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# Risk Mitigation Design as a Proposed Improvement of Blood Supply Chain During the Covid-19 Pandemic Using House of Risk and System Dynamic

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**ABSTRACT**
Every service company or manufacture definitely has and will not separate from supply chain management. Like in health supply chain management, for example one of them is blood supply chain. Before pandemic Covid-19, UDD Indonesian Red Cross (PMI) can do all the tasks that has been planned. But unfortunately, Activities such as blood donation during the COVID-19 pandemic have become hampered/reduced in intensity. Damage to the blood supply chain due to disasters can lead to failure of activities such as improper distribution and lack of blood. Based on these conditions, there needs to be risk management by identifying risks associated with blood supply chain during the pandemic. HOR and System Dynamics used to identify the most dominant risks and after that we can see the effect to other variables in the system use System Dynamics approach. Based on HOR data processing there are 21 risk events and 28 risk agents. From 28 risk agents there are 5 dominant risk agents that must be handled priority. From 5 dominant risk agents obtained 8 prevention actions. Variable dominant risk agent and prevention action used in the simulation System Dynamics and obtained simulation results there are 3 policies that must be done immediately.

***Keywords:*** *Blood Supply Chain, HOR data, Prevention Action*

## 1. INTRODUCTION

Every service company or manufacture definitely has and will not separate from supply chain management. Not only in companies but also in organizations. According to Heizer &Render (2004) supply chain management is the integration between all activities in the company, namely materials and service procurement activities, converting goods into semi-finished goods until the final product, as well as delivery to customers. In the development of the business world, companies need to pay attention to supply chains related to possible problems and ensure that the supply chain can support the company's activities and strategies [1]. Blood is one of the important components for the body consisting of blood cells called blood plasma. The function of blood is as a carrier of various nutrients needed by the body such as oxygen, food, and others. The volume of blood in the human body is 1/12 of the body weight [2]. Blood itself is a perishable product that in its delivery and availability must be timely and available to be given to patients in need to reduce mortality [3].

The Indonesian Red Cross (PMI) is one of the national association organizations in Indonesia based in Jakarta, the organization is engaged in social humanity. PMI has 3 types of main service activities, namely disaster preparedness, community-based first aid, and blood donation. To reach regions in Indonesia, PMI has 408 branches at the district / city level. PMI Gunungkidul Regency branch is one of the branches of PMI in charge of blood donation activities and providing blood supplies for the benefit of the community. Like the company, PMI Gunungkidul Regency branch also has a supply chain, especially in blood supply chain. supply chain management in the health sector is much more complex than other industries because it has a higher level of variation [4]. In blood supply chain there are 4 main processes, namely blood collection, product processing, laboratory testing and storage and distribution of blood products [5].

 

This is similar to the activities in PMI, especially in blood donation units (UDD).

Activities in the supply chain have a variety of risks encountered as well as affect the supply chain. Supply chain risk is an event that causes damage and negatively affects business processes in the supply chain [6]. Under normal circumstances before the COVID-19 pandemic, UDD PMI in carrying out tasks, especially in the collection of blood from donors can be done by holding a mass blood donation in several places such as Kecamatan, field or donors who have often made blood donations will come to the PMI office to make voluntary blood donations. Activities such as blood donation during the COVID-19 pandemic become hampered / reduced in intensity due to government policies such as social distancing, PSBB, and in addition, people during the COVID-19 pandemic tend to be afraid to donate blood. Based on the data of the average voluntary donors obtained from the Gunungkidul Branch PMI before and after the COVID-19 pandemic, the average daily donors who come to PMI decrease significantly to 50% from 10-12 people in the period before the pandemic to 5-6 people in the period after the COVID-19 pandemic.

In addition, the diversity of easily damaged blood products, errors in the blood transfusion process, and uncertainty in the demand for blood from hospitals are also problems that affect the blood supply chain [7] [8]. In some emergency cases, a lack of blood supply can lead to an increase in patient deaths, while expired blood will incur additional costs [4]. There are conditions where the PMI gunungkidul district branch must do more activities such as finding donors from among the families of employees themselves to get blood donors, so that the demand for blood remains met. Based on data obtained from the Gunungkidul Branch PMI there were 229 bags of surrogate donor blood from February-August 2020 during the COVID-19 pandemic. Damage to the blood supply chain due to disasters can lead to failure of activities such as improper distribution and lack of blood. Therefore, during the disaster, blood transfusion activities become a serious problem [9].

