System dynamics simulation to determine financial strategy for social health insurance in Indonesia

Diva Kurnianingtyas, Budi Santosa, Nurhadi Siswanto

Industrial Engineering Department, Institut Teknologi Sepuluh Nopember Surabaya Indonesia, Indonesia.

Email: siswanto@ie.its.ac.id.

Abstract. Social Health Insurance (SHI) in Indonesia is still experiencing financial constraints because the financial condition of the SHI has continued to be a loss since it was established in 2014 until present so it becomes special attention needed to get achieving the Universal Health Coverage (UHC) target by the government. Therefore, this study intends to provide an appropriate SHI financial strategy recommendation by considering the stability of the balance of income and expense. In addition, a system dynamics simulation approach is needed to find optimal SHI financial strategies with variables including participant premium rates, average cost of benefits, number of health cases, and number of insurance participants. The data used came from BPJS Health data for 2016 and 2017. Afterwards, the equation used was Income ≥ Expenditures. In addition, there are several scenarios designed to reduce the level of financial losses that occur at SHI. The scenario of reducing the number of health cases is the best strategy recommendation decision. The results show that reducing average benefit costs and increasing premium rates also gets it can reduce financial problems. From the results that have been obtained, this study can contribute to the resolution of SHI Health financial problems in Indonesia.

1. Introduction
Social Health Insurance (SHI) is one of the central government programs that has shown interest in expanding access to health services. This scheme offers free health programs to the community (Sparrow et al., 2013). The SHI program in Indonesia is seen as a response to the challenges of general policy due to the lack of a comprehensive national health insurance policy [2]. The institution that manages SHI in Indonesia is the BPJS Health program [10].

National Health Insurance Agency (BPJS) is an institution designated based Law No. 40 in 2004 and Law No. 24 in 2011. Institutions formed by the government to organize National Social Security, one of which is the BPJS Health program [10]. Since the program was implemented, many have passed through one of them with an increase in financial shortages every year [11]. Based on BPJS Health data in 2014, SHI in Indonesia have experienced a loss of 1.94 trillion. Then, at the end of 2015, the loss was 5.85 trillion and the loss rose in 2016 to 9.2 trillion [7]. In these data, losses can be occurred because financial condition experiencing imbalance between income and expense. In addition, a loss give impact in decreasing the equity value of the program [3].

To suspend ongoing loss in the SHI program in Indonesia, the government issued a policy. The policy is to impose new premium rates to replace previous premium rates [6]. The policy was based on government speculation that assumed the loss that occurred due to premium rates of participation paid was lower than the health costs incurred by SHI [7]. Incompatibility with government expectations
due to many participants did not agree with the policy. SHI participants feel that premium rates determination are not comparable to the services provided by SHI [3].

From a number of problems at Social Health Insurance (SHI) in Indonesia, it is necessary to review them by using SHI finance by raising premium rates from previously set. Basically, the increase in fixed premiums has not been able to give an impact to reduce the loss on SHI's finances [6]. There are many steps that need to be determined by the government to maintain the sustainability of the SHI program, namely reducing the package of health services, adjusting and allocating funds from the APBN. In connection with that, a system dynamics approach is needed at this time to find out the causes of SHI finance problem in Indonesia. With a system dynamics model approach, it can find out the trigger of the problem. This basic model is to build a system using relationships that affect the structure inside. Therefore, this research is very important because it provides the right information for SHI managers in Indonesia so that financial problems are quickly resolved.

2. Methodology
The study was conducted using a system dynamics approach to find solutions to financial problems of Social Health Insurance (SHI) in Indonesia for preventing loss financing. The data currently used is obtained from the audited BPJS Health Financial Report from 2016 to 2017. The data needed include the number of Non-Recipient Participants (PBPU) per service class, total expense, total income, number of First Level Inpatient cases (RITP), number of First Level Outpatient cases (RJTP), number of Advanced Level Outpatient cases (RJTL), the number of Advanced Level Inpatient Cases (RITL), and health costs of each person in each case.

The steps to carry out this research will be shown in the flow diagram of Figure 1. Next, in detail the methodological stages are explained as follows.

a. Modelling
There are four stages to design the model with a system dynamics approach, including building a Causal Loop Diagram, creating a Stock Flow Diagram, performing Verification and Validation Models, designing several scenarios, and analyzing result.

