, Selangor - Malaysia*

<sup>2</sup>*swidarto@unise.edu.my*

<sup>3</sup>*nur\_syufiza@unise.edu.my*

**Abstract**— The measurement of the higher education performance is a complex issue and becoming increasingly important. Currently, performance measurements have been changed. It is no longer evaluated from the classical financial indicators. Instead, the customer satisfaction has been proposed as the basis for a ‘management strategic’ within organizational. This paper presents performance measurement at the higher education concerning in customers and stakeholders’ perspective using the Analytic Hierarchy Process (AHP) method. AHP is a quantitative method which can deal with complicated decision-making problem for evaluation. Total of four main criteria and 26 sub-criteria were identified as significant to the customers and stakeholders’ perspective. This empirically finding is suggested to be a good performance measurement for solving the problem multi criteria and contributes strategic goal in higher education.

**Keywords**— *Analytic Hierarchy Process (AHP), Performance Measurement, Customer and Stakeholders Perspective*

## 1. Introduction

In order to increase its competitiveness in providing quality services, it is necessary for higher education service provider to have regular self-assessment. With rapid development in the education sector today, it is crucial for the education service provider to assess its achievement not only on the financial aspects but also on the non-financial aspects. By assessing both the financial and non-financial aspects, it helps to identify the strengths and weaknesses of the higher education provider in achieving its objectives and strategies. In addition, this assessment become one of the most important parameters in macro management. However, it is not easy to choose the

effective methods and techniques, as opined that stated it is important as well as very challenging to choose effective methods and techniques[1].

Some previous research indicated that higher education service provider focused on some strategic educational services and not to provide many low quality services [2]. It is important for higher education service provider, especially in private university to increase customers and stakeholders’ satisfaction by looking into important elements that contributing towards increasing customers and stakeholders’ satisfaction. This study provides evidence that the customers and stake-holders satisfaction is an important element for self-assessment criteria for higher education service provider to provide better quality services[3].

Another study on private higher education, indicated that customers and stakehold-ers will be satisfied if their wishes, expectations and needs are met[4],[5]. A service is considered satisfactory when it meets the needs and expectations of its customers and stakeholders. Their study also stated that customers and shareholders' perspectives is the main objective for the private higher education. In another study by two different researchers [6], [7], pointed that customers and stakeholders perspective is the main assessment criteria that contribute to the successful management of higher education or universities Other researchers such as [8]-[11], shared the same view on the importance of customers and shareholders' perspectives in making the manage-ment of higher education a success.

However, in some higher education service provider the customers and shareholders' perspectives are not seriously considered as part of

their assessment measurement criteria [12]. This happens because the concept of measurements that have been designed in such a way that it cannot be fully applied due to the complexity factor of measurement, and different emphasis of measurement criteria for each university. The criteria and the designated indicators are still complex and still do not reflect measurement of higher education that can be used by decision makers and stakeholders as a parameter of university achievement.

Analytic Hierarchy Process (AHP) method since it was introduced by Saaty in 1971, has become one of the most widely used methods in Multiple-Criteria Decision-Making. [13] stated that AHP is usually used for the purpose of setting priorities of various options or options available and the choice is complex or multi-criteria. Furthermore, Saaty (2001) also explained that (AHP) provides a framework that enables effective decision-making on complicated issues by facilitating and expediting the decision support process. Basically, AHP is a method in formulating complex conditions, which are structured into one component. This means that by using AHP approach we can solve the problem in making a decision, especially if the decision is subjective [14].

The contribution of this paper rests on the attempt to address the thorny issue the performance measurement in private higher education in Indonesia. These measurements which stressing on customer and stakeholders perspectives. Therefore, the main purpose of this study is to determine the performance measurement of the higher learning from the perspective of customers and stakeholders using the AHP method. Because the AHP method is an effective tool in structuring or compiling and modeling multi criteria issues [15]. In other words, is also the important things are with AHP's method try to quantify human judgment and ignore other approaches. Using the paired comparisons that exist in the AHP method will calculate the tendency between criteria based primarily on some data and subjective considerations from the senior management level, so the outcome is based on decision-making considerations.