Based on these conditions, there needs to be risk management by identifying risks associated with blood supply chain during the COVID-19 pandemic and its effect on the variables in the system. According to Waters (2011) in Abtahi research, Risk management is the process of identifying, analyzing, and designing the right plan to control it. The purpose of risk management is to take precautions against an event that can cause harm, and basically not to eliminate [10].

Therefore, this study aims to identify all risks that affect the blood supply chain as well as to determine the mitigation design that can be done by the Pmi Gunungkidul Regency Branch as a new strategy in carrying out tasks in new normal conditions. The method used is House of Risk (HOR), the method has 2 phases namely HOR phase 1 and HOR phase 2. HOR phase 1 is used to rank risk agents according to their significant level through aggregate risk potential (ARP) calculations. In the identification of risks and risk agents in the blood supply chain PMI Gunungkidul Branch is carried out using risk assessment. HOR phase 2 is used to identify the right mitigationmeasures [11]. System Dynamic is used to look at all variables in the system holistically, especially the risk variables that have been identified and their influence on other variables that are realized by modeling the condition of PMI Gunungkidul Branch during the COVID-19 pandemic. The first step is to create a causal loop diagram (CLD) to find out the causal relationship of variables in pmi. It then formulates each variable that has been identified into a flow diagram (FD). So that the System Dynamic simulation will be used to project how effective the mitigation measures that have been proposed by researchers if implemented and to know operational costs if applying mitigation measures. So that the PMI gunungkidul district branch can have a new strategy in dealing with problems.

### *1.1. Indonesian Red Cross (PMI)*

Indonesian Red Cross which is a PMI is a non-profit organization or wrong also with semi-public organizations active and strategic role in the field of social humanity [12]. According to Government Regulation No. 7 of 2019, PMI is a national association that stands on the basis of humanity and on the basis of beavers with no distinction between nations, groups, and political understanding. PMI pairs some of the main tasks in terms of a quality and timely service, the tasks are Maintenance of humanitarian aid in case of emergency and implementation of social services and public health such as one of them is blood donation.

### *1.2. Supply Chain Management*

Supply chain is all activities that include the flow and transformation of goods or services from the initial stage that is still in the form of raw materials to the end user that is the customer and also related to the flow of information [13]. While supply chain management (SCM) is a method, tool, or an integrated approach with the basis of collaboration and coordination to manage a network that exists in companies, in the concept of SCM in the company there are suppliers, factories, distributors, stores / retail, logistics services, etc. that simultaneously work to create and deliver a product into the hands of end users /end users [14].

### 1.3. Risk Definition

There are several definitions of risk. First, risk is defined as the chance of an event that causes losses due to uncertainty of what will be faced [15]. Second, definition of risk is an event that has a negative impact on the company's goals and strategies [16].

### 1.4. Risk Management

Risk management is the location of the science of how to organize so that in the case of being a key figure that exists with its location in conjunction with complete management and systematic [17] [10]. While according to Hanggraeni (2010) in Sirait research (2016) risk management is interpreted to a series and methodology procedures that for the location of eni, monitoring, and from a risk arising. There are 7 steps in the risk management process [18]:

1. Communication and consultation
2. Build context
3. Identify risk events
4. Perform risk event analysis
5. Evaluate risk events
6. Risk treatment
7. Monitor and review

### 1.5. Supply Chain Risk Management

Supply chain risk management (SCRM) is an approach used to monitor / control the risks carried out in the supply chain structure. Risks arising in the supply chain generally arise in activities such as scheduling, technology and uncertainty of costs [18].

### 1.6. House of Risk (HOR)

House of risk (HOR) is one of the methods used to analyze risk. The method is taken from the principle of Failure Mode and Error Analysis (FMEA) which is generally used to measure risk quantitatively combined or combined with the House of Quality (HOQ) used to know the relationship between risks with each other and to prioritize risk agents that must be prioritized. Then design and choose an action that can reduce the severity and emergence of the onset of risk [4] [17].

