

## A HYBRID BALANCED SCORECARD AND SYSTEM DYNAMICS FOR MEASURING PUBLIC SECTOR PERFORMANCE

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### Abstract

Performance measurement on an organization whether it is a profit or non-profit, has to be conducted in order to evaluate plan attainment. This measurement is considered incomplete as the performance of a company is not only based on financial perspective, but also other perspectives. Balanced Score Card (BSC) is a performance measurement method using four perspectives: financial, customers, internal business processes and learning and growth. BSC measurement can be applied on profit and non-profit organizations. BSC focuses on causality (cause and effect) which is based only on linear correlation. This situation is the weakness on BSC because it cannot continue to the specific forward step that can predict the future activities. In this study, BSC is combined with System Dynamics (SD) that can identify the interaction among four perspectives and also related variable through a causal loop design model. Hybrid modelling design between BSC and SD gives an effective and interesting contemporary study. Then, the model performed with 2012 data input and performance forecasting until 2017. The result obtained for the financial perspectives related to fund absorption from 2013 until 2017 consecutively 100%, 100%, 85%, 72% and 100% with the most influential variable of tax and non-tax by 44.3% and the smallest variable effect is levies variable with 0,08%. Perspectives toward customers related to the efficiency and effective value by 50%, 43%, 43%, 48%, 49 % to customer dissatisfaction variable 48.09%, and 12.03% of customer's satisfaction. Internal business process perspective relates to the value of the total effective capacity by 80%, 71%, 69%, 71%, and 70%. With the most influential variable is the productivity and innovation for 50.77% and 1.94% variable staff morale. The last

perspectives is learning and growth effective value for 50%, 44%, 56%, 47%, 46% with the most influential variable is the skill level of workers 27.98% and the smallest effect is variable retention of the worker is 8.07%.

*Keywords:* Balanced Score Card, System Dynamics, Performance.

## **1. Introduction**

Performance measurement of an institution needs to be done to determine achievement level of the plan that have been implemented. In general, performance is measured from the financial perspective. However, that kind of measurement is considered to be less complete, because there are many other factors that influence the performance improvement. Kaplan and Norton [1] have introduced performance measurement with four perspectives: financial, customer, internal business process and learning and growth. Then, this performance measurement is called the Balanced Scorecard (BSC). BSC method for performance measurement can also be used to measure the executive performance and financial and non-financial organizations too.

Research on performance improvement of an organization by using the BSC method have been done by experts or the industry itself. In USA, Davis and Albright [2] have investigated the influence of a BSC implementation on financial performance. This research has given a contribution on the existing performance measurement, by provided evidence on the ability of the BSC in improving financial performance. Bhagwat and Sharma [3] built the BSC to measure the daily business operations in the context of supply chain management. This study has revealed that the BSC can be the primary base of the SCM system strategy. Northcott [4], studied about the implementation of BSC to manage organizational performance in public sector. This research has been proclaimed that BSC is very potential to support performance in public sector. It is also recognized by the organization manager who participated in the research. Ioppolo [5], built models of performance measurement using BSC theory to compare the twin projects of local development funded by international financial institutions. This model allows the competitive competence of the territorial system that can be measured.

Performance measurement of organization has been considered succeed by many industry organizations. Thus many industrial organizations have gained improvements. However, performance measurement of an organization has a temporary trait that means it needs to be monitored in a particular period of time, for example, every end of the year. It is also happened to the performance measurement through the BSC method, Linard [6]. Akkermans [7] says there are weaknesses in the BSC which is focusing on the cause and effect relationship in one direction. Thus, it will give one direction result of cause and effect, without seeing the causes or variables that affected the ups and downs of performance.

System Dynamics (SD) is one method that can solve complex problems with simulation models. SD is studying the problem systemically. The problems are considered complex systems due to the components that are inside interact dynamically and provide cause and effect. Such interaction is called the Causal Loop. This interaction is also a feedback relationship between components with the others. Thus, it generates an activity or behavior that is positive or negative. This interaction can be modeled in the form of a mathematical model, which then can be calculated with the help of a computer simulation, Forrester [8]. Research

using the SD approach ever done by Santos et al., [9]. This research explained that the SD approach has been proven in helping to provide information and make decisions. This study has shown that the SD is very clear potentially supporting the approach in performance measurement and management.

Further developments in performance measurement using BSC that is merged with other various methods have been carried out, however, based on the literature review that has been conducted, incorporation methods or measuring devices with BSC need to be further examined. Linart et al., [6] has initiated the merger of BSC with SD and research is still being carried out to examine the result of the merger in these two methods.

The objective of this paper is to examine this two merger method, conducted by measuring the performance using BSC and SD referred as Hybrid BSC and SD for improving dynamic performance. Alter components of the BSC concept will interact. The result of the interaction among these components will be simulated using SD method, with the help of software Powersim 2005. Then the influence from each component that affects organizational performance will be generated.

## **2. Literature review**

### **2.1. The balanced scorecard approach**

According to Kaplan and Norton [1], the definition of a BSC is “a set of measures that gives top manager a fast but comprehensive view of the business, includes financial measures that tell the results of actions 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 the drivers of future financial performance”. Meanwhile, Anthony et al., [10] defines BSC as “a measurement and management system that views a business unit’s performance from four perspectives: financial, customer, internal business process, and learning and growth”. Base on those two definitions, BSC is a management system, measurement, and quickly, precisely, and comprehensively control to provide insight to managers on business performance using 5 perspectives.

There are numerous numbers of research that discuss about BSC applied at different sector of industry. Chen et al. [13] developed model using a balanced scorecard approach for evaluating the performance of hot spring hotel. While Grigoroudis et al. [14] applied BSC for healthcare organization, and Lin et al. [15] also implemented at the hospital by adding fuzzy linguistic method. In addition, Hung-Yi [16] initiated BSC and DEMATEL for banking institution. As educational sector, Turki et al. [17] applied BSC for school safety performance purpose. In the general business process, several research have also been conducted. Bhagwat & Sharma [18] measured and evaluated day-to-day business operations from finance, customer, internal business process, and learning and growth perspective and Huang [19] also evaluated the same topic by adding AHP tools. Senarath & Patabendige [20] initiated BSC to support the corporate plan preparation and implementation process, and Veen-dirks & Wijn [21] discussed the same goal by adding the Critical Success Factors method. While, Zeng and Luo [22] summarized the limitations of BSC and determined the obstacles as well as provided recommendations of how to successfully implement the BSC.

