Application of Dynamic System to Improve the Efficiency of Operational Activities in PT. Indo Trisula Karya

Dio Rizky Perdana, Adi Teguh Suprapto

Abstract: PT Indo Trisula Karya is a company engaging in the field of industrial manufacturing within subdivision of textile goods, producing made-to-order t-shirts. In the past few production periods, the company has been undergoing opportunity loss that is caused by incapability of regular production capacity to fulfil production demand. Meagre fund in an attempt to expand the business such as addition of equipment and tools to support operational activities, as well as addition to manpower, are the cause of the deprivation. The purpose of this research is to retrieve the performance of company's operational activities to which every production period and production demand converge by applying system dynamic model, using overtime and subcontract production system approach, and data is processed using vensim software. The outcome is by applying 3 systems simultaneously production system regular, overtime, and subcontract, the company is able to fulfil its highest demand achieved in production period of May 2017 as much as 9.760 t-shirts with 42 t-shirts in excess at the end of simulation.

Keywords: system dynamic, operations management, overtime, subcontract

I. INTRODUCTION

A country's economic growth is heavily influenced by several industrial sectors. One of them is the manufacturing industry, specifically the textile and textile products (TPT) sector. Based on data from the Ministry of Industry (2017), the textile industry contributed to the absorption of the number of workers in 2017. In the January-May period, the textile industry was able to absorb 2.69 million workers or 17.03 percent of the total workforce employed in processing industry. The textile industry is also able to contribute to the country's foreign exchange by 8.2 percent of total national exports or valued at USD 11.87 billion in 2016. In the 2017 January-May period, the national export value of the textile industry reached USD 5.11 million and experienced an increase by 3.40 percent compared with the previous year in the same period.

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In addition, data was also obtained from BPS (processed by the Ministry of Industry, Quarter III, 2014), during the period 2010-2014 showing that the TPT industry consistently never experienced a decline. The highest growth was achieved in 2011 compared to 2010, which amounted to 7.52%. Amid the growth, companies engaged in the textile industry were faced with increasingly fierce competition. In competing and developing, companies are often unable to meet all the number of existing requests, thus causing opportunity loss. Lack of large funding to expand such as for the purchase of machinery and equipment to support other production activities, as well as increasing the number of qualified human resources, triggers a company to not be able to maximize its operations in the midst of great opportunities.

In the production system there are interactions between variables that provide feedback effects and influence on other variables. This causes the value of between variables to change in each period. To make it easier to describe how the interaction between these variables, a model can be made, then a production system simulation is done using the dynamic system method. System dynamic is a concept of modelling simulation that aims to frame, understand, and discuss a complex problem using simple mathematical calculation concepts that involve the use of variables related to activities (company operations), visualized and designed according to the flow that occurs in reality, so in the modelling system it will be seen how the variables interact with and influence each other. This system simulation is a representation of a real-world system that will help companies identify how much influence each variable has in the system, and the results of data processing can be taken into consideration by managers in making decisions, in order to improve existing systems [1]. PT Indo Trisula Karya is a company engaged in the manufacturing sector of the textile product (apparel); producing apparel type of shirts (t-shirts). The company applies the concept of made-to-order, which is doing production in accordance with the wishes of the customer and production as much as the request of the customer. In one year, there are 12 production periods. Based on company data from January 2017 to March 2018, the company always experiences opportunity loss because the number of requests exceeds the company's regular production capacity. The following are historical data on the number of company production requests, for the period January 2017 - March 2018:

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Table-I: Report of Company Demand Data for 2017-2018

	LAPORAN DATA PERMINTAAN TAHUN 2017 (Dalam Satuan Pcs)		
BULAN	**JUMLAH PERMINTAAN**	**KAPASITAS PRODUKSI**	**JUMLAH PERMINTAAN TIDAK TERPENUHI**
JANUARI	9654	5820	3834
FEBRUARI	8125	5820	2305
MARET	8304	5820	2484
APRIL	8362	5820	2542
MEI	9760	5820	3940
JUNI	9675	5820	3855
JULI	8210	5820	2390
AGUSTUS	8309	5820	2489
SEPTEMBER	9575	5820	3755
OKTOBER	8024	5820	2204
NOVEMBER	9750	5820	3930
DESEMBER	9554	5820	3734

