QUANTITATIVE APPROACH TO MEASURE PROCESS CONNECTIVITY IN BALANCED SCORECARD MODEL

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ABSTRACT

For measure the performance, Strategy map based on Balanced Scorecard method has been built. However, using only balanced scorecard approach, it is difficult to measure quantitatively relation between result, process, and its indicators. How strong performance of specific indicator affect to specific process, and strong specific process affect to result. To accommodate this purpose, Analytic Hierarchy Process (AHP) model has been built. Using its ability in assessing process that has hierarchy, the initial strategy map is rearranged by giving weight (importance value) to its indicators. Using the hierarchical model, weight, and indicators value; the weights and performance value of process and perspectives can be assessed.

Key words: *Balanced Scorecard, analytic Hierarchy Process,*

1. INTRODUCTION

Performance of education institution such as university should be maintained carefully to bring out best output of students and researches. In order to achieve target of goal, person in charge that responsible for particular Key Performance Indicator / KPI (in area of organization, unit, or individual) has to be able to monitor their KPIs and required processes to achieve the target of KPI.
In previous paper (Marsellinus, 2012),(Vivi, 2012), a strategy map based on Balanced Scorecard has been built to measure performance of Faculty of Engineering, Atma jaya catholic University. The model consist of

(1) Strategy map of Engineering Faculty
(2) Key Performance Indicator for each Strategic Objective for faculty, department, and unit level.
(3) Person in contact that responsible for the achievement of each KPI

This paper will discuss more detail about the quantitative connectivity among each value in KPI, process, strategic objective, an perpective so that performance of organization can be measured quantitatively in each required level and area (individual, unit, department, and faculty). In next planning, this quantified strategy map model will be base for dashboard management development.

Using the management dashboard, each Person in contact in related level could monitor performance of each activity level. Hence, he/she can focus on making strategic decision to ensure achievability of longer term goal.

2. THEORITICAL BACKGROUND

2.1. Balanced Scorecard

The balanced scorecard is a strategic planning and amanagement system that is used extensively in business and industry, government, and nonprofit organizations worldwide to align business activities to the vision and strategy of the organization, improve internal and external communications, and monitor organization performance against strategic goals. (www.balancedscorecard.org), (Martin, 2013)

2.1.1. Perspectives

The Balanced Scorecard concept involves creating a set of measurements for four strategic perspectives. These perspectives include: 1) financial, 2) customer, 3)

internal business process and 4) learning and growth. The idea is to develop between some measurements for each perspective. The measurements should be focused on a single strategy and be linked, consistent and mutually reinforcing.

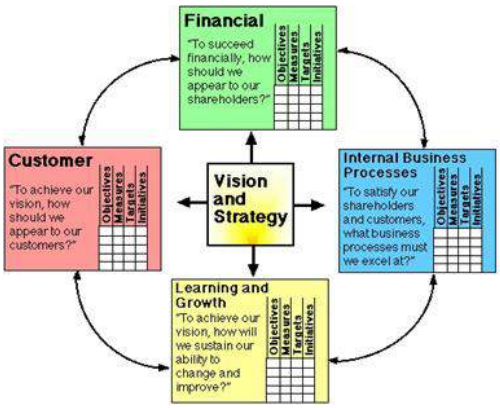


Figure 1. Balanced Scorecard Perspectives Adapted from Robert S. Kaplan and David P. Norton, "Using the Balanced Scorecard as a Strategic Management System," Harvard Business Review (January-February 1996): 76.

The Learning & Growth Perspective
This perspective includes employee training and corporate cultural attitudes related to both individual and corporate self-improvement..

The Business Process Perspective
Metrics based on this perspective allow the managers to know how well their business is running, and whether its products and services conform to customer requirements

The Customer Perspective
In developing metrics for satisfaction, customers should be analyzed in terms of kinds of customers and the kinds of processes for which we are providing a product or service to those customer groups.

The Financial Perspective
Including financial-related data, such as risk assessment and cost-benefit data

2.1.2. Strategy Mapping

It show a logical, step-by-step connection between strategic objectives (shown as ovals on the map) in the form of a cause-and-effect chain. Generally speaking, improving performance in the objectives found in the Learning & Growth perspective (the bottom row) enables the organization to improve its Internal Process perspective Objectives (the next row up), which in turn enables the organization to create desirable results in the Customer and Financial perspectives (the top two rows).