The research as mentioned before, are performance measurement using BSC that were applied in several industries. Then this paper will extend using the hybrid of BSC and SD to measure the public sector performance.

#### **Four perspectives the balanced scorecard**

Kaplan and Norton [1] in the measurement of performance through BSC method there are four perspectives performance will be measured, while the four perspectives are:

##### **Financial perspective**

Traditionally, the financial statements are the historical-aggregate indicator that reflects the result of the implementation and execution of strategy in one period. Financial performance measurement will indicate whether the planning and implementation of strategies that provide fundamental improvements for the benefit of the company. This improvement is reflected in the objectives that are specifically related to measurable benefits, business growth, and shareholder value. Measurement of financial performance considering the stage of the business life cycle, they are: growth, sustain, and harvest.

##### **Customer perspective**

Recent management philosophy has shown an increase in recognition of the importance of customer focus and customer satisfaction. This perspective is a leading indicator. So, if customers are not satisfied they will find other producers that fit their needs. Poor performance from this perspective will reduce the number of customers in the future, despite the current performance of the financial perspective looks good.

##### **Internal business process perspective**

Analysis of the company's internal business processes performed by using the value-chain analysis. In this perspective, management identifies the critical internal business processes that must be excelled by the company. Score Card may allows the manager to know how well their business running and whether their products or services is suited with the customer's specifications. This perspective must be designed carefully by those who are most likely to know the company's mission that cannot be done by other consultants.

##### **Learning and growth process perspective**

This process of learning and growth factors derived from human resources and organizational procedures. This perspective is included in employee training and corporate culture that relate to individual and organizational improvement. In a knowledge-worker organization, people are the main resources. In many cases, the learning and growth perspective is the foundation for the success of knowledge-worker organization with regard to systems and organizational factors.

## **2.2. The system dynamics approach**

SD is a methodology for studying and managing feedback from the components contained in the complex system. SD can help to resolve the problem until the level of top management at the macro level, dynamically and continuously. SD sees the system from its flow, both material and information flow. Jay W. Forrester [8] stated that the SD method learns the problem from a systematic point of view, in which the elements of the system interact with each other in a specific relationship feedback to produce a certain behavior. Interactions in this structure are translated into a mathematical model that subsequently simulated with the help of a digital computer to obtain its historical behavior.

The consideration of using the SD model is because it has several advantages, there are; SD is able to meet a series of requirements of the system and managerial issues to shape modeling framework. SD is able to combine traditional management with management science to gain more information and solve problems more effectively. SD uses the power of human thought and overcome its weaknesses by dividing the work between managers and technology. Input structure generation is done by the manager, while the simulation is done by computer. SD issues several different resources: mental, written and numerical data in order to better contain and representative models. SD models can create feedback to decision makers about the absence possibility an impact of a series of wisdom by simulating and analyzing the behavior of the system on different assumptions. SD method can not be separated from the parts to complete the build SD models, parts are:

### **Causal loop**

Causal loop diagrams (Cause and Effect Diagram) or also called influence diagrams, are used to help modelers understand the system with the providing an overview through the relation of cause and effect in the system (conceptualization of the system). By using Causal Loop Diagram modelers can quickly structuring model based on the assumptions used.

### **Flow diagram**

Flow Diagram is a representation of a form of detailed depiction of the system. In the flow diagram it is shown of components and types of relationships between the components within the system. The main purpose of flow diagram is to represent the flow and structure of the system in detail, in order to facilitate mathematical modeling.

## **2.3. Questionnaire**

The questionnaire is a list of the questions used by the researcher to obtain data directly from the source, through the distribution of questionnaires to the informant to obtain an answer. Questionnaire is a research instrument consist of a series of questions for the purpose of gathering informations from the respondents. Synodinos [11], stated that steps are as follows:

- (1) Research objective.

- (2) Administration method.
- (3) Questionnaire construction.
  - Questions
  - Response choices
  - Response sequences
  - Other considerations
- (4) Questionnaire Pretesting.
- (5) Final version of questionnaire.

### **3. Research methodology**

The model was developed based on the problems faced by the Provincial Government of Tanjung Pinang Kepulauan Riau (KEPRI) in improving the performance of an SKPD. BSC is one of performance measurement in organization, including public sector. However, because of the business environment is always dynamic, the disadvantage of BSC to deal with a dynamic environment needs to be combined with SD, to anticipate the sudden change in particular condition.

Both of these methods was combined integrated together as the hybrid BSC and SD. Model construction in the form conceptualization system of cause and effect diagram (causal loop) is described in Fig. 5.

#### **3.1. Developing four perspectives from BSC**

##### **Financial perspective**

Developing a shared understanding with objective statements. By this point, reviewed background information will validate mission and vision to execute the strategic goal. Improving efficiency of financial perspective is conducted by analyzing the amount of expenditures that government spent. Later, it can be analyzed and identified which variable need to be reduced. There is any non-general fund, the sources of government income are needed to be analyzed. Most of people have less motivation to pay (tax for example). Then the variables that have contribution must be identified and improved.

Financial Perspective consists of several interrelated variables, especially in terms of government incomes and government expenses. Until the obtained amount of absorption funds, that then can be used to be a value of financial Perspectives performance.

Financial perspective that used in this study only focused on income and expenditure that occurs, which affects the governance cash financial. As the cost reduction used in causal loop diagrams were included in internal business process. Since it is a strategy variable of correlation to build better internal business process. Causal loop diagrams that are used in the financial perspective as described in Fig. 1

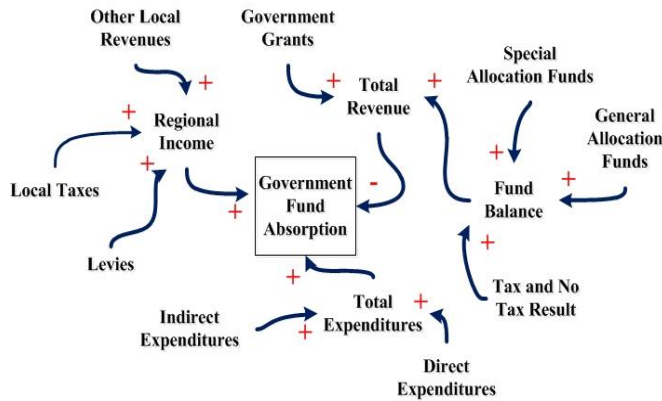


Fig. 1. Causal loop diagram of financial perspective.