	LAPORAN DATA PERMINTAAN TAHUN 2018 (Dalam Satuan Pcs)		
BULAN	**JUMLAH PERMINTAAN**	**KAPASITAS PRODUKSI**	**JUMLAH PERMINTAAN TIDAK TERPENUHI**
JANUARI	9604	5820	3784
FEBRUARI	8250	5820	2430
MARET	8295	5820	2475

Source: PT Indo Trisula Karya (2018)

The data above shows that there are fluctuations or the number of requests is not the same in each period. The highest demand was recorded in May 2017, totaling 9,760 pcs with the company's regular production capacity of only 5,820 pcs. This caused an opportunity loss of 3,940 pcs. For now, this problem does not directly make PT Indo Trisula Karya suffer losses, but if this problem is not addressed, then PT Indo Trisula Karya will lose many opportunities to achieve maximum profit amidst existing opportunities, and impact on slow business development.

To increase the amount of production capacity, companies can apply dynamic system modeling simulation by analyzing the relationships between variables and their values in complex production systems [1]. So through this modeling, companies can find a clearer picture of how the production system works, and know how the planning will be designed to meet the number of production shortages. The dynamic system is also flexible or can adjust to fluctuating demand conditions or not the same in each period. In addition, this method allows us to do scenario testing, where variables or the values of these variables can be changed as needed. This is done in order to see different results according to the actual situation in the real world, so that the processed data can be taken into consideration by managers to determine the best strategy to meet market demand.

The dynamic system modeling method will be processed using Vensim software because this software has been commonly used to process the dynamic system modeling method according to the recommendations stated in the research of [2]. Information and data will be presented through 2 types of diagrams, namely Casual Loop Diagrams (qualitative) and Stock Flow Diagrams (quantitative). Through these 2 diagrams will be known the influence of the nature and relationship between variables in the system. The value of the results of automatic data processing will each appear into several periods, so it will be seen how the impact of the application of each scenario in influencing important variables for several periods in the future.

Through dynamic system modeling, speed and accuracy in analyzing a complex set of systems can assist managers in making decisions regarding the best strategy for production planning, also can save time in solving problems. This dynamic system modeling simulation will use two types of aggregate planning approaches, namely overtime and subcontract system production approaches, each of which has advantages and disadvantages. According to [3], the function of aggregate planning is as a company's production strategy in the face of fluctuating demand so that this plan can provide adjustments and efficiency to existing conditions by considering the capacity of resources, time, and costs. Regular system production capacity is the maximum amount of production output that a company can produce at one time. The overtime system production approach is the company's effort to increase production capacity beyond regular working hours by increasing the number of employees working hours on weekdays. The subcontract system production approach is a system where a company cooperates with other companies in producing certain products that cannot be fulfilled by the company itself [3].

II. METHOD

This type of research is descriptive research, which is a study that aims to collect a number of data to provide an overview of the characteristics of people, events, or situations [4]. PT Indo Trisula Karya is the unit of analysis for this research. The type of time (time horizon) data collection used in this study is cross sectional type. According to [4], cross sectional is the activity of collecting data from several objects at a certain time period, such as daily, weekly and monthly periods. This is done to show the level of difference. This research uses quantitative data types. According to [5], quantitative data is presented in the form of numbers. Then the source of data obtained from this study are primary and secondary data. According to [4], primary data is data or information related to research variables obtained directly by researchers from research subjects. In this study, primary data were obtained directly from interviews and observations of PT Indo Trisula Karya. While secondary data is data or information that has been there before, so researchers do not need to develop further information. In this research, secondary data used by researchers is PT Indo Trisula Karya's demand data report from January 2017 to March 2018 (in pcs).

A. Stages of Data Processing Dynamic System Method

The research activity begins with collecting data in advance through literature studies, interviews, and observations. Then the research continues to the identification and formulation of the problem, and setting goals. The data that has been obtained, then processed using Vensim software to create dynamic system modeling simulations. Following are the next stages of research in using the dynamic system method according to [1]:

- *Defining the system and identifying variables*. In the initial stages of data processing, researchers identify what factors are involved in the company's production system, then determine the names of the variables that will later be made modeling and simulation.
- *Conceptualizing the model*. To make it easier to see the relationships and interactions between variables in the system, causal loop diagrams (CLD) and stock flow diagrams (SFD) are made with the help of Vensim software.