In developing the SHI system model in Indonesia, the variables that will be considered are income and expense that can determine the financial condition of the SHI. In addition, the independent variable is premium rates and average cost of benefits. Premium rates variable use a sample of Participants Not Recipient Wages (PBPU) premium rates determination. Other than PBPU participant, other premium rates determination represented in Other Premium rates variable which is set at a rate. Meanwhile, the sample for health costs uses the allocation of average cost of benefits in FKTP and FKRTL. The results of this system dynamics will contribute by providing financial strategy recommendations.
b. Causal Loop Diagram
Based in this research, the existing financial conditions in Social Health Insurance (SHI) in Indonesia modeled uses the Causal Loop Diagram (CLD). The special virtue of CLD is to make connections and connect between variables that affect the financial condition of the SHI based on related data, literature related to the SHI, and the BPJS Health system. CLD which is designed will shown in Figure 2 below.
Figure 2. Causal Loop Diagram.

c. Stock Flow Diagram
Stock Flow Diagrams (SFD) concept is needed to know both the patterns and relationships between variables. SFD can be used to determine the suitability of the model with behavior in actual conditions. The SFD design will be carried out in Figure 3.
d. Verification and Validation Model
In conducting verification, the model will be proven by ensuring that the process implementation to the Stella tool does not occur a bug. Based on the definition, the process carried out by running the model that has been made. In this study, verification is done by checking the units each variables on the model that has been built correctly. Furthermore, ensuring the output of the model is accurate, acceptable and in accordance with validation. At this stage, result of validation will be avowed if the results of the verified model matching with the data that has been obtained so that the base model can be said to be accurate.

e. Design Scenario
After the basic model that has been built is valid, then the next is the planning some scenario. The scenario is intended to be able to find out what factors can cause loss of social insurance in Indonesia. There are several scenarios that have been planned, including:
1. Scenario 1 – Increasing Premium rates
Make changes to the value of premium rates for Class 1, Class 2, and Class 3 as much as 20% of the initial provisions. The change in value will be shown in Table 1.
**Table 1.** Change in Variable Value for Scenarios 1.

| Class level in the PBPU segment | Government Determination (Initials) | Increased by 20% |
|--------------------------------|-----------------------------------|------------------|
| Class I                        | 80.000                            | 96.000           |
| Class II                       | 51.000                            | 61.200           |
| Class III                      | 25.500                            | 30.600           |

2. **Scenario 2 – Decreasing Average Cost of Benefits**

Make changes in the value of the variable cost of care at the First Level Health Facility (FKTP) and the Advanced Referral Level Health Facility (FKRTL) as much as 20% of the initial provision. Calculations to obtain data on average maintenance costs are assumed to use Equation 1 below.

\[
\text{Average cost of benefits} = \frac{\text{Total of benefits cost}_i}{\text{Total inpatient cases} + \text{Total outpatient cases}}
\]

Data and changes value variable will be shown in Table 2.

**Table 2.** Change in Variable Value for Scenarios 2.

| Health facility         | Average cost of benefits | Initial | Decreased by 20% |
|-------------------------|--------------------------|---------|------------------|
| First level             | 108,230                  | 86,584  |
| Advanced Referral level | 887,343                  | 709,874 |

3. **Scenario 3 – Decreasing Number of Cases**

Changing values in case variables is as much as 20% of the initial provision. The following are shown changes in the value of the variables in Table 3.

**Table 3.** Change in Variable Value for Scenarios 3.

| Health facility         | Total of Case (millions) |
|-------------------------|---------------------------|
|                         | BPJS Kesehatan data (Initial) | Decreased by 20% |
| First level             | 150,300,000               | 120,240,000     |
| Advanced Referral level | 73,100,000                 | 58,480,000      |

4. **Scenario 4 – Increasing Number of Cases in FKTP and Decreasing Number of Cases in FKRTL**

Changing values for case variables in FKTP and FKRTL was approximately 10 million from the initial provision. The reason for this scenario is that based on Table 2, the average cost of benefits in FKTP tend to be cheaper than the average cost in FKRTL. Changes in the value of variables will be shown in Table 4 below.