**Customers perspective**

Customer perspective is the perspective of a customer-oriented service as users for services that are produced by the government. Two questions in customer perspective are who are the customers and what do customer expect. The cuspomper in this study were SKPD (*SatuanKerjaPerangkat Daerah-Local Work Unict*) that consist of 23 SKPD in Kepri Government. While the expectation of the customer are efficiency and effectivity of their works, which is standard working in government.

The government should pay attention to what customer wants in this regard to education. Customer in this case is SKPD (*SatuanKerjaPerangkat Daerah*) who directly served by Kepri Government. While, internal customers in this research are described in internal business process and learning and growth. Causal loop diagrams that were used in the customer perspective as described in Fig. 2.

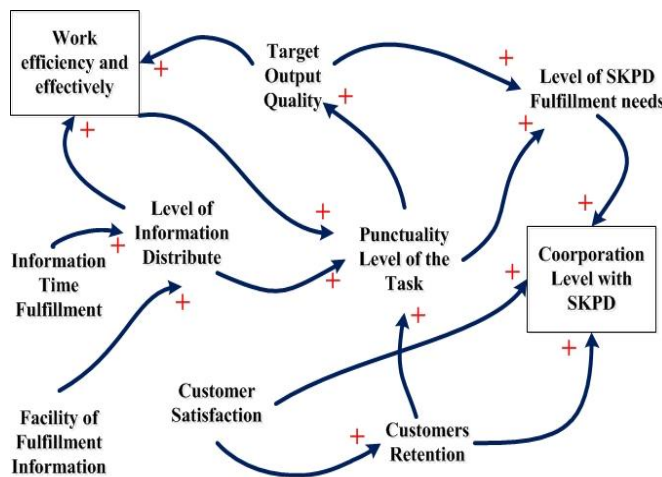


Fig. 2. Causal loop diagram of customer perspective.

### Developing objectives for internal business process perspective

In the internal business process perspective, managers identify the processes that are most critical for achieving customer and shareholder objectives. Companies typically develop their objectives and measures for this perspective after formulating objectives and measures for the financial and customer perspectives. In the case of public sector, the effectivity and efficiency works of the government is important to achieve the customer objectives. Information technology is one of the answer to increase the effectivity and efficiency works. Resistance of the employee sometimes disturb the innovation of the information technology implementation.

More specifically, internal business process perspective is a series of activities that exist within the government to create services in order to meet customer expectations. This perspective describes the business processes that are managed to provide service and value to meet the management effectiveness. Causal loop diagrams that were used in the internal business process perspective asdescribed in Fig. 3

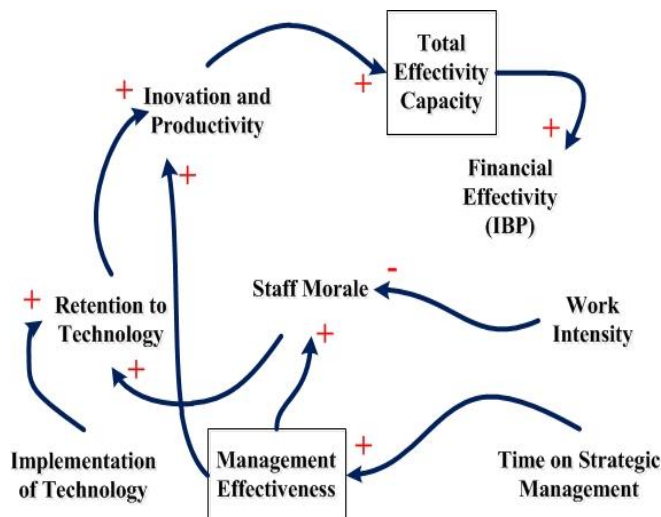


Fig. 3. Causal loop diagram of internal business process perspective.

### Developing objectives for the learning and growth perspective

Aligning people with strategy, to align people to achieve the goal, the government needs to improve skill that related to vision and mission, which consist of the skill level itself and time to develop their skill. Skill improvement, gives a positive correlation to productivity, rework or error, their workload, and capability to adapt with technology that implemented. Increase employee satisfaction. When government aligns people (employee) with strategy, employees have a trend to decline/rejected. This is the reason of maintaining employee satisfaction and retention is one of important point to be focused on.



Learning and growth perspective is the perspective that illustrates the ability of government to make improvements and changes, to utilize internal resources in achieving sustainability. Causal loop diagrams that are used in the learning and growth perspective as described in Fig. 4

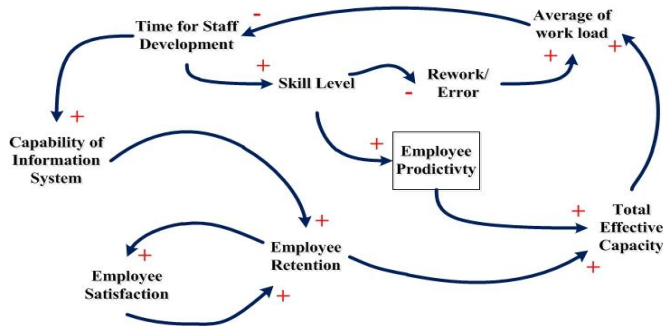


Fig. 4. Causal loop diagram of learning and growth perspective.