## 2. Literature

### 2.1 Analytical Hierarchy Process (AHP)

AHP is an analytical tool that can be used to make decisions on conditions with complex factors,

especially if the decision is very subjective [16]. AHP can simplify complex, unstructured, structured, and dynamic problems into its parts, structured in the form of hierarchy. The preparation of this hierarchy is the most important rank in applying AHP as a model of the desired problem solved. In compiling this hierarchy requires creative thinking, gathering of informations, connection grafting, remembrance process, parent's perspective as well as development. In practice, there is no standard procedure for forming objectives, criteria and other elements in the hierarchy. Suspensions of the hierarchy are multiliner and compose from top to bottom the most common and least controllable factors to the most general and least controllable factors to concrete and controllable factors [17]. The advantages of AHP method is as follows

- 1) The hierarchical structure, as a result of the selected criteria to the deepest sub-criterion.
- 2) Taking into account the validity that has the tolerance of the inconsistency of the various criteria and alternatives chosen by the decision maker
- 3) Taking guess of resistance barriers or sensitivity analysis outcomes make decisions. [18]

### 2.2 Balanced Scorecard

*Balanced ScoreCard (BSC)* was originally developed by Robert Kaplan and David Norton at Harvard Business School in 1992, a popular and useful method of identifying business performance using lagging and leading indicators based on the foundations of the organization's vision and strategy. The initial flaws are that they identify that many organizations have a tendency or tendency to manage their business based solely on financial measurements while in reality they have a good performance at first. For this reason, today's business significant requires a large and comprehensive measurement for the future successful measurement of business firms [19]. BSC is used as a tool to measure the performance of both public and private organizations to achieve business goals and strategies. [20] define Balanced Scorecard:

*... "a set of measures that gives top managers a fast but comprehensive view of the business...include financial measures that tell result of action already taken...complements the financial measures with operational measures on customer satisfaction, internal processes, and the organization's innovation and improvement activities-operational measures that are drivers of future financial performance".*

This definition provides an understanding that Balances Scorecard is a management system that

includes measurement and control to describe the organization of 4 perspectives namely, financial, customer, internal processes and growth and learning. These four perspectives have relationship and causality. That is, the financial perspective is considered to have a result that moves the other three operational indicators. Study to understand the BSC's terms on Higher Education performance, the following definitions of BSC and Higher Education [21]:

1. Balance Scorecard refers to the performance tool developed by Kaplan and Norton in 1992

2. Higher Education Organization refers to public and private 2-year nonprofit organizations for high schools and public and private non-profit organizations 4 years of universiti.

fundamentally developed a Scorecard consisting of 4 main perspective elements [22], namely:

1) Customer Perspective: This element measures customer satisfaction (customer) as requirements that must be fulfilled

2) Internal Business Process Perspective:

This perspective is used to measure the required process and is important for the customer

3) Financial Perspective:

This element is used to measure financial and performance tracks that excel in organizational finance

4) Learning and Growth Perspective:

This perspective will focus on how organizations provide training and education to their employers, acquire and capture the knowledge they gain, and how organizations use it to maintain competitive power into the marketplace.

### 3. Research Method

Research done by using quantitative method by spreading 2 different questionnaires to respondents in two phases. To ensure continuity of the research direction kpd respondent seperti di senarai di Table 1

**Table 1.** List of The Respondent

No	Position	Years Of Service
1	Rector	>= 10 year
2	Vice Rector	>= 10 year
3	Dean	>= 10 year
4	Vice Dean	>= 10 year
5	Head of The Program	>= 10 year