2.2. Analytic Hierarchy Process

The basic procedure to carry out the AHP consists of the following steps (Kasperczyk, 2011),(Saaty, 2008):

1. Define the problem and determine the kind of knowledge sought.
2. Structure the decision hierarchy from the top with the goal of the decision, then the objectives from a broad perspective, through the intermediate level (criteria on which subsequent elements depend) to the lowest level (which usually is a set of the alternatives).

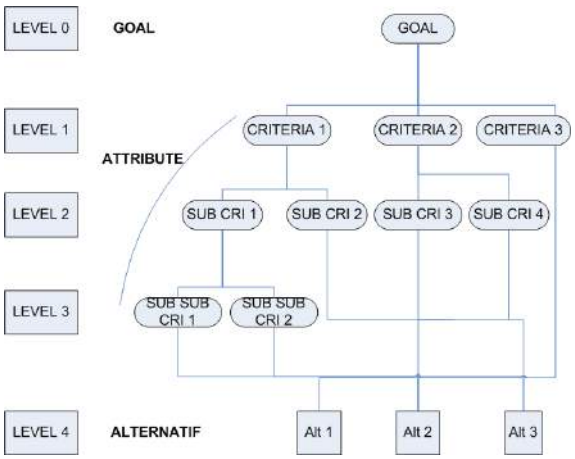


Figure 2. AHP Structure

3. Construct a set of pairwise comparison matrices. Each For each pair of criteria, the decision maker is required to respond to a question such as "How important is criterion A relative to criterion B?" Rating the relative "priority"of the criteria is usually done by pairwise comparison approachelement in an upper level is used to compare the elements in the level immediately below with respect to it. Pairwise comparison approach again is done for each pairing within each criterion.
4. Use the priorities obtained from the comparisons to weigh the priorities in the level immediately below. Do this for

every element. Then for each element in the level below add its weighed values and obtain its overall or global priority. Continue this process of weighing and adding until the final priorities of the alternatives in the bottom most level are obtained.

3. METHODOLOGY

This paper is continuity of paper from Bachtiar, dkk (Marsellinus, 2012) that discuss the building of strategy map for Faculty of Engineering, Atma Jaya Catholic University of Indonesia, based on Balanced Score card Perspective.

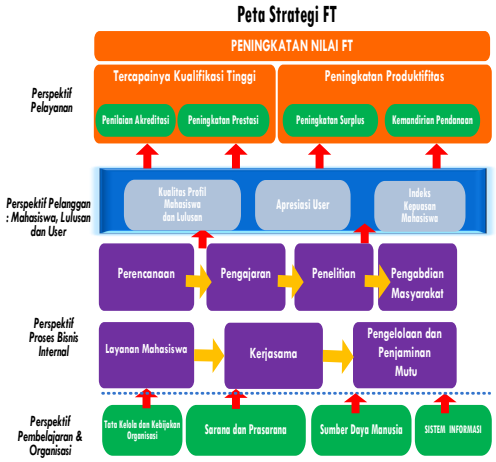


Figure 3. Strategy Map of Engineering Faculty

In another paper, Triyanti and Bachtiar (Vivi et.al, 2012) continue the strategy map with building the detail indicator and form for the same case. The paper discussed how each indicator can be measured quantitatively and objectively. Each indicator connect to sub strategic objective (SSO) or Strategic objectives (SO). Each SSO and SO could be connected to one or more indicators.

This paper will focus to build and measure the connectivity within the models so that performance can be measured in any level of process, unit, or perspective, according to the requirement. Based on the BSC model, each *sub strategic objective*, *strategic objective*, business process, and indicators will be connected based on modified Analytic Hierarchy Process (AHP) logics. Using the AHP approach, the logic of why performance in each level in one aspect/level/unit is good or bad, can be traced easily.

Detail of steps that has been done are:

3.1. **Preparing Detail System Design**

Before the model can be used in more integrated system, some input forms and data flow process should be prepared to support the process of data collecting and input performance. Output (performance of each indicator and unit) should be designed carefully to avoid bias and misinterpretation for any reader, including the data input officer, supervisor, and top management. On the other hand, business data flow should be designed to avoid the confusion in process of data collection and assessment.

3.2. **Designing Modified AHP Model**

Previous Balanced scorecard model is translated to Hierarchy model. The model is look like AHP model. However, we only use the hierarchy principle, not the detail calculation. For instance, we do not use pair wise comparison approach to calculate weight and value. The result is shown in Appendix A. Color line is given to clarify connectivity among indicators, SSOs, SOs, and perspectives.