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In this study, the vensim software used is PLE 7.2 version. Causal Loop Diagram (CLD) is a visualization of the arrangement of system variables (production) in the real world, where there are arrows that are interrelated to form a diagram showing a causal relationship. CLD is a qualitative aspect of a system. From making the CLD model on vensim software, the study continued with a simulation of Stock Flow Diagrams (SFD). Stock Flow Diagram (SFD) is a description of the relationship of variables by writing the calculation formulation (equations) in the variables based on the relationship between variables in vensim software. The value of the simulation results will make it easier for managers to know the relationship of variables quantitatively.

- *Model verification and validation*. The model that has been created is verified and validated by ensuring the system flow chain matches the company's real-world system flow representation. Verification is done by checking the overall model and doing a unit check of each variable whether it is in accordance with the company's real system circuit. Validation is done by showing the modeling that researchers have made to the company to find out whether the modeling is in accordance with the company's real system. In addition, researchers conducted a simulation test as evidence of a series of modeling systems working dynamically without any errors. And if reviewed further, the output data can be proven by means of manual calculations to ensure that the modeling simulation works according to logic and has accurate results. If there is still an error during the simulation test, the researcher will return to the stage of defining the system and identifying variables.

- *Analysis of Simulation Results*. The results of the simulation will be analyzed to determine whether the simulation has been able to meet the number of company requests by calculating the "total production capacity so" reduced by "the number of requests". Modeling simulations are carried out by trial and error

in order to find the right formulation and the most efficient strategy to meet demand with the lowest possible production costs.

III. PROBLEM SOLVING DESIGN

The purpose of this study will provide results about:
1. Proposed series of dynamic system modeling simulations right at PT Indo Trisula Karya.
2. Comparison of the application of overtime system production before and after dynamic system simulation at PT Indo Trisula Karya.
3. Comparison of the application of subcontract system production before and after dynamic system simulation at PT Indo Trisula Karya.

IV. RESEARCH METHODS

This section is the result of an analysis of research conducted at PT Indo Trisula Karya using dynamic system modeling simulation methods and using a type of overtime and subcontract system production approach based on company demand data reports for the period January 2017 to March 2018 (in units of pcs). The following is a sequence of stages of research according to [1].

System and Variable Identification, the following is the data resulting from the identification of the variables involved in the operations of PT Indo Trisula Karya. The variables below will then be processed using vensim software version PLE 7.2 for simulating dynamic system modeling through causal loop diagrams (CLD) and stock flow diagrams (SFD). Then the researcher will know the relationship between variables and their values. This modeling aims to study and understand the workflow and characteristics of PT Indo Trisula Karya's production system so that it helps managers in determining the right strategy related to meeting demand, according to the demand conditions in each period, quickly, easily, and accurately.

Table-II: Data from the Identification Results of Operational Activities PT Indo Trisula Karya

No	Variable	Information	Calculation Formulation (*Equation*)
1	Number of Requests	Using data on the highest number of T-Shirt production requests at PT Indo Trisula Karya (May, 2017)	9,760
2	Number of Production Employees	Number of employees in the Production section	15
3	Number of Working Days Per Month	Number of working days in a month	25
4	Total Hours of Work Per Day	Number of working days in one day	8
5	Regular Production Capacity Per Employee Per Hour	Number of regular production capabilities per employee per hour	2
6	Regular Production Capacity Per Employee Per Day	Number of regular production capabilities per employee per day	Regular Production Capacity Per Employee Per Hour * Number of Work Hours Per Day