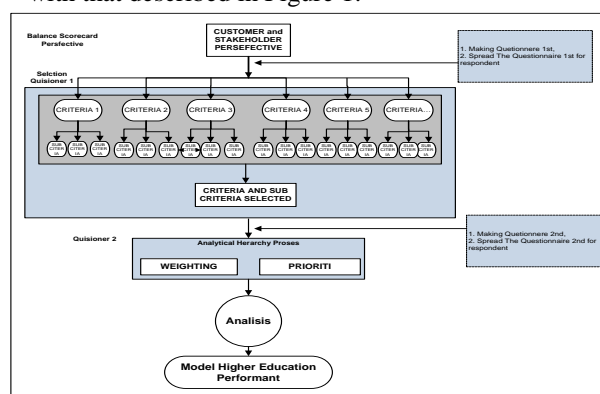
$$75\% \times (\sum \text{Respondent} \times \text{Maximum Score}) \quad (1)$$

phase 1 - search for criteria & sub-criteria by distributing questionnaire 1 to the respondent, after the questionnaire has been filled in, then the data quisioner will get the selected criteria.

Phase 2 - from quisioner 1, the criteria and sub-criteria are selected, then made the second questionnaire to be filled in by the same respondent, after quisioner 2 is filled in, then make weighting and quelling of the criteria and sub-criteria, from the results of the dispute get the criteria and sub-criteria that have the greatest weight, these criteria and sub-criteria will be the main criteria and sub-criteria for the Higher Education performance measurement model (PT).

From Figure 1 above explains that After the questionnaire is filled by the respondents the next step identifies the criteria and sub-criteria that have been selected. Selected criteria and sub-criteria are then selected by determining the value of each criterion and sub-criteria. If the minimum total score is reached then the criteria and sub-criteria are selected criteria and sub-criteria as indicators in the determination of performance.

This research design illustrates the incidence or phase of each step taken in research from the beginning to the completion stage. This research design is made to facilitate the completion of the stages that will be done in this study in accordance with that described in Figure 1.



**Figure 1.** Design Research

Selection of criteria and sub criteria by using formula [1]:

Fasa 2 – weight n priority calculation

Criteria and sub-criteria selected from this stage then made in the second stage of the questionnaires then distributed to the respondent, criteria and sub-criteria that have been in the content then will be calculated value to determine the value of matrix in pairs by using the formula:

$$R = [(1+R_1) (1+R_2) (1+R_3) \dots (1+R_n)]^{1/n} - 1 \quad (2)$$

Detail:

$R_1 \dots R_n$  = result of respondents 1 for respondent n

## 4. RESULTS AND ANALYSIS

Result and analysis data on Customer and Stakeholder perspective by using the AHP process for measuring the performance of universities is as follows

### 4.1. Criteria and Sub Criteria from Customer and Stakeholders Perspective

Criteria and sub criteria are used to measure college performance by using AHP, the criteria selected are called main criteria, main criteria and sub criteria are selected in the results of data processing from repondent, there are 4 (four) main criteria derived from the customers and stakeholders' perspective. In addition there are 26 sub criteria extracted from four main criteria. Each main criteria and sub criteria has different value of weight.

#### 4.1.1. Main Criteria

The main criteria are quality of graduate, quality of research, quality of academic services and quality of information system. Each of the main criteria has weighted accordingly namely 0.256, 0.190, 0.363, and 0.189 , as can be seen in Table 2:

**Table 2.** Main Criteria Customers and stakeholders' perspective

#### 4.1.2. Sub Criteria

##### 4.1.2.1. Sub Criteria Quality of Graduate

For the Quality of Graduate criteria, four sub criteria were selected, and each of the sub criteria has been assigned with their weight. The list are: graduation get a job one year has weight of 0.294, percentage of graduation student on time has weight of 0.307, have a career services and information vacancy for student and graduate is weighted 0.203, and the ratio of alumni response to tracer study five year has a weight of 0.196 as shown in Table 3:

**Table 3.** Sub criteria Quality of Graduate

No	Quality Of Graduates	weighted
1	Percentage of Graduation Get a Job One Year	0.294
2	Percentage of Graduation Student on Time	0.307
3	Have a career service and Information vacancy for Student and Graduate	0.203
4	The ratio of Alumni Respond to tracer study five year	0.196