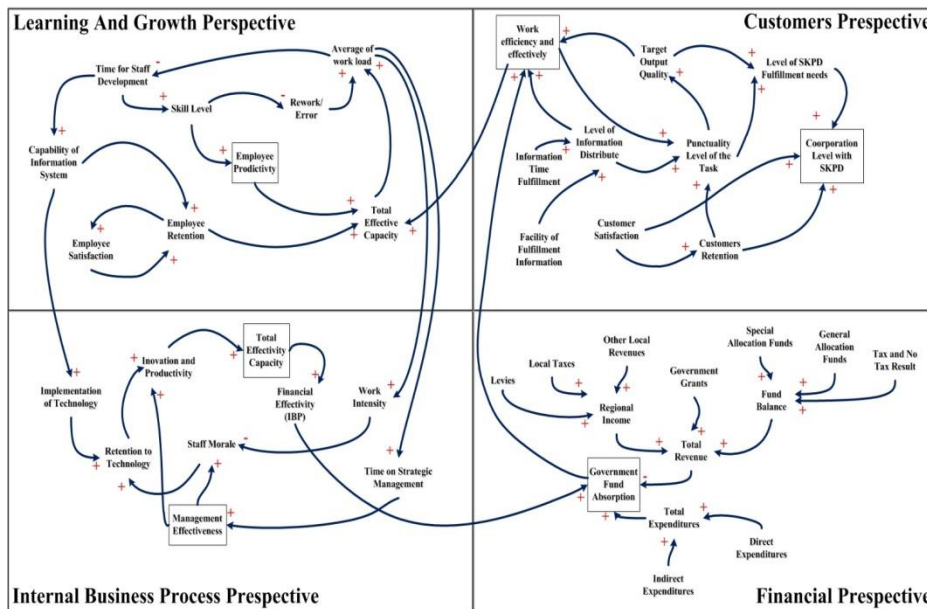


Fig. 5. Causal loop model of the concept of the four perspectives of BSC.

### 3.2. Data collection method

The data were taken to support research preparation. In the process of data collection, it is necessary to know the type and the method used, as follows:

#### Primary

Primary data is data obtained from direct observations of the object to be studied or examined. Primary data can be obtained through direct observation, interviews

and questionnaires. Those that included in the primary data are the customer perspectives, the data obtained from the questionnaire based on causal loop models were created as described in Fig. 2, the data obtained as in Table 3. Internal business process perspective, the data obtained from the questionnaire based on causal loop models are created as described in Fig. 3, the data obtained as in Table 4. Learning and growth perspective, the data obtained from the questionnaire based on causal loop models are created as described in Fig. 4, the data obtained as in Table 5.

### Secondary

Secondary data is data obtained indirectly as a support in the preparation of this research. Secondary data can be obtained through the method of study of literature. Financial perspective is secondary data drawn through the budget. The data based on causal loop models are created as described in Fig. 1, the data obtained as in Table 1.

**Table 1. Financial data (revenue) of Kepulauan Riau quarter 1**  
Financial data used are the data of 1-4 quarters in 2013.

Revenue Type	Realization Quarter 1		
	January (IDR)	February (IDR)	March (IDR)
<b>Regional Income</b>			
Levies	48,587,788,216	48,163,188,147	53,356,333,926
<b>Local Taxes</b>	126,319,150	172,132,115	188,897,750
- General Services Retribution	7,137,000	4,598,000	8,403,000
- Public Services Retribution	118,932,150	152,584,115	176,744,750
- Specific License Retribution	250,000	14,950,000	3,750,000
<b>Regional Wealth Management Results</b>	-	-	-
Other local revenues	584,787,524	1,171,366,238	1,238,028,969
<b>Total of Regional Income</b>	49,298,894,890	49,506,686,500	54,783,260,645
<b>Fund Balance</b>			
Tax and Non Tax Result	374,682,234	124,321,913,429	166,573,469,331
- Share Profit of Tax	374,682,234	334,559,665	-
- Share Profit of Non Tax	-	123,987,353,764	111,424,825,219
- Personal Income Tax	-	-	-
<b>Non Tax Result/Profit</b>	-	-	-
<b>General Allocation of Funds</b>	76,809,634,000	38,404,817,000	38,404,817,000
<b>Special Allocation of Funds</b>	-	-	-
<b>Total of Fund Balanced</b>	77,184,316,234	162,726,730,429	204,978,286,331
<b>Government Grants</b>			
Revenue from Government Grants	38,350,688,000	341,510,000	-
<b>Total Revenue</b>	164,833,899,124	212,574,926,929	259,761,546,976

**Table 2. Financial data (expenditure) of quarter 1**  
Financial data used are the data of 1-4 quarters in 2013.

Expenditure Type	Realization Quarter 1		
	January (IDR)	February (IDR)	March (IDR)
<b>Indirect Expenditures</b>			

Expenditure Type	Realization Quarter 1		
	January (IDR)	February (IDR)	March (IDR)
- Employee Expenditures	13,005,175,780	25,303,207,568	49,098,376,098
- Subsidies Expenditures	-	-	-
- Grant Expenditures	-	-	5,650,000,000
- Social Support Expenditures	-	-	-
- Share Profit to Province Expenditures	-	-	22,875,356,325
- Financial Support to Province Expenditures	-	28,407,207,942	15,770,347,807
- Unexpected Expenditures	-	-	-
- Financial Support Expenditures	-	-	-
<b>Total of Indirect Expenditures</b>	13,005,175,780	53,710,415,510	93,394,080,230
<b>Direct Expenditures</b>			
- Employee Expenditures	-	1,541,005,000	12,217,367,766
- Goods and Services Expenditures	-	7,312,521,513	18,262,132,048
- Capital Expenditures	-	-	282,494,650
<b>Total of Direct Expenditures</b>	-	8,853,526,513	30,761,994,464
<b>Total Expenditures</b>	13,005,175,780	62,563,942,023	124,156,074,694

Table 3. Customers Data

Customer data obtained from questionnaires using a Likert scale in 2013.

Category	Question	Total weight of question					Total weight value	Score (%)	Score of Category (%)	STDEV (%)
		1	2	3	4	5				
Retention Customers	1	1	1	8	55	17	332	80.976	83.659	13.659
	2	1	0	4	44	33	354	86.341		
	3	3	6	19	49	5	293	71.463	70.976	17.110
	4	4	5	19	52	2	289	70.488		
Unsatisfied Customers	5	1	0	13	56	12	324	79.024	77.317	14.707
	6	1	5	16	49	11	310	75.610		
Customers Satisfaction	7	1	2	12	46	21	330	80.488	78.049	14.476
	8	2	1	15	59	5	310	75.610		
Punctuality of Tasks	9	4	6	29	36	8	287	70.000	71.341	18.818
	10	5	5	11	55	6	298	72.683		

Table 4. Internal Business Process Data

Internal business process data obtained from questionnaires using a Likert scale in 2013.