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7	Total Regular Production Capacity Per Month	Total number of regular production capabilities per employee per month	(Regular Production Capacity Per Employee Per Day *Number of Production Employees) * Number of Working Days Per Month
8	Product Defects	Percentage of product defect rate in company regular production (3%)	Total Regular Production Capacity Per Month * 3/100
9	Production Becomes Regular Per Month	The number of finished goods, regular production per month	Total Regular Production Capacity Per Month - Product Defects
10	Fulfilling Requests	Number of requests a company can fulfill per month	Production Becomes Regular Per Month-Number of Requests
11	Production Must Be Added	Shows the number of manufactured goods that the company must add	ABS (Fulfilling Requests)
12	Salary Per Employee Regular Production Per Month	Total salary per production employee per month	3,000,000
13	Total Monthly Regular Salary of Employees	Total salary of all production employees per month	Salary Per Regular Production Employee Per Month * Number of Production Employees
14	Salary Per Employee Regular Production Per Day	Total salary per production employee per day	Salary Per Employee Regular Production Per Month / Number of Working Days Per Month
15	Salary Per Employee Regular Production Per Unit	Total salary per production employee per unit	Salary Per Employee Regular Production Per Day / Regular Production Capacity Per Employee Per Day
16	Cost of Regular Production Raw Materials Per Unit	Total cost of raw material for regular production per unit	13,500
17	Total Regular Production Costs Per Month	Total cost of raw materials for regular production per month	(Cost of Regular Production Raw Materials Per Unit * Total Regular Production Capacity Per Month) + Total Regular Production Employee Salaries Per Month
18	Overtime Hours Per Day	Number of hours of overtime per day	3
19	Overtime Production Capacity Per Day	Total ability to produce overtime per day	(Regular Production Capacity Per Employee Per Hour * Overtime Hours Per Day) * Number of Production Employees
20	Total Overtime Production Capacity Per Month	Total number of overtime production capabilities per month	Overtime Production Capacity Per Day * Number of Working Days Per Month
21	Overtime Product Defects	Percentage of product defect rates in the company's overtime production	Total Overtime Production Capacity Per Month * 3/100
22	Production Becomes Overtime Per Month	The number of finished goods, overtime production per month	Total Overtime Production Capacity Per Month - Overtime Product Defects
23	Overt Salary Rate Increase Per Employee Per Unit	The rate of increase in overtime wages per company employee	1.5

24	Overtime Salary Per Employee Per Unit	Overtime pay per employee per unit	Annual Salary Per Employee Production Per Unit * Overt Salary Rate Increase Per Unit Per Unit
25	Overtime Production Cost Per Unit	Total cost of overtime production per unit	Cost of Regular Production Raw Materials Per Unit + Overtime Salary Per Employee Per Unit
26	Total Overtime Production Costs Per Month	The total cost of overtime production per month	Total Overtime Production Capacity Per Month * Overtime Production Costs Per Unit
27	Production Becomes Subcontracted Per Month	The number of finished goods, subcontracted production per month	1,800
28	Subcontracting Costs Per Unit	Total subcontract production costs per unit	45,000
29	Total Subcontract Production Costs Per Month	Total amount of subcontracted production costs per month	Subcontracting Costs Per Unit * Production Becomes Subcontracted Per Month
30	Additional Production Per Month	Additional amount of finished goods production, from overtime and subcontracting	Production Becomes Overtime Per Month + Production Becomes Subcontracting Per Month
31	Total Finished Production Capacity	Total amount of finished goods production, from regular, overtime and subcontracting	Regular Finished Production Per Month+ Additional production
32	Total Regular Production Costs, Overtime, Subcontracting	Total costs of regular, overtime and subcontracted production costs	Total Regular Production Costs Per Month + Total Overtime Production Costs Per Month + Total Subcontract Production Costs Per Month
33	Lack of Production Status	Indicates the shortage status of manufactured goods. If the result is negative, then the number of finished goods must be increased	Total Finished Production Capacity - Number of Requests

Source: Company and Author (2018)

From the results of system identification, researchers found 33 complex variable arrangements involved in PT Indo Trisula Karya's operational activities. In addition, based on the results of the interview, PT Indo Trisula Karya has 1 trust subcontract partner company that is able to produce 1800pcs of t-shirts in one month. From the interviews, researchers also obtained information about overtime policies. PT Indo Trisula Karya applies a maximum overtime of 3 hours every day on working days in accordance with the laws of the Republic of Indonesia number 13, article 78, year 2003 regarding employment. Wages for overtime work for each worker are 1.5 times more than regular work production wages. The rate (level) of the company's defective products is as much as 3% in each production period. In addition, PT Indo Trisula Karya each month also has other fixed operational costs for electricity, water, telephone, transportation, office supplies, monthly advertising costs, and other costs, amounting to Rp13,000,000.00.