##### 4.1.1.1. Sub Criteria Quality Of Research

Main criteria quality of research has ten sub criteria selected and each sub criteria has different weight. The sub criteria for number of publication of the international indexed reputable for the last three years is weighted 0.136; number of lectures and student in the form of patent is weighted 0.137; the number of publications of the national accredited the last three years is 0.114 the number of research grants external the past year is 0.088; the number of publications of the national not accredited the last three years has a weight of 0.100; number of publication of the international the last three years is 0.112; the number of research grant internal the past year is 0.087; the number of training methods to improve the quality of research is 0.065; have a complete management guidelines for CSR, developed and published by institutions that weight 0.075; and have a complete management guidelines for research, developed and published by institutions is weighted 0.086. The summary of the sub criteria and their weight is shown in Table 4.

No	Main Criteria	weighte d
1	Quality of Graduate	0.256
2	Quality of Research	0.190
3	Quality of Academic Services	0.363
4	Quality of Information System	0.189

**Table 4:** Sub criteria Quality of Research

N	Quality Of Research	Skor
1	Number Of Publication of The International indexed Reputable the Last three years	0.136
2	Number of lectures and student in the form of patent	0.137
3	Number Of Publication of The National Accredited the Last three years	0.114
4	Number of research grant External the past year	0.088
5	Number Of Publication of The National not Accredited the Last three years	0.100
6	Number Of Publication of The International the Last three years	0.112
7	Number of research grant internal the past yearr	0.087
8	Number of training methods to improve the quality of research	0.065
9	Have a Complete Management Guidelines for CSR, Developed and Published by Institutions	0.076
10	Have a Management Guidelines research Complate, Developed and Published by Institutions	0.086

4.1.2.2. Sub Criteria Quality Of Academic Services

Main criteria of quality of academic services have seven sub-criteria selected, each sub category has different weighted sub criteria The Ratio of Class Room / Student has weighted 0.168, Number of Business Service has weighted 0.108, The Satisfaction of student has weighted 0.203 , The Number of Activity for Community Services has a weighted 0.106, The Ratio of Laboratory / student has weighted 0.121, The Satisfaction of Lecture on Academic Services has weighted 0.185, The Ratio of Lecture room has weighted 0.108, as shown in Table 5:

Table 5: Sub criteria Quality of Academic Services

4.1.2.3. Sub Criteria Quality Of Information System

No	Quality Of Academic Services	weighted
1	The Rasion of Class Room/Student	0.168
2	Number of Bussines Servis	0.108
3	The Satisfaction of student	0.203
4	Number of Activity for Community Services	0.106
5	The Rasion of Laboratory / student	0.121
6	The Satisfaction of Lecture on Akademik Services	0.185
7	The Rasion of Lecture room	0.108

Main criteria of quality of academic services have five sub-criteria selected, from each sub criteria have different weighted sub-criteria Benefit

of Infomation System for Student and Faculty and access to resources mempunyai weighted 0.212, Have Information System very effective has weighted 0.301, Have Management Information System Infrastructure accurate and Transparant has weighted 0.129, Have a Quick Response in Handlers Information System has a weighted 0.202, The Security of Information System has a weighted 0.157, as shown in Table 6:

Table 6: Sub criteria Quality of Information system

NO	Quality Of Infomation System	Weighted
1	Benefit of Infomation System for Student and Faculty and access to resources	0.212
2	Have Information System very effective	0.301
3	Have Management Information System Infrastructure accurate and Transparant	0.129
4	Have a Quick Response in Handlers Information System	0.202
5	The Security of Information System	0.157

4.2 Prioriti And Consistency

4.2.1 Main Criteria

Criteria Quality of Academic Services has the highest weighted compared to the other three criteria indicates that this criteria is a top priority because Quality Academic Services as the basis of satisfaction from students and lecturers at universities result from this research is supported by Sudaryo.[23] which explains that the perspectives of the customer and shareholders are key to important information on private PT. The overall inconsistency level of the main criteria of the customer and stakeholders of this perspective is 0.00231, this result means that the value of this inconsistency is less than 0.10 so that the respondent's assessment of five subcriteria is consistent, this can be seen in Figure 2:

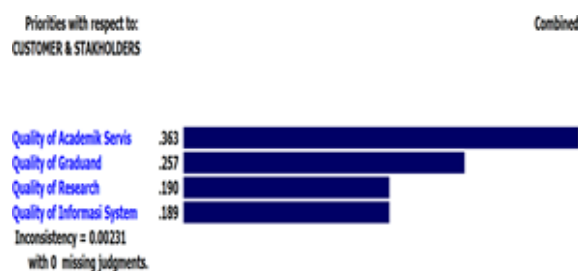


Figure 2. Main Criteria Customer and Stakeholders Persefective

### 4.2.2 Sub Criteria Quality of Academic Services

Criteria Quality of Academic Services has seven sub Criteria of the seven sub-criteria sub criteria of the satisfaction of students who have the highest weighted because these sub criteria assess how the services are in the College (PT) in the value of the student. This study is also supported by hidayati.et al [24] which explains that universities of educational institutions committed to producing quality education can measure their customer satisfaction levels in this regard from student ratings

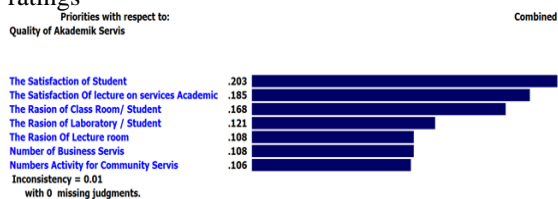


Fig.3: Sub Criteria Quality of Academic Services

### 4.2.3 Sub Criteria Quality of Graduate

Criteria Quality of Graduan has four sub Criteria from the four sub criteria. The sub criteria of the Percentage of graduation student on time which has the highest weighted since this sub criteria will assess the graduation rate of the student on time which is an important factor in determining the quality of the university (PT ) then high pergruan will mempnyuai commitment to improve the quality of learning that exist in college. This study is also supported by Salmu and Solichin [25] which explains that to improve graduates on time, colleges must improve the quality of learning in high-level learning.

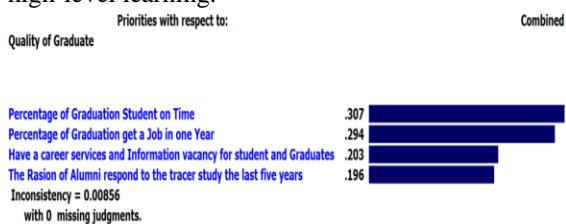


Fig.4: Sub Criteria Quality of Graduate

### 4.2.4 Sub Criteria Quality of Research

Criteria Quality of Research has ten sub criteria of the ten sub criteria Sub Criteria of the ten sub criteria Sub-criteria Number of lecture and student in the form of patent which has the highest weighted because sub patent criterion is the intellectual property right of someone who is important to increase the performance of college this matter in tunjang by research kumalasari [26]

which states that intellectual property rights (HKI) become very important, because the HKI is closely related to global trade at the international level.

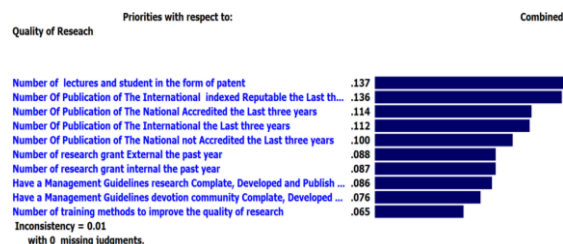


Fig.5: Sub Criteria Quality of Research

### 4.2.5 Sub Criteria Quality of Infromation System

Criteria Quality of Information System has five sub Criteria of the five sub criteria sub criteria have Information system very effective that has the highest weighted because sub criteria is assess how all activities in the college already using the information system ter integration so as to facilitate all users freely utilize information system effectively. This study is also supported by Aswati.et ,al [27] which explains that the utilization of efective information system in universities will be the determining factor of success and progress of the college.