Category	Question	Total weight of question					Total weight value	Score (%)	Score of Category (%)	STDEV (%)
		1	2	3	4	5				
Staff Morale	1	8	10	32	22	10	262	63.902	74.878	18.097
	2	1	0	5	44	32	352	85.85		

Category	Question	Total weight of question					Total weight value	Score (%)	Score of Category (%)	STDEV (%)
		1	2	3	4	5				
Strategic Management	3	2	3	7	59	11	320	78.049	78.415	13.376
	4	1	0	10	63	8	323	78.780		
Productivity and Innovation	5	1	6	18	45	12	307	74.878	75.610	16.619
	6	3	1	15	52	11	313	76.341		
Efficiency and Affectivity	7	2	3	13	58	6	309	75.366	78.171	15.570
	8	2	2	7	50	21	332	80.976		
Retention to Technology	9	1	0	5	64	12	332	80.976	80.488	11.524
	10	1	0	8	62	11	328	80.000		

**Table 5. Learning and Growth Data**  
Learning and growth data obtained from questionnaires using a Likert scale in 2013.

Category	Question	Total weight of question					Total weight value	Score (%)	Score of Category (%)	STDEV (%)
		1	2	3	4	5				
Skill Level	1	5	11	17	41	8	282	68.780	71.829	17.429
	2	0	7	12	58	5	307	74.878		
Retention to Technology	3	2	4	13	61	2	303	73.902	73.293	13.908
	4	2	0	27	50	3	298	72.683		
Productivities	5	2	2	22	49	7	303	73.902	75.854	15.661
	6	3	2	7	59	11	319	77.805		
Customers Satisfaction	7	0	1	15	61	5	316	77.073	71.951	14.566
	8	4	8	32	32	6	274	66.829		
Customers Retention	9	3	4	29	41	5	287	70.000	69.878	16.703
	10	2	5	33	35	7	286	69.756		

### 3.3. Data processing

#### Validity

Validity test is a state that describes the level of the relevant instrument that able to measure what is to be measured.

Formula of  $r_{value} =$   

$$r_{value} = \frac{N\sum XY - \sum X \sum Y}{\sqrt{N\sum X^2 - (\sum X)^2} \cdot \sqrt{N\sum Y^2 - (\sum Y)^2}} r_{value} = \frac{N\sum XY - \sum X \sum Y}{\sqrt{N\sum X^2 - (\sum X)^2} \cdot \sqrt{N\sum Y^2 - (\sum Y)^2}} \quad [12]$$

Formula of  $t_{table} = (\alpha, N-2) \quad [12]$

Formula of  $r_{table} = \frac{t_{table}}{\sqrt{df + t_{table}^2}} \quad [12]$

**Reliability**

Reliability test is the measurement of the accuracy (consistency) of an instrument. This test is intended to ensure that the instrument used is an instrument that is reliable, consistent, stable and dependibalitas, so that when it is used multiple times to generate the same data.

Formula of Reliability Test  $= \alpha = \left(\frac{K}{K-1}\right) \left(\frac{S_r^2 - \sum S_i^2}{S_x^2}\right) \quad [12]$

**Normality**

Normality test is a test to measure whether our data have a normal distribution.

NO	Xi	$Z = \frac{X_i - \bar{X}}{SD}$	F <sub>T</sub>	F <sub>S</sub>	F <sub>T</sub> - F <sub>S</sub>
1					
2					
3					
4					
5					
dst					

Fig. 6. Table Kolmogorov Smirnov test.

$F_S = z \frac{\text{Number of digits up to the number } n_i}{\text{Number of all data}} [12]$

**3.4. Modeling balanced scorecard-system dynamics in software powersim 2005**

Causal loop models that have been constructed as described in Fig. 5, will be converted into a flow diagram and processed using software Powersim Studio 2005. Flow diagram is a mathematical model contains the components of the data processing. Flow diagram that has been constructed as described in Fig. 7.

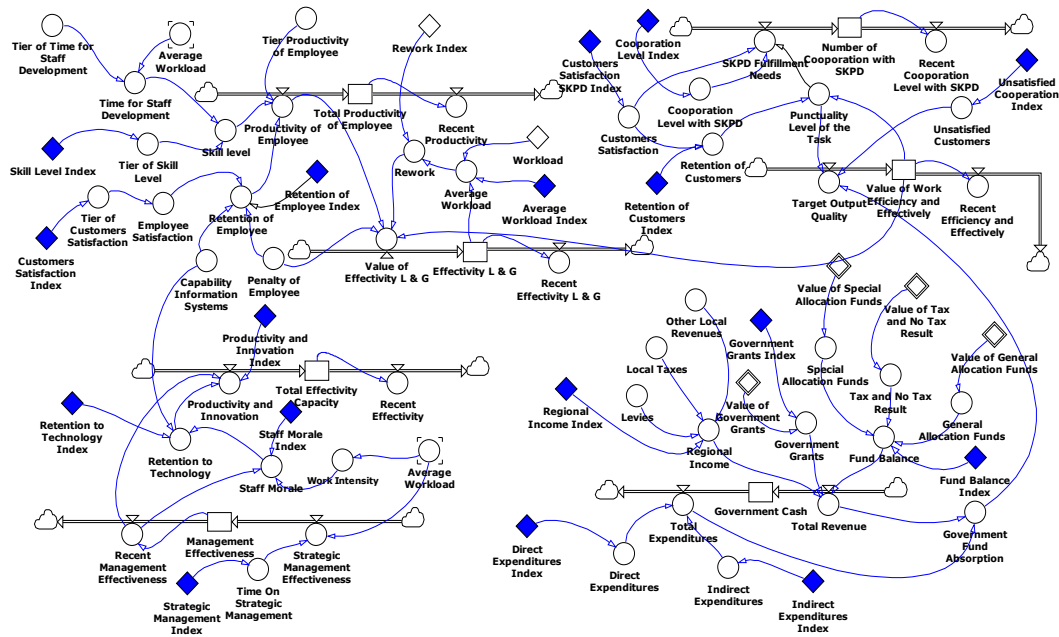


Fig. 7. Flow diagram model of the four perspectives BSC concept.