### 1.7. System Dynamics

System Dynamic is one of the methods used in modeling a system to predict an event and create new policies related to predictive results. System Dynamic can produce better predictions in long, medium, and/or short-term trends. In addition, this method can also identify all the variables that exist and have an effect in a system. Here are the steps in modeling system as follows [19] :

1. Identify and define problems
2. Conceptualizing a system
3. Model formulation
4. Model simulation and validation
5. Policy analysis and improvement
6. Policy implementation

### 1.8. Model Validation and Verification

Model verification is to ensure that computerized programming and conceptual model implementation are correct. Verification aims to prove that something exists or is true/to ensure that something is true. Model validation is the process of building a belief in a model that has been created [20].

### 1.9. Expert Judgement

Expert judgement is a method used in the search for information related to a problem by involving people who are experts in their field. Expert judgement can be seen as a representation of an expert's knowledge at any given time. While expert is defined as a person who has a background in a particular field and is considered able to answer the given problem. There are 3 techniques in the expert judgement method [21], namely:

1. Individual Interview: This technique is done by conducting interviews to experts face-to-face and personal.
2. Interactive Groups: This technique is done by discussing with each other with experts related to the problem.
3. Delphi Situations: This technique is done by separating experts from each other. Experts give each other views through moderators, then moderators distribute expert views to other experts.

For determining an expert, we cannot determine with just anyone. There are several criteria for choosing an expert [22]:

1. Have expertise
2. Experience or reputation
3. Willing and willing to participate
4. Understand existing problems
5. Fair
6. Absence of economic or pripadi interests in research conducted

Meanwhile, according to Dei expert criteria are as follows [23]:

1. Experts with education ≥ Bachelor's Degree with a minimum requirement of long working experience of 5 years.
2. Experts with education under Bachelor's Degree, minimum high school / equivalent high school with a minimum of 10 years work experience.

The assessment given by the expert on a problem must be unbiased, so in choosing an expert for decision making must be 3-7 experts [24].

### *1.10. Knowledge Engineering*

Knowledge engineering is a method to approve the results of several individual parties and groups including formalization of knowledge, reasoning of knowledge,and analysis of knowledge. In its application knowledge engineering requires experts to explain new systems or new knowledge that cannot be described properly [25].

## 2. METHODS

### *2.1 Location and Object*

The research location was conducted at PMI Gunungkidul Regency Branch. While the object of research is in the blood supply chain in PMI Gunungkidul Regency Branch.

### *2.2 Research Subject*

The subject of this study was the head of PMI Gunungkidul Regency Branch, head of administration unit, head of service and inventory unit who knows business process and supply chain system in PMI Gunungkidul Regency Branch. So, it plays a role in determining risk identification as well as in determining risk mitigation strategies.

### *2.3 Data*

They are 2 kinds of data, first is primary data and second is secondary data. In this research, researchers use data identification of risks that affect blood supply chain, risk source data, blood supply data, expired data, blood supply shortage data, and blood demand data as a primary data. While, the secondary data from research (journal/proceeding) or books that support this research.

### *2.4 Research Flowchart*

This research procedure is divided into three stages, namely the preliminary stage, the stage of seeding and processing of data, and the discussion stage, conclusions and suggestions.