3.2.1. **Measuring Strategic Objective Value**

Different from common AHP model, in this model weight indicates level of importance of all system, not just level of importance of the level. Each indicator has weight and indicator value. Indicator value is assessed based on the achievement in some work. The value then is converted to scale 0 – 4 (higher better), named performance scale. Performance scale multiply weight will result in indicator performance value. Performance value of Strategic Objective is obtained from total related indicator performance value

3.2.2. **Measuring Process That Has Many Levels**

Since the weight in initial model has represented importance level of overall system (not just of the related level), then weight does not have to multiply to weight in upper level. We just have to sum up the weight in sub level to obtain weight of upper level. This approach is also used to calculate the performance value. Performance value in upper level is total of performance value in related sub level.

4. RESULT AND DISCUSSION

4.1. Result

From the FT strategic map that has been built before, we can identify all indicators. The SO, indicators, formula, coding, and weight then are rearranged based on position and the responsibility in unit (ex: head of department, coordinator of research, etc).

Input for is arranged for each position (named performance assessment input form). Each position has to input the form periodically. Since the performance assessment input form is designed in computerized system, all required calculation is performed automatically.

In this form, input value will be converted to scale value (scale 0-4, higher better) that shows performance for each indicator in the position. Average of indicators value is the overall performance for the position. Therefore, each position may see its unit performance as soon as he/she finish the input process.

Table 1. Example of assessment form for particular position (ex: lecturer)

Jabatan	: Dosen							
Periode Input	: 2 bulan (1/2 Semester)							
Sasaran Strategis	Indikator	Bobot	Input				Nilai Indikator	
			Keterangan	Nilai	Satuan		Nilai	Skala
Meningkatkan kinerja pengajaran dosen	Tingkat kehadiran dosen tetap dalam mengajar.	0,72	Jumlah kehadiran dosen tetap dalam mengajar	13	Dosen		87%	3
			Jumlah kehadiran dosen yang yang direncanakan	15	Dosen			
	Tingkat kehadiran dosen tidak tetap dalam mengajar.	0,72	Jumlah kehadiran dosen tidak tetap dalam mengajar	12	Dosen		80%	3
			Jumlah kehadiran dosen yang yang direncanakan	15	Dosen			

Data flow process then is designed for each indicator. Table 2 shows how data is collected and distributed. Primary source of data is noted by no 1. From no 1, then data is distributed to no 2, and so on.

Table 2. Example Data of Data Collection Flow

PI	Pet.Jur	Kajur	Sekjur	Pet.Lab	Pet.Jab	BAA
Persentase kelulusan tepat waktu.		2			1	
Rata-rata Indeks Prestasi Kumulatif (IPK) per semester	2	3				1
Kelengkapan Muatan Kurikulum (pada dokumen)		2			1	
Persentase dosen yang memasukkan nilai tepat waktu	1	2				

4.1.1. Model Interpretation

Modified Analytic Hierarchy Process (AHP) model based on BSC model for Faculty of Engineering, Atma Jaya Catholic University of Indonesia, is shown on Appendix A. On this figure, color line shows connectivity among indicators, SSO, SO, business process, and perspectives. To explain the quantitative connectivity among indicators, SSO, SO, and business process, an example is given using one of business process, which is "*perencanaan*" (planning).

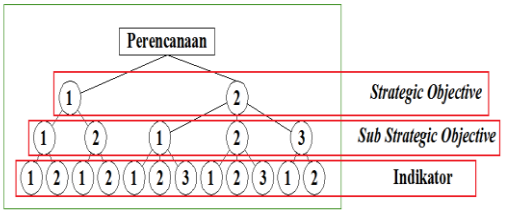


Figure 3. Example of Hierarchy in Business Process "Perencanaan (Planning)"

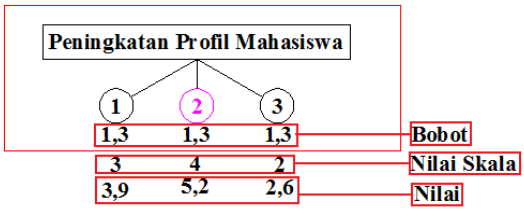
Planning process has 2 *strategic objectives*, i.e.: 1.increase planning effectiveness and 2. Increase curriculum quality). *Strategic objective* 1 has 2 *sub strategic objectives* (1.1. Increase strategy's clarity and 1.2 increase strategy's effectiveness). At lowest level are indicators. S*ub strategic objective* 1.1 has 2 indicators (1.1.1 and 1.1.2). Same logic can be used for other processes and SOs.