### 3.5. Model validation

Model validation is a necessary step to ensure that the model created has the same behavior as the real system. Validation is done by comparing the output of the system in fact with the output of the model that's been made. If the model has not been believed to behave similarly to the real system, then the next step will not be performed. In this research, model validation will be done withcausal loop based structural validation that have approved by experts/specialists.

## 4. Simulation results and discussion

Based on data analysis conducted in Section 3, this research consists of 4 research questions that will be discussed, designated to construct a model to help the government in making the policies to achieve the vision and mission of the Kepulauan Riau Province and also to measure the initial performance of the provincial personality. This section also provides deeper explanations based on research data and calculations in the previous section.

Validation of the model takes a relatively long time, by comparing the results of simulation and implementation results on a real system. Validation also requires the implementation of continuous observations to obtain optimal results in the validation of the model.

Causal Loop Diagram as a model of system dynamics based balanced scorecard to represent the cause and effect diagram of variable. Balanced scorecard as performance measurement method and system dynamics as simulation tool, combining both of them to achieve system dynamics based

balanced scorecard. Design of integrated between concept of Balanced Scorecard and System Dynamics in Kepulauan Riau Government can be seen in Fig. 5 for causal loop diagram and Fig. 7 for flow diagram.

**4.1. Performance in 2012**

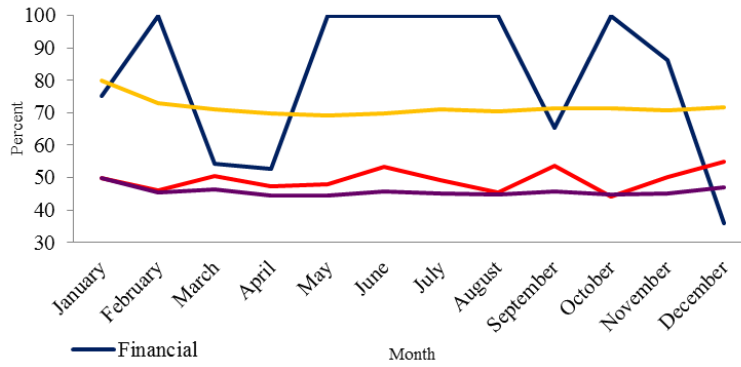
Table 6 shows detail value for each perspective in which to financial, customers, internal business process, and learning and growth sequentially is 80.82%, 49.40%, 71.64%, 45.75%. Performance that the research found from system dynamics based balanced scorecard can be seen on customers and learning and growth still in the range of 45% and 49%. So, the next design will be improved performance on two perspectives.

From Table 6 and Fig. 8, for the financial perspectives, we can see that within five years the government funds absorption is equal to 83.26%. There are also some points going 100% absorption, the absorption of funds occurred in whole or even on the lack of funds in the period. Amount of cash in the previous period are not taken into cash number, so full absorption is experienced with no minus calculation or a debt.

Internal business process score obtained was 70.91% showed the satisfactory performance when compared with customers and learning and growth that are only worth 45.96% and 45.93%. Improvements that needed in the 2 last perspectives are important perspective in improving relationships and the work quality in Kepulauan Riau government. Improvement in case of customers' perspective and learning and growth is needed to achieve the vision and mission of Kepulauan Riau Government.

**Table 6. The initial conditions performance of the Kepulauan Riau Government in 2012.**

Month (2012)	Financial (%)	Customers (%)	Internal Business Process (%)	Learning and Growth (%)
January	75.22	50.00	80.00	50.00
February	100.00	46.14	73.00	45.37
March	54.36	50.63	70.95	46.30
April	52.72	47.40	69.86	44.41
May	100.00	47.98	69.25	44.52
June	100.00	53.21	69.94	45.85
July	100.00	49.36	71.15	45.06
August	100.00	45.36	70.43	44.87
September	65.31	53.49	71.44	45.69
October	100.00	44.21	71.39	44.81
November	86.36	50.02	70.74	45.20
December	35.88	55.01	71.55	46.96
Average	80.82	49.40	71.64	45.75

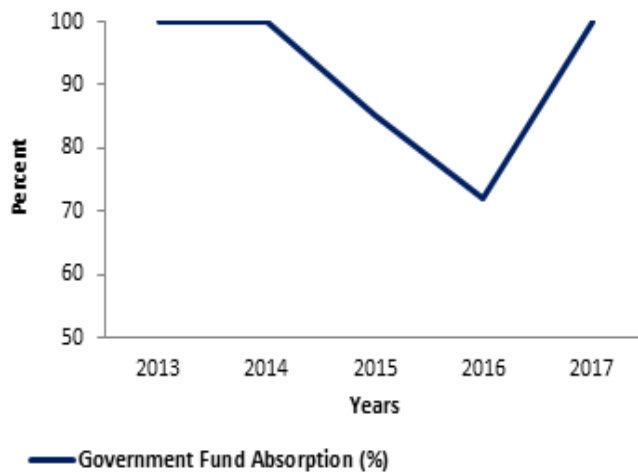


**Fig. 8. Performance of Kepulauan Riau in 2012.**

**4.2. Performance for the next 5 years (2013 – 2017)**

**Financial perspective**

The financial perspective, from the results of simulations run for 5 years from 2013 until 2017 as described in Fig. 9. Simulation results are obtained for the following funds absorption as follows respectively 100%, 100%, 85%, 72%, and 100%. From these results, could be explained that the absorption of the funds Provincial Government of Kepulauan Riau is good enough. Most influential variables in terms of financial perspective as described in Table 7, indirect expenditure (namely 50.05%), then direct expenditure (49.96%). While in the most influential variable income is tax and non-tax results (44.33%), local taxes (27.37%), the general allocation fund (20.60%), government grants (6.22%), other local revenue (0.89%), special allocation fund (0.51%), and local levies (0.08%).