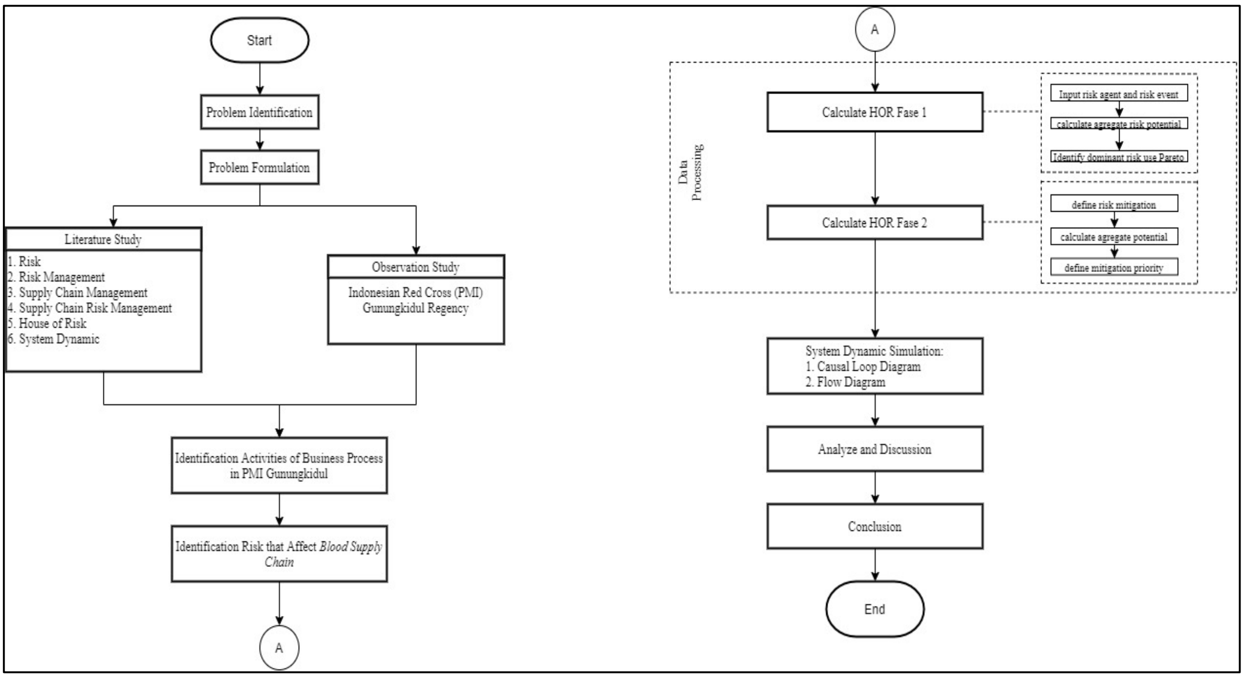


**Figure 1**. Research Flowchart.

**Table 1.** Risk Event.

| Code | Risk Event | Severity |
|---|---|---|
| E1 | Lack of blood donors | 8 |
| E2 | Not all communities are willing to accept and approve blood donation activities | 8 |
| E3 | Planned mass donor activities are disrupted/cannot be carried out. | 8 |
| E4 | Damage to blood components | 3 |
| E5 | Blood contaminated with bacteria from the environment | 8 |
| E6 | Errors in the blood retrieval process | 9 |
| E7 | Screening process stopped | 10 |
| E8 | Blood does not pass screening test | 5 |
| E9 | The temperature in the storage is not appropriate | 9 |
| E10 | Failure in the blood production process | 3 |
| E11 | There are blood products that have expired | 3 |
| E12 | Blood deficiency occurs | 6 |
| E13 | Delivery of blood products back to PMI because it is not appropriate (Blood return) | 5 |
| E14 | No blood stock in the stock | 9 |
| E15 | Delays in the delivery process | 9 |
| E16 | The distribution process is not appropriate | 9 |
| E17 | Blood damage during delivery | 9 |
| E18 | Cool chain can't preserve blood on the go | 9 |
| E19 | Cool chain temperature conditions are not suitable | 9 |
| E20 | Temperature control on thermometer box error | 9 |
| E21 | The box used to carry blood is not in accordance with the standards | 9 |

**Table 2.** Risk Agent

| Code | Risk Agent | Occurrence |
|---|---|---|
| A1 | People are afraid because of the COVID 19 pandemic | 7 |
| A2 | Lack of education related to blood donation during the pandemic to the community | 6 |
| A3 | Current COVID 19 pandemic conditions that require social distancing | 8 |
| A4 | Blood preservatives (anti-coagulation) in damaged blood bags | 2 |
| A5 | The sleeve of the donor is not clean | 3 |
| A6 | Human error | 2 |
| A7 | Needle stabbing on improper blood collection | 3 |
| A8 | Reagent error | 3 |
| A9 | Power outage | 2 |
| A10 | Damage to the appliance | 3 |
| A11 | Health discrepancies of donors | 3 |
| A12 | Human error (wrong setting on the tool) | 2 |
| A13 | Staff who have not been trained properly | 2 |
| A14 | Blood storage too long | 2 |
| A15 | Difficulty finding donors during the pandemic | 8 |
| A16 | Overstocking in BDRS hospitals | 2 |
| A17 | Blood in BDRS is stored too long (10 days) | 3 |
| A18 | Difficulty finding donors during the pandemic | 7 |
| A19 | Disruption during logistics delivery process | 2 |
| A20 | Blood box opened by taker when he didn't arrive at hospital | 3 |
| A21 | Transportation process blocked by traffic jams or too long distance (1 hour) | 2 |
| A22 | Damage to the coolchain tool | 3 |
| A23 | Negligence of the person who takes blood when bringing blood to the patient | 2 |
| A24 | People taking blood for too long in the outside environment | 4 |
| A25 | Coolbox used is broken | 3 |
| A26 | The lack of knowledge of people taking blood bags. | 7 |
| A27 | Blood bag taker in PMI is not an officer from the hospital | 7 |
| A28 | Lack of coolbox facilities from RS | 2 |