4.1.2. Measuring Strategic Objective Value

Indicator weight mainly is taken from weight from Borang Accreditation for Higher Education guideline book www.balancedscorecard.org, (Buku IIIA Borang Akreditasi Yang Diisi oleh Program Studi, 2008), (Buku IV Borang Akreditasi Yang Diisi oleh Program Studi, 2008).

Slightly different from common AHP, in this AHP model, weight has already represented indicator's importance level relatives to whole system, not just other indicators in the level. For few indicators, the weight should be adjusted by the decision maker since they are not taken from borang (Cicilina, 2011),(Nataniel, 2013),(Shelina, 2011),(Sistem Penjaminan Mutu : Standar, 2012)

As example, we will calculate performance of one of strategic objectives in Customer Perspective, which is "Peningkatan Profil Mahasiswa" (Improvement in Students Profile). This SO has no SSO; therefore the SO is directly related to 3 indicators. Each indicator has weight and indicator value (in scale of 0-4). Performance value of indicator is obtained from weight multiply to indicator value.



Note: performance value = weight x indicator value

Figure 4. Example of performance value calculation

Performance value of SO "Peningkatan Profil Mahasiswa" is total value of indicators' performance value, which are 11.7. The illustration of the calculation can be seen in figure 4

4.1.3. Measuring Process Performance Value That Has many Level

For process that has many level (ex: SO, SSO, indicators) the calculation has the same logics. As example, here we use one of business process in Business Process perspective, that is "Perencanaan" (Planning). Using the same logics as before, weight of upper level is total of weight in the sub level (table 3)

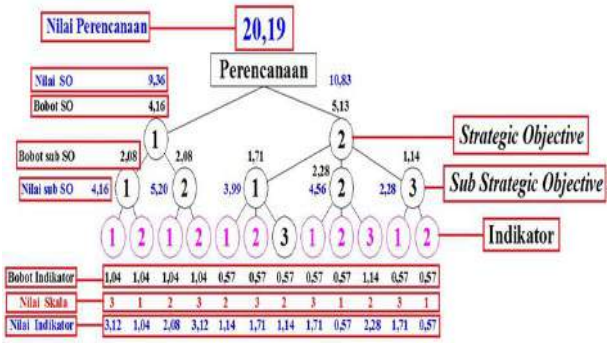
Meanwhile, performance value of upper level is also taken from total of performance value in the sub level (table 4). The illustration is shown in figure 5.
To analyze connectivity of process among perspectives, separated model is built. Basically the model is the same to initial model except the SSOs, SOs, and indicators are not included to make it simpler (Appendix B).

Table 3. Assessing Weight (bobot) of Business Process "Perencanaan"

Indikator	Nilai Skala	Bobot Indikator	Bobot Sub SO	Bobot SO	Bobot Perencanaan
P 1.1.1	3	1.04			
P 1.1.2	1	1.04	2.08	4.16	
P 1.2.1	2	1.04			
P 1.2.2	3	1.04	2.08		
P 2.1.1	2	0.57			
P 2.1.2	3	0.57			
P 2.1.3	2	0.57	1.71		9.29
P 2.2.1	3	0.57		5.13	
P 2.2.2	1	0.57			
P 2.2.3	2	1.14	2.28		
P 2.3.1	3	0.57			
P 2.3.2	1	0.57	1.14		

Table 4. Assessing Performance Value of Business Process "Perencanaan"

Indikator	Nilai Skala	Bobot	Nilai Indikator	Nilai Sub SO	Nilai SO	Nilai Perencanaan
P 1.1.1	3	1,04	3,12	4,16	9,36	
P 1.1.2	1	1,04	1,04			
P 1.2.1	2	1,04	2,08	5,2		
P 1.2.2	3	1,04	3,12			
P 2.1.1	2	0,57	1,14	3,99	10,83	20.19
P 2.1.2	3	0,57	1,71			
P 2.1.3	2	0,57	1,14			
P 2.2.1	3	0,57	1,71	4,56		
P 2.2.2	1	0,57	0,57			
P 2.2.3	2	1,14	2,28			
P 2.3.1	3	0,57	1,71	2,28		
P 2.3.2	1	0,57	0,57			