**Table 4.** Change in Variable Value for Scenarios 4.

| Health facility         |
|-------------------------|
| First level             |
| Advanced Referral level |
5. Scenario 5 – Number of Participants
Running in Stella tools from 2016 to 2019 is to find out the total participants. If the model built in 2019 can reach the target set by the SHI manager in Indonesia, amounting to 257.5 million people registered, this variable does not need to be changed.

f. Analyzing of Result
The next stage is analyzing the results of several scenarios so that obtain the right strategy for the financial condition of SHI in Indonesia. In finding this strategy, an equation is needed to find out the financial condition of the SHI shown by Equation (1) below.

\[ \text{Income} \geq \text{Expense} \]  

(1)

If the results obtained from the financial condition variable can be equated with Equation (1) then the strategy has a positive impact on the financial of SHI in Indonesia because the results obtained are financial conditions that are surplus or balance not loss.

3. Results
Social Health Insurance (SHI) in Indonesia is experiencing problems in the financial aspects because of financial conditions where the loss continues to increase. The financial condition of SHI is shown in Figure 4 below.

![Financial Condition - Existing Condition](image)

**Figure 4.** Existing Condition in Indonesia.

Based on Figure 4, the financial condition of SHI in Indonesia will continue to experience a loss until the following years. The conditions like this are a problem that should be worth investigating further and found solutions for the short and long term. The financial condition of losses occurs when the income imbalance is received and the expense borne by the SHI management [6]. It has been proven in Figure 4 that the expense borne by SHI continues to increase but the income earned cannot cover the expense incurred.

The factor assumed in this study has an important influence on the financial problems of SHI in Indonesia, namely premium rates, average cost of benefits, number of health cases, and the number of
insurance participants. The first scenario that is raised is to change the value of initialization of premium rates. The government is advised to provide policies by increasing premium rates because of the SHI's financial loss [6]. The rationale is that financial loss are caused by the participants premiums lower than the benefits costs incurred by the SHI managements [7]. Therefore, the scenario built in accordance with the speculation is to increase the premium rates set by the government. Change in variable values according to Table 1 so that the results of the scenarios obtained are shown in Figure 5.

![Financial Condition - Scenario 1](image)

**Figure 5.** Result of Scenario 1.

The results obtained from running the scenario on Stella's tool starting from 2016 to 2026 are the financial conditions of the SHI in Indonesia which continue to experience a loss if the government's decision continues to raise premiums. The results obtained from this scenario are inversely proportional to other researchers who explain that raising premiums can overcome the problem of losses. The decision to increase premiums was only to charge SHI participants but did not provide a solution to the current financial condition of SHI which was still in loss. Expenses that continue to increase cannot be covered by increasing premiums unless the premium increase is very high but it has violated the vision of SHI which will provide quality and sustainable health insurance rather than burden the Indonesian people.

The next scenario is to reduce the average cost of benefits. The average cost of benefits is the average health cost used by each SHI participant when doing both inpatient and outpatient care at a First Level Health Facility (FKTP) or Advanced Referral Level Health Facility (FKRTL). Based on Figure 5, this scenario will have a positive impact on the financial condition of the SHI in Indonesia because it is clearly seen in Figure 5 that expenditure continues to increase each year so this speculation is the reason. The change in variable values shown in Table 2 is needed to find the results represented in Figure 6.
Based on Figure 6, the results obtained by lowering the average cost of benefits tend to be better. The financial condition has not experienced a loss from 2018 to 2022 so that this scenario can be considered as a short-term strategy recommendation. That is, to reduce loss problems, reducing the average cost of benefits can provide a solution even though it does not have a significant and sustainable effect.

Then, the next scenario is to reduce the number of health cases in FKRTL and increase the number of cases in FKTP. Although the third scenario has obtained results that match expectations, this fourth scenario can also get better results than the previous scenario. Speculation that has been built is that the average cost of benefit for FKRTL is higher than FKTP so that cases of diseases that can be handled in FKTP do not need to be referred to FKRTL. In fact, this incident is increasingly prevalent because of the high number of non-specialist cases referred from FKTP to FKRTL. Variable changes are shown in Table 4 so the results of this scenario are shown in Figure 7.

Based on Figure 7, the results obtained tend to be similar to the results of the scenario of raising premium rates. The financial condition by conducting scenarios of reducing the number of cases in FKRTL and increasing the number of cases in FKTP is still experiencing a loss until 2027. Strategies
like this are not appropriate to be used as a solution to the problems of SHI's financial loss in Indonesia.