**Table 3.** House of Risk Phase 1.

| Risk Event | Risk Agent | | | | | | | | | | | | | | Severity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | …. | A26 | A27 | A28 | |
| E1 | 9 | 9 | 9 | | | | | | | | …. | | | | 8 |
| E2 | 9 | 9 | 9 | | | | | | | | …. | | | | 8 |
| E3 | 3 | 9 | 3 | | | | | | | | …. | | | | 8 |
| E4 | | | | 9 | 1 | 1 | | | | | …. | | | 3 | 3 |
| E5 | | | | | 9 | | | | | | …. | 3 | | 1 | 8 |
| E6 | | | | | | 3 | 9 | | | | …. | | | | 9 |
| E7 | | | | | | 1 | | 3 | 9 | 1 | …. | | | | 10 |
| E8 | | | | | | | | | | | …. | | | | 5 |
| E9 | | | | | | 1 | | | | 1 | …. | | | | 9 |
| E10 | | | | | | 1 | | | | | …. | | | | 3 |
| … | … | … | … | … | … | … | … | … | … | … | … | … | … | … | … |
| E17 | | | | | | | | | | | …. | 1 | 3 | | 9 |
| E18 | | | | | | | | | | | …. | | | | 9 |
| E19 | | | | | | 1 | | | | | …. | | | | 9 |
| E20 | | | | | | | | | | | …. | | | | 9 |
| E21 | | | | | | | | | | | …. | 9 | | 3 | 9 |
| Occurrence | 7 | 6 | 8 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | …. | 7 | 7 | 2 | |
| ARP | 1365 | 1458 | 1344 | 54 | 225 | 122 | 243 | 90 | 180 | 84 | …. | 798 | 189 | 88 | |
| Priority | 2 | 1 | 3 | 24 | 11 | 16 | 10 | 20 | 14 | 22 | …. | 5 | 12 | 21 | |

## 3. RESULTS AND DISCUSSION

### *3.1. Identification, Assessment Risk Agent and Risk Event*

The following are the results of identification and assessment of risk events and risk agents through the interview stage and provide a list of questions and assessments to experts, namely the head of UDD PMI, head of IMLTD, and head of service and quality assurance.

### *3.2. House of Risk*

HOR phase 1 begins by calculating the ARP value of each risk agent by multiplication of occurrence value by the number of everity values multiplied by the correlation value between risk event and risk agent. The calculation of ARP value aims to see which risk agents need to be prioritized first handled. The following is the calculation of the ARP value specified in the HOR phase 1 table (Table 3)

Based on the calculation of House of Risk phase 1 by determining the ARP value obtained risk rating from 28 risks that have been identified. The ARP value of each risk attribute will be the input in the Pareto diagram to determine the dominant risk affecting the blood supply chain of PMI Gunungkidul Regency Branch. Here is a pareto diagram that has been created. The following are the results of the dominant risk agent shown in Table 4.

**Table 4.** Dominant Risk Agent.

| No | Code | Risk Agent | ARP |
|---|---|---|---|
| 1 | A2 | Lack of education related to blood donation during the pandemic to the community | 1458 |
| 2 | A1 | People are afraid because of the COVID 19 pandemic | 1365 |
| 3 | A3 | Current COVID 19 pandemic conditions that require social distancing | 1344 |
| 4 | A15 | Difficulty finding donors during the pandemic | 936 |
| 5 | A26 | The lack of knowledge of people taking blood bags. | 798 |

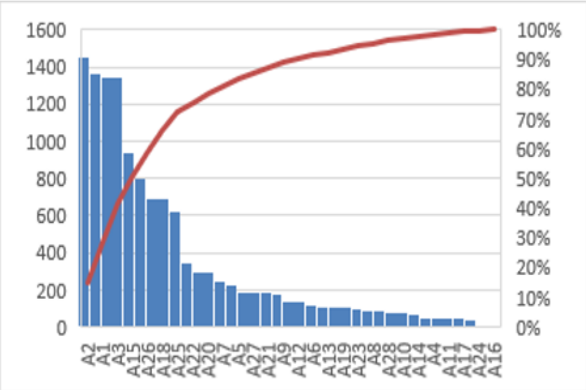


**Figure 2**. Pareto.

Next step is to determine the prevention action of each dominant risk agent that has been identified previously using the House of Risk phase 1 model and Pareto diagram. The next step is to determine risk mitigation measures that can reduce the impact or possible emergence of risk. Then conducted a correlation assessment between mitigation actions and risk agents and calculate the value of total effectiveness, degree of difficulty, and effectiveness to difficulty to know the priority of actions to be done first.