Note:
Indicator's perf. Value = weight x indicator's value
SSO's perf. Value = Σ indicators' perf. Value
SO's perf. Value = Σ SSO's perf. Value
Process's perf. Value = Σ SO's perf. Value

SSO's weight = Σ indicators' weight
SO's weight = Σ SSO's weight
Process's weight = Σ SO's weight

Figure 5. Measuring Performance Value of Business process "Perencanaan"

In this simplified model, Decision Maker may adjust which process that has connectivity. However, in this model, it is assumed that all processes (between two perspectives) have connectivity. For instance, it is assumed that all business processes (in business process perspective) are related to "Peningkatan profil mahasiswa" (Improvement in Student's profile) in "peningkatan nilai unit" (Improvement in Unit Value) perspective.

Since there is no initial data that adjust importance value (weight) process in sub level to process in upper level, then the weight should be adjusted by decision maker. However in this paper, weight is adjusted based on normalized weight of processes at lower level

Table 5. Measuring Performance Value of Perspective Business Process

Business Process	Business Process Value (V)	Weight (W)	Normalized weight (N)	V x N
Perencanaan	20,19	9,29	0,13	2,67
Pengajaran	23,69	21,09	0,30	7,11
Penelitian	13,14	13,28	0,19	2,48
Pengabdian Masyarakat	8,06	4,43	0,06	0,51
Kejasama	5,12	6,28	0,09	0,46
Pengelolaan & PM	11,06	11,03	0,16	1,74
Layanan Mahasiswa	6,02	4,88	0,07	0,42
Total		70,28	1,00	**15,38**

For instance, from table 5, it can be shown that based on previous calculation, weight of each business process can be assessed. By normalizing the total weights, we get weight of each business process relative to the level (business process perspective). It is also assumed that importance value (weight) business process to all processes in upper level (in this example "peningkatan profil mahasiswa", "peningkatan apresiasi user", and "indeks kepuasan mahasiswa") is similar.

Process's Performance values are also taken from previous calculation. For instance, for process "Perencanaan", the performance value is 20.19 (See figure 5). Performance value of "Peningkatan Profil Mahasiswa" then can be assessed by multiplying Process's Performance values to normalized weight. If the result is summed up, we have the value of **15,38**, which is Performance value of "Peningkatan Profil Mahasiswa".

4.1. Discussion

In the BSC-AHP model, the performance of SO or process in particular perspective can be assessed by two approaches:

1. Directly calculate using its related indicator (see figure 3)
2. Assess the value using the performance from lower level (see figure 5)

Since there are 2 approaches in assessing one value, there is possibility that the value is different. For instance, in our example, based on approach one, performance value of "Peningkatan Profil mahasiswa" is 11.7. However, using the approach 2, the value is 15.38. The difference occurs because some factors:

1. Fault in designing connectivity between process in different perspectives

There is possibility of error in designing connectivity between processes. Error might occur in assumption of connectivity itself, or error in assessing the importance value. This error can be avoided or minimized by observing each process more accurate. The weight or connectivity could be readjusted in trial period or while it is implemented

2. Assumption that there is relation between process and result

There is possibility of mistake in assuming connectivity between process and required result. For instance, it is assumed that number of lecturer with doctoral degree is related to quality of business process of "pengajaran' (teaching), and "pengajaran" will affect in "peningkatan profil mahasiswa" (improvement of student profile), which are GPA and on time study period. However, sometimes many lecturers with doctoral degree cannot guarantee improvement in GPA nor study time.

3. Lack of data to prove process's performance.

Lack of data or evidence to assess performance of process may cause performance assessment for some indicators become low or cannot certainly assessed, since each measured performance of indicators has to have supporting data or evidence. For example, "penelitian" (research) is one of business process that connected to "peningkatan profil mahasiswa" (improvement in student profile). In fact, there are many researches that have been done properly. However some supporting data are not available. This lack of data will make indicator value become low.