**Fig. 9. Simulation result of financial perspective (2013 – 2017).**

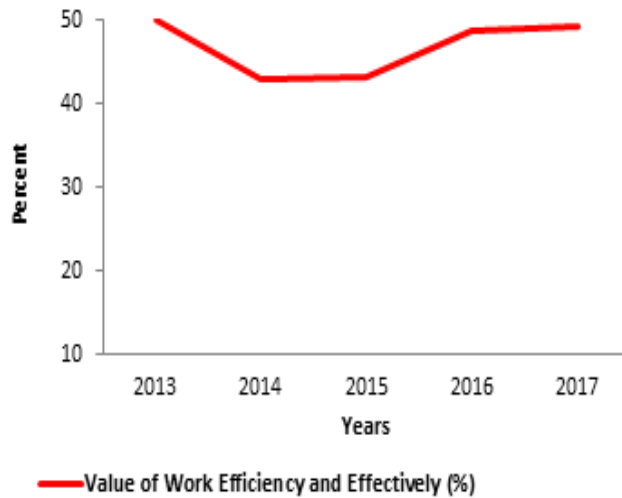


**Table 7. Percentage contribution variable of financial perspective.**

Variable	Contribution (%)
<b>Expenditures</b>	
a) Direct Expenditures	49,96
b) Indirect Expenditures	50,04
<b>Revenue</b>	
<b>Regional Income</b>	
- Local Taxes	27,37
- Levies	0,08
- Other Local Revenues	0,89
<b>Fund Balance</b>	
- Tax and Non - Tax Result	44,33
- General Allocation Funds	20,60
- Special Allocation Funds	0,51
- Government Grants	6,22

**Customers perspective**

Figure 10 shows the simulation result for 5 years, from 2013 until 2017. The efficiency and effectiveness of the simulation in year 2013 until 2017 are 50%, 43%, 43%, 48%, and 49% respectively. This suggest that the efficiency and effectiveness are low.



**Fig. 10. Simulation result of customers perspective (2013 – 2017).**

Table 8 described the percentage of contribution variable ini customer perspective. The highest contribution is unsatisfied customers (48.09%), the

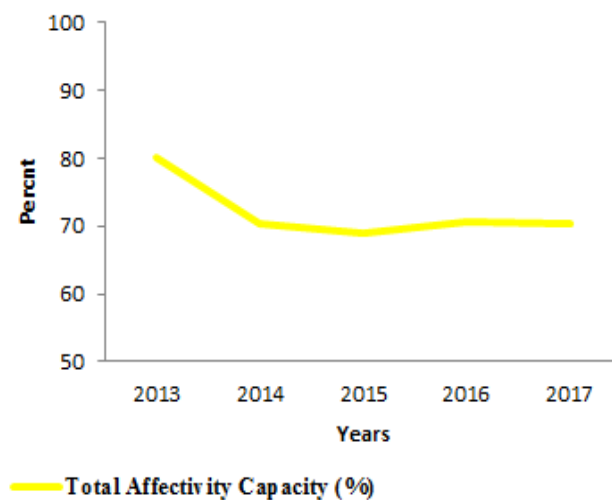
Punctuality rate in the task (25.09%), retention of customers (14.79%), and customer satisfaction (12.03%).

**Table 8. Percentage contribution variable of customer perspective.**

Variable	Contribution (%)
Customers satisfaction	12,03
Retention customers	14,79
Unsatisfied customers	48,09
Punctuality level of the task	25,09

### Internal business process perspective

The internal business process perspective, from the results of simulations run for 5 years from 2013 until 2017 as described in Fig. 11. Simulation results obtained the total value of the effective capacity in the internal business process as follows respectively 80%, 71%, 69%, 71%, and 70%. From these results could be explained that the total effective capacity of the internal business process in the Provincial Government of Kepulauan Riau is considered sufficient. In the internal business process perspective, the most influential variable in percentage as described in Table 9, namely productivity and innovation (50.77%), Intensive work (15.00%), strategic management effectiveness (13.94%), staff morale (1.94%), capability information systems (9.51%), and retention of the technology (8.86%).



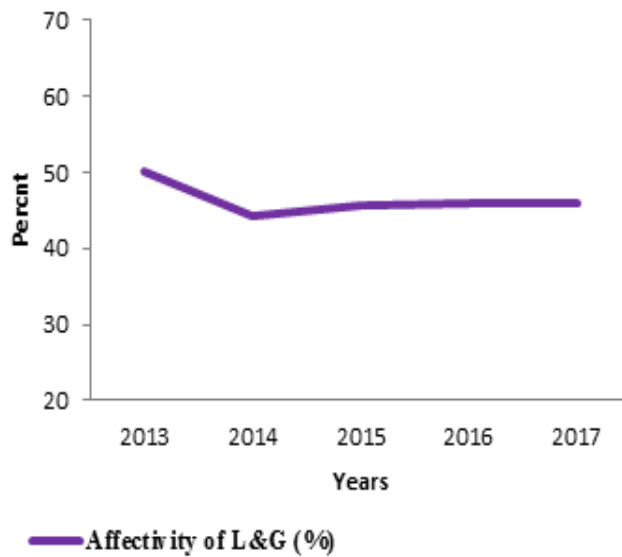
**Fig. 11. Simulation result of internal business process perspective (2013 – 2017).**

**Table 9. Percentage contribution variable of internal business process perspective.**

Variable	Contribution (%)
Capability information systems	9,51
Retention to technology	8,86
Productivity and innovation	50,77
Staff morale	1,94
Strategic management effectiveness	13,94
Work intensity	15,00

**Learning and growth perspective**

The learning and growth perspective, from the results of simulations run for 5 years from 2013 until 2017 as described in Fig. 12. Simulation results obtained from the effective value in the learning and growth as follows respectively 50%, 44%, 56%, 47%, and 46%. These results could be explained that effective learning and growth in the Provincial Government of Kepulauan Riau deemed not good or less. In the learning and growth perspective of the most influential variable, based on the proportion of the percentage in influencing the learning and growth perspective as described in Table 10, namely skill level (27.98%), sanctions against employees (20.28%), time for staff development (12.38%), workload (12.38%), rework (10.36%), employee satisfaction ( 8.31%), capability information systems (8.31%), and retention of employee (8.07%).