**Table 5.** Prevention Action

| Code | Risk Agent | Code | Prevention Action |
|---|---|---|---|
| A2 | Lack of education related to blood donation during the pandemic to the community | PA1 | Effective public counseling such as using billboards, banners, sharing to villages / villages and contacting donors directly about the importance of maintaining national blood availability, the need for blood donors, and the security of the blood donation process. |
| A1 | People are afraid because of the COVID 19 pandemic | | |
| A3 | Current COVID 19 pandemic conditions that require social distancing | | |
| A15 | Difficulty finding donors during the pandemic | PA2 | Working with TNI/POLRI/majelis taklim/gereja to conduct blood donation en masse and routinely by implementing strict health protocols. |
| | | PA3 | Seek a replacement donor from the employee's family. |
| | | PA4 | Provide information on the importance of blood donation and the safety of blood donation during the pandemic, and invite the closest people and families to make blood donations. |
| | | PA5 | Routinely held mobile donor activities pmi unit to the village in Wonosari. |
| | | PA6 | Contact donors who have already donated blood using the information system owned by PMI. |
| A26 | The lack of knowledge of people taking blood bags. | PA7 | Provide explanations related to the importance of keeping the blood coolbox from being opened by the blood bag taker before arriving at the hospital and explanation so that the blood taker should arrive at the hospital as soon as possible because the coolbox can not last long that appears in the form of SOP delivery of blood products to the hospital |
| | | PA8 | Provide education for blood takers to use the tools provided by the hospital if taking blood instead of other tools, and raised in the form of SOP the use of appropriate tools. |

**Table 6.** House of Risk Phase 2

| Risk Agent | Prevention Action | | | | | | | | ARP |
|---|---|---|---|---|---|---|---|---|---|
| | PA1 | PA2 | PA3 | PA4 | PA5 | PA6 | PA7 | PA8 | |
| A2 | 9 | | | 3 | | | | | 1458 |
| A1 | 9 | | | 3 | | | | | 1365 |
| A3 | 9 | | | 1 | | | | | 1344 |
| A15 | 3 | 9 | 9 | 9 | 9 | 9 | | | 936 |
| A26 | | | | | | | 9 | 9 | 798 |
| Total Effectiveness of Action | 40311 | 2808 | 8424 | 18237 | 8424 | 8424 | 7182 | 7182 | |
| Degree of difficulty performing action | 4 | 3 | 5 | 4 | 4 | 3 | 3 | 3 | |
| Effectiveness to difficulty ratio | 10078 | 2808 | 1685 | 4559 | 2106 | 2808 | 2394 | 2394 | |
| rank priority | 1 | 3 | 8 | 2 | 7 | 3 | 5 | 5 | |
| Total Effectiveness of Action | 40311 | 2808 | 8424 | 18237 | 8424 | 8424 | 7182 | 7182 | |