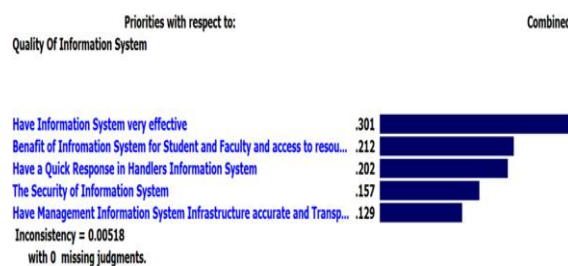


Fig.6: Sub Criteria Quality of Information System

From the results of this study can be analyzed that from customers and stakeholders' perspective in the four main criteria that become the measurement of college performance of the fourth the quality of academic services criteria are the most priority criteria and the last priority of this criterion is quality of information system, the four criteria are lower sub-criteria that become the measure of college performance and on the overall sub criteria that get from the criteria is diat-as amounted to twenty-six sub criteria and sub-criteria of the most priority of each criterion and level of inconsistency the main criteria and each sub criteria differ but not exceeding 0.1, can be seen in Fig.3,

Fig.4, Fig.5, Fig.6, from the criteria and sub criteria can be made Model of college measurement by using model criteria and sub criteria from customers and stakeholders perspective as shown in Fig.7.



Fig.7: Model Kriteria Dan Sub Kriteria Persepektive Customer And Stakeholder

There are 4 main criteria from the perspective of jd measurement for IPT, the main academic quality plg, the last IS, There are 26 sub criteria that become the measurer, Priprioti every sub criteria like in fig - 3-6, - Based on the criteria, the customer stakeholders perspec-tive was modelled as in Fig 7

## 5. Conclusion

This research can be concluded that there are four main criterion that is Quality of Academic Service with weighting which in can is 0,363 and this criterion become criterion of priority main steering of quality of Graduand become priory to third with weighted 0,257, then priority to three Quality of Research has weighted 0.190, the last ingredient is Quality of Information System which has weighted 0.189

This research has also got twenty six sub selected criteria from each criteria. The highest criteria sub criteria of the Quality of Academic services criteria are The Satisfaction of student and have weighted is 0.203 while for the criteria of Quality of Graduand the priority criterion sub is percentage of Graduation Get a Job One Year that has a weighted 0.294, Quality of research criteria is Number Of Lectures And Student In The Form Of Patent that has weighted 0.137, while the Quality of information System criteria that become priority is Benefit Of Information System For Student And

Faculty And Access To Resources which has a weighted 0.212.

From the results of the above research can be concluded that the criteria and sub criteria can be the basis for measuring universities as a reference in determining the performance index of universities.

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## References

- [1] Lestari, A. S. (2014). Analisis Penilaian Kinerja Lembaga Pendidikan Tinggi Dengan Metode Balanced Scorecard: Penerapannya Dalam Sistem Manajemen Strategis ( Studi Kasus Pada Universitas Brawijaya Malang ), 52(April 1988), 441–450.
- [2] Tohidi, H., Jafari, A., Afshar, A.A(2010)using balanced scorecard in education organization. International jurnal procedia social an behavior sciences,2 , 5544-5548
- [3] Iriani, Y.(2005)Rancangan Model pengukuran kinerja PTS di tinjau dari persepektif pelanggan; Prosiding seminar nasional kopertis wilayah 14,1 , issn:0216-9681,3-8
- [4] Griffin. R. W (2003) Management. Second edition boston huuthon mifflin press.
- [5] Sudaryo, Y (2005). Kinerja perguruan tinggi dengan pendekatan strategic map balanced scorecard.sosiohumaniora,17(1), 1-12
- [6] Niven , P.R.(2008).Balanced scorecard step-by-step for government and nonprofit agencies, Hoboken NJ: Jhon wiley & Sons Inc.
- [7] Pietrzak, M.(2013). The need of managerial control in public universities. In: E. Nowark, & M. Nieplowich(eds). Accounting and Controlling, Wroclaw: Economic University of Wroclaw, 404-414.
- [8] Rohm, Howard (2003). Improve Public sector with a Balanced scorecard. <http://www.balancedscorecard.com>
- [9] Imelda, R.H.N(2004) implementasi balanced scorecard pada organisasi publikjurnal