A. Conceptualization of the Production System Model of PT Indo Trisula Karya
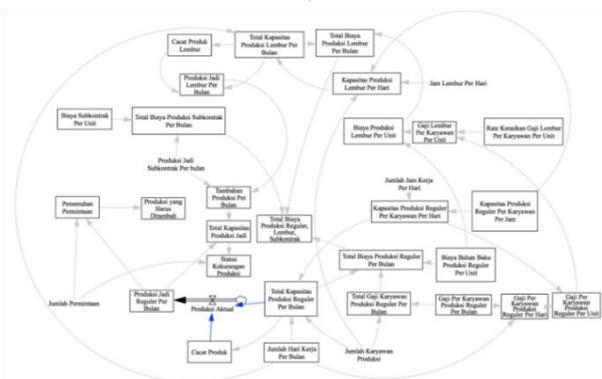
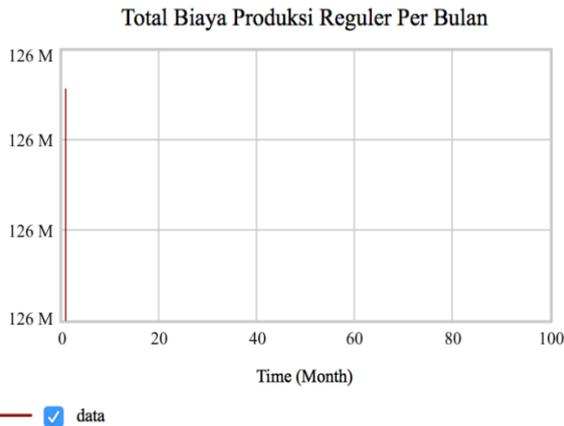**Fig. 1. Causal Loop Diagram Simulation Series (CLD) of PT Indo Trisula Karya**
Source: Author's Processed Results (2018) with Vensim Software Version PLE 7.2

Causal loop diagram (CLD) in vensim software, the 33 variables are arranged, based on the order of the actual process flow of regular system production at PT Indo Trisula Karya, with the addition of overtime and subcontract system production variables.

The arrows between the variables contained in the causal loop diagram indicate a causal relationship (causal relationship) between these variables.

Fig. 2. A series of simulation of PT Indo Trisula Karya's Production Flow Diagram (SFD) Production System Source: Author's Processed Results (2018) with Vensim Software Version PLE 7.2

Stock Flow Diagrams (SFD). At the stage of modeling stock flow diagrams (SFD), the authors write a calculation formulation (equations) on each variable based on their relationship with other variables, so that each of these variables has a value. In processing data in Vensim software, The researcher used the reference data of the highest number of requests ever obtained by PT Indo Trisula Karya, namely in the period of May 2017 totalling 9,760pcs t-shirts, so that this dynamic system modeling simulation circuit can be used by companies at the highest conditions.

This dynamic system modeling simulation circuit is active and integrated, if the modeler changes the value of a variable, then the value of the variable that has a direct relationship with that variable will also change.

B. Model Verification and Validation

Model Verification

Fig. 3. PT Indo Trisula Karya Production System Simulation Series

Source: Author's Processed Results (2018) with Vensim Software Version PLE 7.2

At the model verification stage, the researcher checks the model as a whole and has ensured that the modeling simulation series made is in accordance with the company's regular regular production system series.

In addition, the results of the calculation formulation (equations) on each variable carried out at the stage of the stock flow diagram (SFD), also there is no error.

So it can be said that the dynamic system modeling simulation series at PT Indo Trisula Karya is feasible and in accordance with the actual situation.

Model Validation

Dynamic system modeling simulation that has been made by researchers shown to the company.

The company has agreed and assessed that the dynamic system modeling simulation series is in accordance with the company's regular production process flow in the real world.

In addition, it was also proven that the series of modeling simulations made had worked dynamically through a simulation test.

The results of the simulation test show there are no errors, and the circuit system can work dynamically.

The results of further review is to do manual calculations, to increase confidence that this modeling simulation system works according to logic, and has accurate results.

Values from the results of manual calculations performed, are stated to have accurate results (have the same value as the value stated in the Vensim software data processing).

Analysis of Simulation Results

Time (Montl	"Pemenuhan	Pemenuhan Permintaan
1	Permintaan"	-3940
2	Runs:	-7880
3	data	-15760
4	data 1	-31520
5	DATA	-63040
6	SIMULASI	-126080
7	VENSIM	-252160
8	FINAL	-504320
9		-1.00864e+06
10		-2.01728e+06
11		-4.03456e+06
12		-8.06912e+06

Fig. 4. Status of Production Deficiency, Regular Production System of PT Indo Trisula Karya

Source: Author's Processed Results (2018) with Vensim Software Version PLE 7.2

The data processing above is a representation of the performance of the regular system production run by PT Indo Trisula Karya today.