### *3.3. System Dynamics*

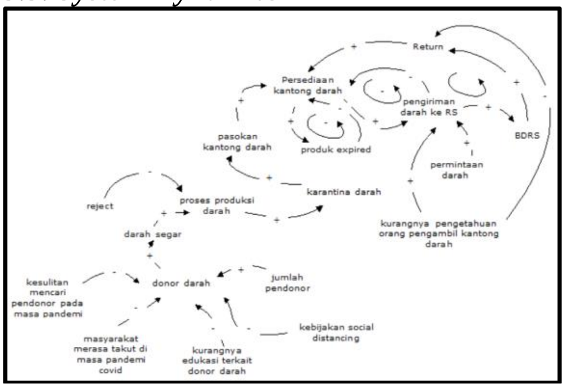


**Figure 3.** Causal Loop Diagram

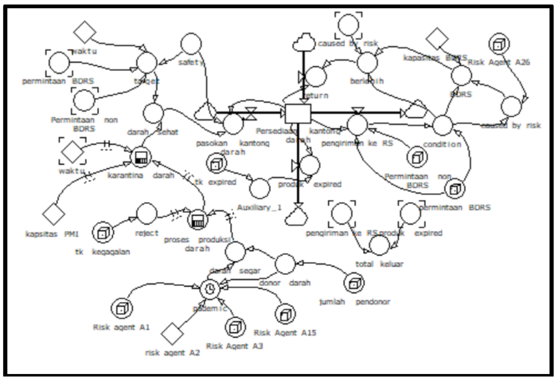

**Figure 4.** Flow Diagram

Causal Loop Diagram or CLD is a diagram that describes the relationship between system variables and also describes the pattern of relationships between those variables. Here is the CLD that has been created. It can be seen in Figure 3 conceptual model in the form of causal loop diagram and validated related to variables and relationships between variables so that later no errors caused garbage in, garbage out. The conceptual model validation process is done using face validity.

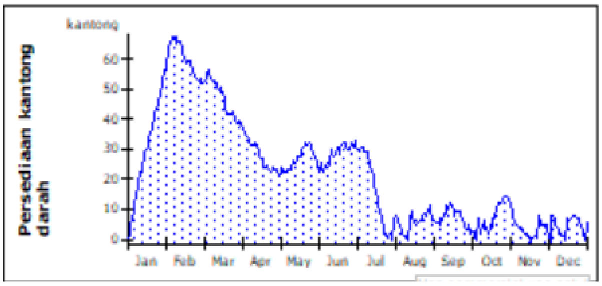


**Figure 5.** Simulation

### *3.4. Validation and Verification*

Next step is to validate and verify the model that has been created.

a. Verification
   Researchers verify by checking the formula of each variable in the simulation whether it has behaved the same as the real system or not.
b. Validation
   Validation in this study using statistics validation techniques test and face validity.

c. **F Value**

$$F_{hitung} = \frac{v_1^{\,2}}{v_2^{\,2}}$$

F Value= 2,493403

d. **Conclusion**

because F Tab 0,975 < F value < F tab 0,025, then

0,172 < 2,493403 < 5,82

**Ho ACCEPTED**

c. **t value**

$$Sp^2 = \frac{(n_1 - 1)v_1^{\,2} + (n_2 - 1)v_2^{\,2}}{n_1 + n_2 - 2}$$

$Sp^2$ = 554,7857143

$$t_{hitung} = \frac{Mean_1 - Mean_1}{\sqrt{Sp^2 \times \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

t value= 0,794275904

d. **Conclusion**

because - t 0.025 < t value< t 0.025

-2,048 < 0,794275904 < 2,048

Ho Accepted

**Figure 6.** Validation

Based on the two statistical tests seen in Figure 6 it is known that Ho was accepted, which means that the simulation model created can already represent the actual system. Besides, to face validity by asking directly to experts and 1 lab assistant who understands about Power Sim. As a result, the four agreed and were declared valid.

### *3.5. Design Improvement*

Here is a design improvement based on HOR Phase 2 on prevention action.

a. In cooperation with TNI/POLRI/Majelis Taklim, the following are the results of design improvement 1. Based on the design of the first experiment, researchers tried to add variables of tni donor assistance and taklim to reduce and handle its risk agent. In the tni donor assistance variable, researchers added 50 bags of blood to 150 bags of blood and carried out once every 2 months, while for the help of the taklim assembly researchers defined the addition of blood bags of 40 bags to 50 bags of blood and carried out once every 3 months. The results in the first proposed model of blood bag supply to increase above 50 bags per month and the graph of simulation results increased. Here the result of first experiment.

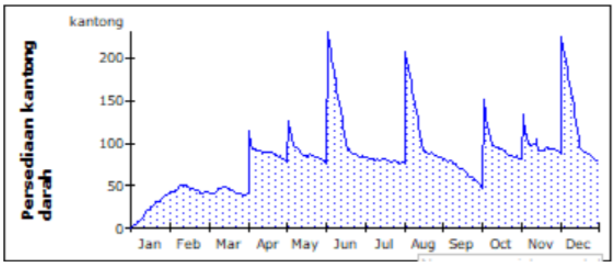


**Figure 7**. Design Improvement Result.

b. Massive Public Counseling and Use of Information Systems, the following are the results of design improvement 2. To handle the risk of donor shortages, researchers propose to provide public counseling using billboards /banners containing information about blood donations and procedures using health protocols to increase public awareness of the importance of blood donation. In addition, researchers also proposed that employees contact donors who had donated blood directly with a target of 20 people / shift. In the system dynamics model researchers change the percent risk agent because after implementing the proposed impact improvement and the possibility of decreased risk, and the result is that pmi blood bag supply becomes stable. Here the result of first experiment.