- akuntansi dan keuangan,6(2), 1006-122  
;Doi:https://doi.org/10.9744/jak.6.2pp.%2010  
6-12
- [10] Yu, M, L., hamidi, S.I, M.T.,soo, H.P(2009)The e-balanced scorecardfor measuring academic staff performance excellence. Haigh education, 57(6), 813-828
- [11] Beard , D.F., Humphrey, R, L.(2014). Alignment of university information Technology resouces with the Malcolm baldrige result criteria for performant excellence in education:A balnced scorecard approach, jurnal of eduction of business, 89(7), 382-388
- [12] Lee, A.H.I. Chen, W.C, and Chang, C.J. (2008). A Fuzzy AHP And BSC Approach For Evaluating Performance Of IT Department In The Manufacturing Industry In Taiwan, Expert Systems With Applications
- [13] Wang,Y., and Xia,Q. (2009) A Fuzzy AHP and BSC Approach for Evaluating Performance of A Software Company Based on Knowledge Management, The 1st International Conference on Information Science and Engineering (ICISE).
- [14] Bhutta Khurum s. dan Faizul Haq, (2002), Supplier selection problem: acomparison of the total cost ownership.
- [15] Yuksel , I & Dagdeviren , M(2007) Using the analytic network process(ANP) in a SWOT Analysis-A case study for a textile firm. Journal information scince: and journal archive.177(16)3364-3382
- [16] Bhutta Khurum s. dan Faizul Haq, (2002), Supplier selection problem: acomparison of the total cost ownership.
- [17] Peniwati, Kirti. 2000. *The Analytic Hierarchy Processnt's Basic andAdvancement*. Proceedings of The Indonesian Symposium on the Analytic Hirarchy Process.
- [18] Marimin. (2004). Teknik dan Aplikasi Pengambilan Keputusan Kriteria Majemuk. Jakarta: PT Gramedia Widiasarana Indonesia.
- [19] Hannabarger, C., Buchman, R., & Economy P (2007) *Balance Score Card Strategy for Dummies*. Indiana: Wiley Publishing, Inc.
- [20] Kaplan, Robert S. dan David P. Norton. 2000. *Balanced Scorecard : Menerapkan Strategi Menjadi Aksi*. Diterjemahkan oleh Peter R. Yosi Pasla, M.B.A. Jakarta : Erlangga.
- [21] Rollins, A.M.2011. *A Case Study: Application of the Balance Scorecard in Higher Education*. San Diego State University.
- [22] Kaplan, R. S and Norton, D.P (1992). Putting the Balanced Scorecard to Work, Harvard Bussiness Review.
- [23] Sudaryo, Y (2005). Kinerja perguruan tinggi dengan pendekatan strategic map balanced scorecard.sosiohumaniora,17(1), 1-12
- [24] Hidayati Ana, Fudholi , Sumarni.(2014) Analysis Of Student Satisfaction Service Quality In Pharmacy Faculty University Of Ahmad Dahlan Yogyakarta Pharmaçiana, Vol. 4, No. 1, 2014 : 59-64 Hal.60
- [25] Salmu, S & Solichin,A (2017), prediction of timeliness graduation of student using naïve bayes : a case stdy at Islamic state university syarif Hidayatullah Jakart:Prociding Seminar Nasional Multidisiplin Ilmu universitas Budhi Luhur 2017, issn 2087-0930
- [26] Kumalasari.N.(2009), Pentingnya Perlindungan Hak Kekayaan Intelektual (Hki) Dalam Era Globalisasi Oleh Jurnal Ilmiah Ilmu Hukum Qisti Vol 3, No 2 (2009),Issn:1979-0678
- [27] Aswati.s, Mulyani.N, siagian.S, Zikra Syah. A, Peranan system informasi dalam perguruan tinggi, Jurnal tekhnologi dan system informasi,volume.1, nomor 2, maret 2015, hal 79-86