Furthermore, the scenario that was built was to reduce the number of patients using health services both inpatient and outpatient care at FKTP and FKTRL. This scenario is assumed to have a positive impact on the financial condition of the SHI because the expense of health services is also influenced by the number of visits of participants to request health services for both FKTP and FKRTL. The variable value will be reduced by 20% to find out its effect with the data shown in Table 3. The results of running this scenario are shown in Figure 8.

![Financial Condition - Scenario 3](image)

**Figure 8.** Result of Scenario 3.

Based on Figure 8, the results obtained have a positive impact because from 2018 to 2027 there has never been a loss. In addition to taking the strategy in the second scenario, SHI managements and the government must also balance by cultivating healthy living in Indonesia so as to reduce SHI participants to use health services and enable SHI participants to only use First Level Health Facilities (FKTP) for monthly checks.

Scenarios such as premium rates, average cost of benefits, and number of cases have been built by increasing and decreasing factor values. In addition to these factors, the number of insurance factors of participants are likely to have an influence on financial SHI in Indonesia. From this assumption, the base system will be tried to find out the number of insurance participants can reach the target or not, the results will be shown in Figure 9.
Based on Figure 9, the number of insurance participants in 2019 can reach 302 million, which is obtained from running the base system that has been built from 2016 to 2019 even though the target to be achieved by the government is only 257.5 million. Such a situation can be achieved if the parties concerned can coordinate with each other so that the government vision to achieve the UHC is achieved. From these results, the number of insurance participants can exceed the target, meaning that this variable has no effect on reducing the loss rate.

4. Discussion
The increase in SHI participant premiums in Indonesia is a government policy in 2016 to overcome the financial health BPJS that has continued to experience losses over the past four decades. This problem still continues until mid-2018, the policy felt by SHI participants that the increase in previous premiums is considered not comparable to the services provided by SHI. In addition, the increase in premiums still cannot overcome the problem of the financial loss that has occurred. Based on Figure 10, by increasing 40% of the premiums set in 2016, the finance of the new SHI in Indonesia could not experience a loss. Examples of price estimates for premium rates for Class I PBPU are Rp. 112,000, Class II Rp. 71,400, and Class III Rp. 35,700. From the expectation of this premium increase, the most feared is that SHI participants objected so that participants were registered with SHI but made payments every month. This passive participant can become a new problem for SHI in Indonesia.
Another influential factor is average cost of benefits. Benefits costs will continue to increase each year due to inflation. Based on Figure 11, the financial condition of the SHI did not occur losses starting in 2019 until 2026 if it made a 50% reduction in benefits to participants. If now SHI has provided 100% health services from FKTP and FKRTL means that half of these services will be eliminated to overcome this loss finance. Whereas, if the reduction is only on FKRTL, then a 60% reduction in benefits is needed so that the financial condition does not experience a loss in accordance with Figure 12. This policy will have a negative impact on the sustainability of the program because SHI participants feel disadvantaged by using SHI. Participants have paid each month to use the SHI but the benefits offered are not complete. In addition, this benefit reduction policy will violate regulations that will provide health insurance for the people of Indonesia.
5. Conclusion
In making a system dynamics simulation model, this model has been said to be valid and in accordance with the real system because the output is the same as the original data. This system simulation model can be a reference for determining SHI financially related strategy policy and can be a reference for conducting SHI financial simulations whose main indicator is a balance between income and expenses.

Scenarios are made to provide recommendations related to the improvement of the SHI system in Indonesia. There are five scenarios built in this study including increasing premium rates, lowering the average cost of benefits, lowering the number of health cases, increasing the number of health cases in FKTP and reducing the number of health cases in FKTRL, and running the number of insurance participants up to the year 2019. The results that have been obtained from scenario are that scenarios by lowering the number of health cases have results that match expectations. In addition, from the sensitivity test, the right strategy recommendations can be obtained for the short and long term so that the financial loss of the SHI can be overcome. The strategy by increasing the premium rate by 20-30% by reducing the 20-30% benefit is the best short-term strategy step. Furthermore, the long-term strategy, the government must be more active in promoting the culture of healthy living in Indonesian society so that there is a reduction in visits to health services both FKTP and FKTRL.

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