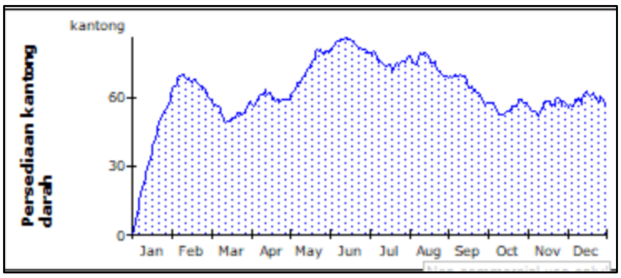


**Figure 8**. Design Improvement Result.

c. Providing Education to Blood Bag Takers, the following are the results of design improvement 3. Experiment 3 was realized by the creation of a new SOP on the delivery of blood products and the use of appropriate tools to carry blood bags. The result in variables caused by risk the number of blood bags that are likely damaged due to the error of the blood taker can be reduced.

| (kantong/mo) | | |
|---|---|---|
| Time | BDRS | caused by risk |
| 01 Jan 2020 | 150,00 | 16,00 |
| 01 Feb 2020 | 146,00 | 13,00 |
| 01 Mar 2020 | 133,00 | 6,00 |
| 01 Apr 2020 | 119,00 | 11,00 |
| 01 May 2020 | 150,00 | 7,00 |
| 01 Jun 2020 | 0,00 | 0,00 |
| 01 Jul 2020 | 150,00 | 20,00 |
| 01 Aug 2020 | 126,00 | 6,00 |
| 01 Sep 2020 | 150,00 | 18,00 |
| 01 Oct 2020 | 131,00 | 6,00 |
| 01 Nov 2020 | 150,00 | 8,00 |
| 01 Dec 2020 | 125,00 | 10,00 |
| 01 Jan 2021 | 90,00 | 9,00 |

| (kantong/mo) | | |
|---|---|---|
| Time | BDRS | caused by risk |
| 01 Jan 2020 | 150,00 | 9,00 |
| 01 Feb 2020 | 119,00 | 4,00 |
| 01 Mar 2020 | 104,00 | 5,00 |
| 01 Apr 2020 | 150,00 | 9,00 |
| 01 May 2020 | 134,00 | 5,00 |
| 01 Jun 2020 | 0,00 | 0,00 |
| 01 Jul 2020 | 150,00 | 7,00 |
| 01 Aug 2020 | 150,00 | 8,00 |
| 01 Sep 2020 | 137,00 | 8,00 |
| 01 Oct 2020 | 0,00 | 0,00 |
| 01 Nov 2020 | 150,00 | 8,00 |
| 01 Dec 2020 | 103,00 | 4,00 |
| 01 Jan 2021 | 150,00 | 8,00 |

**Figure 9**. Design Improvement Result.

## 4. CONCLUSION

Based on the results of data processing and analysis that has been done, then there are several conclusions that can be drawn are:

1. There are 21 risk events and 28 risk agents that exist and affect the blood supply chain in PMI Gunungkidul Regency Branch. Of the 28 risk agents there are 5 dominant risk agents namely the lack of education related to blood donation during the pandemic, people feel afraid, pandemic conditions that require social distancing, difficulty finding donors, and lack of knowledge of people who take blood bags.
2. Policies that can be applied according to the results of data processing using HOR and dynamics system and the results of analysis are:
   - First, to build public trust again related to the information on the safety of blood donations during the pandemic, the PMI must conduct massive public counseling. This is done by using billboards,banners, sharing to villages/villages,and the use of information systems.
   - Second, to help the supply of pmi blood bags and difficulty finding donors, can be done by cooperating with the TNI / POLRI / taklim.
   - Third, to avoid the occurrence of blood bag damage during the blood delivery process. Pmi party must make SOP related to blood product delivery and use of appropriate tools to bring blood products to patients.

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