5. CONCLUSSION

1. The usage of modified AHP method helps in assessing performance and connectivity of indicator value, SSO, SO, process, and perspectives of BSC model
2. There are possibility of error in model building that may cause variation in result, i.e.: Fault in designing connectivity between process in different perspectives, mistake in assuming that there is relation between process and result, and Lack of data to prove process's performance

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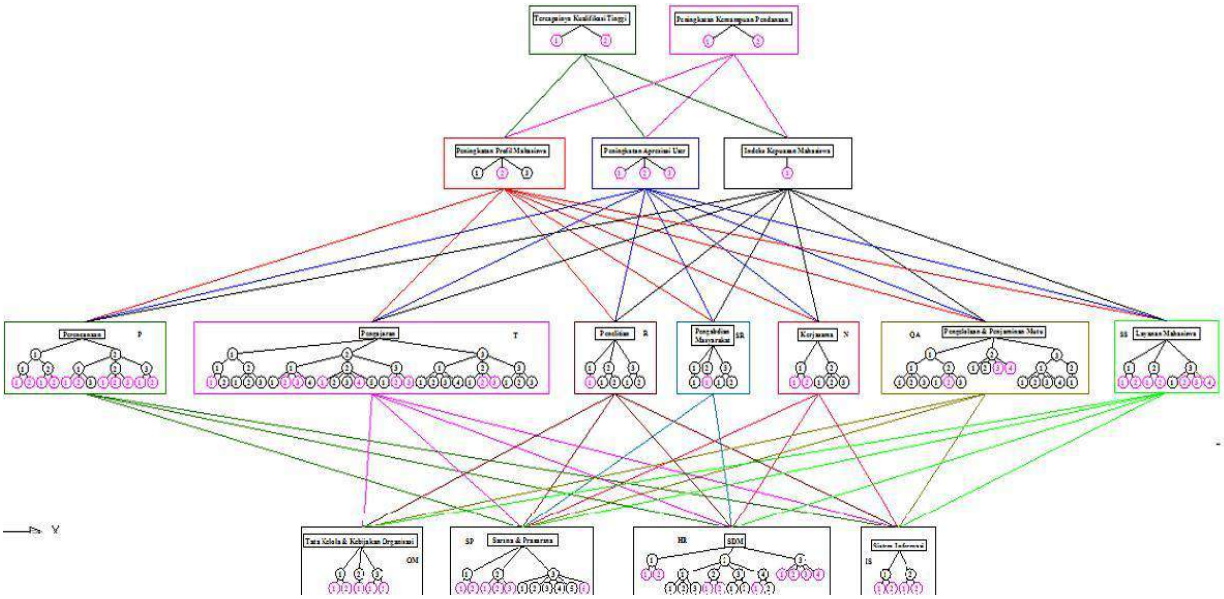
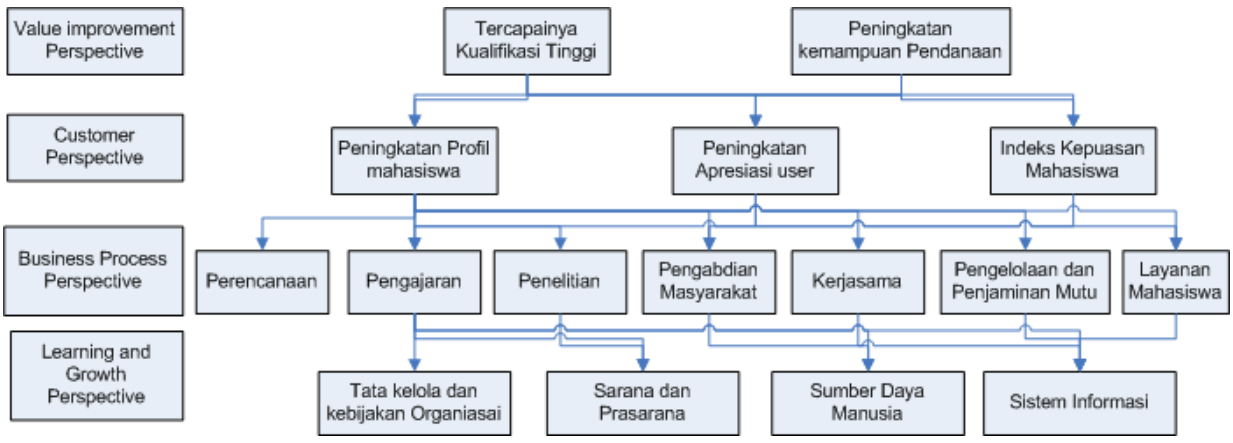


Appendix A. Hierarchy Model of Balanced Scorecard Model



Appendix B. Simplified Hierarchy Model of Balanced Scorecard Model