**Fig. 12. Simulation result of learning and growth perspective (2013 – 2017).**

**Table 10. Percentage contribution variable of learning and growth perspective.**

Variable	Contribution (%)
Skill level	27,98
Customers Satisfaction	8,31
Capability Information Systems	8,31
Penalty of employee	20,28
Retention of employee	8,07
Rework	10,36
Time for staff development	12,38
Workload	12,38

## 5. Conclusion and future work

This paper examined the Hybrid BSC and SD in Provincial Government of Kepulauan Riau. Integration model of the performance measurement design concept between the balanced scorecard and system dynamics in the Provincial Government of Kepulauan Riau is in accordance with Figure 1 (causal loop) and Figure 2. (Flow diagram). Integration of BSC SD and percentage of variables that affect each perspective ranged from large to small in the causal loop are as follows: The most influential variable in financial perspectives was Tax and non-tax results (44.33%), the smallest influence variable is levies (0.08%). The most influential variable in customer's perspective is unsatisfied customers (48.09%), the smallest influence was customer's satisfaction variables (12.03%). The most influential variable for internal business process is productivity and innovation (50.77%), the smallest influence was staff morale variable (1.94%). The most influential variable for learning and growth perspective was a skill level (27.98%), the smallest influence is retention of employee variable (8.07%).

Future work in this research is undertaking research to identify the activities of the variables that have been known for the influence of these variables in improving the performance of each BSC perspective

## Acknowledgments

This research was carried out in Government of Kepulauan Riau Province, the data was established from Mrs. Emilia and derived from 2012.

## References

1. Kaplan, R.S., & Norton, D.P. (1996). *The Balanced Scorecard, Translating Strategy Into Action*. Massachusetts: Harvard Business Scholl Press.
2. Davis, S., & Albright, T. (2004). An investigation of the effect of Balanced Scorecard implementation on financial performance. *Management Accounting Research* 15 , 135-153.

3. Bhagwat, R., & Sharma, M.K. (2007). Performance measurement of supply chain management A balanced scorecard approach. *Computers & Industrial Engineering*, 43-62.
4. Northcott, D. (2011). Using the balanced scorecard to manage performance in public sector organizations Issues and challenges. *International Journal of Public Sector Management*, Vol. 25 Iss: 3, 166-191.
5. Ioppolo, G., Saija, G., & Salomone, R. (2012). Developing a Territory Balanced ScoreCard approach to manage projects for local development: Two Case Studies. *Land Use Policy*, 629-640.
6. Linard, K., Bassett, M., Yoon, J., & Lubomir, D. (2001). A Dynamic Balanced ScoreCaer Template For Public Sector Agencies. *Proceedings Document*.
7. Akkermans, H., & Oorschot, K.V. (2002). Developing a Balanced Scorecard with System Dynamics. *International Conference of the System Dynamics Society*.
8. Forrester. (1961). *Industrial Dynamics*. Massachusetts - U.S.A: The M.I.T. Press Massachusetts Institute Of Technology.
9. Santos, S., Belton, V., & Howick, S. (2001). Adding Value to Performance Measurement by Using System Dynamics and Multicriteria Analysis. *Strathclyde Business School*, Research Paper No. 2001/19.
10. Atkinson, A.A., Banker, R. D., Kaplan, R.S., & Young, M.S. (1997). *Management Accounting*. New Jersey: Prentice Hall, Inc.
11. Synodinos, N. (2003). The 'art' of questionnaire construction: some important considerations for manufacturing studies. *Integrated Manufacturing System*, Vol. 14 no. 3.
12. Walpole, E.R., & myers, H.R. (1986). *Science opportunities and statistics for engineers and scientists*. Bandung: ITB.
13. Chen, F.H., Hsu, T.S., & Tzeng, G.-H. (2011). A balance scorecard approach to establish a performance evaluation and relationship model for hot spring hotels based on a hybrid MCDM model combining DEMATEL and ANP. *International Journal of Hospitality Management*, 30(4), 908-932. doi:10.1016/j.ijhm.2011.02.001.
14. Grigoroudis, E., Orfanoudaki, E., & Zopounidis, C. (2012). Strategic pcrformance measurement in a healthcare organisation: A multiple criteria approach based on balanced scorecard. *Omega*, 40(1), 104-119. doi:10.1016/j.omega.2011.04.001.
15. Lin, Q.L., Liu, L., Liu, H.C., & Wang, D.J. (2013). Integrating hierarchical balanced scorecard with fuzzy linguistic for evaluating operating room performance in hospitals. *Expert Systems with Applications*, 40(6), 1917-1924. doi:10.1016/j.eswa.2012.10.007.
16. Wu Hung Yi. (2012). Constructing a strategy map for banking institutions with key performance indicators of the balanced scorecard. *Evaluation and Program Planning*, Volume 35, Issue 3, August, 303-320.
17. Alolah Turki, Stewart Rodney A., Panuwatwanich Kriengsak, Mohamed Sherif. (2014). Determining the causal relationships among balanced scorecard perspectives on school safety perfomance: Case of Saudi Arabia Accident Analysis & Prevention, Volume 68, July 2014, Pages 57-74.

18. Bhagwat R., & Sharma, M.K. (2007). Performance measurement of supply chain management: A balanced scorecard approach. *Computers & Industrial Engineering*, 53(1), 43-62. doi:10.1016/j.cie.2007.04.001.
19. Huang, H.C. (2009). Designing a knowledge-based system for strategic planning: A balanced scorecard perspective. *Expert Systems with Applications*, 36(1), 209-218. doi:10.1016/j.eswa.2007.09.046.
20. Senarath, S.C.L., & Patabendige, S.S.J. (2015). Balance Scorecard: Translating Corporate Plan into Action. A Case Study on University of Kelaniya, Sri Lanka. *Procedia - Social and Behavioral Sciences*, 172, 278-285. doi:10.1016/j.sbspro.2015.01.365.
21. Veen-dirks, P. Van, & Wijn, M. (n.d.). Strategic Control: Meshing Critical Success Factors with the Balanced Scorecard, 35 (2002), 407-427.
22. Kaisheng Zeng, Xiaohui Luo, (2013), *The balanced scorecard in China: Does it work?*
23. Business Horizons, Volume 56, Issue 5, September-October 2013, Pages 611-620.