The results of vensim data processing indicate a shortage of production, in accordance with the real situation that occurred in the May 2017 demand period, namely the number of requests received by PT.

Indo Trisula Karya is 9,760 pcs of t-shirts, while the regular system production capacity per month or as many as 6,000 pcs of t-shirts is reduced by the number of product defects by 3% of the total production (180 pcs) so that the total production of the regular system becomes 5,820 pcs T shirts. With a regular system production capacity of 5,820pcs t-shirts causing an unfulfilled demand of -3,940pcs t-shirts. And if you use the production system that is run at PT Indo Trisula Karya at this time, in the second period the number of requests that are not met will be a number of -7,880pcs of t-shirts, and so on.
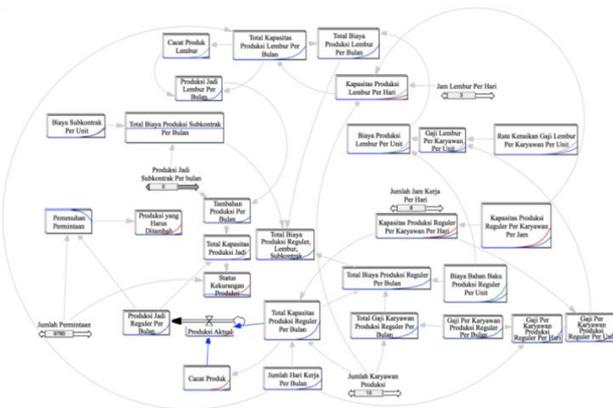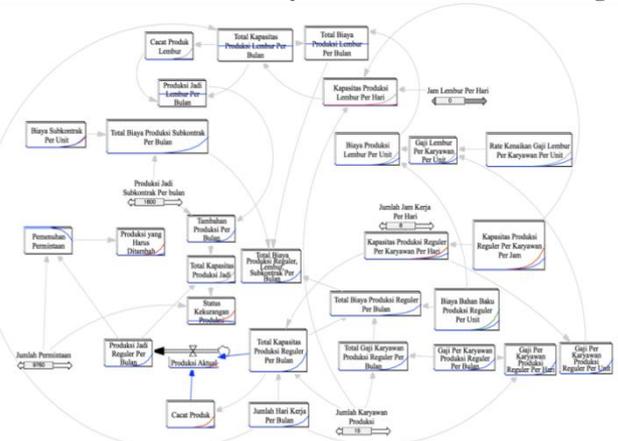
Fig. 5. Total Cost of Regular System Production Per Month of PT Indo Trisula Karya
Source: Author's Processed Results (2018) with Vensim Software Version PLE 7.2

The data above is the total monthly system production cost of PT Indo Trisula Karya, which is IDR 126,000,000.00 with a total production capacity of 6,000 pcs of t-shirts. The regular system production costs are IDR 126,000,000 + other company operational costs per month IDR 13,000,000.00, the total regular system production costs are IDR 139,000,000 per month or per period.

Overtime System Production Modeling Simulation

Fig. 6. Simulation of the Application of Regular and Overtime System Production
Source: Author's Processed Results (2018) with Vensim Software Version PLE 7.2

The figure above is a series of dynamic system modeling simulation at PT Indo Trisula Karya with the application of regular system production coupled with the application of overtime system production of 3 hours per day.

Time (Montl	"Status	Status Kekurangan Produksi
1	Kekurangan	-1757.5
2	Produksi"	-3515
3	Runs:	-7030
4	data	-14060
5	data 1	-28120
6	DATA	-56240
7	SIMULASI	-112480
8	VENSIM	-224960
9	FINAL	-449920
10		-899840
11		-1.79968e+06
12		-3.59936e+06

Fig. 7. Status of Production Shortages, Regular Production System and Overtime of PT Indo Trisula Karya
Source: Author's Processed Results (2018) with Vensim Software Version PLE 7.2

By implementing overtime production system of 3 hours per day, the company is able to produce 2,250pcs of t-shirts, reduced by the number of product defects of 3% of the total production of 67.5 pcs of t-shirts (rounded up to 68 pcs of t-shirts), so the number finished production with overtime system becomes 2,182 pcs t-shirts. The regular system production capacity of 5,820 pcs of t-shirts plus the production of overtime systems of 2,182 pcs of t-shirts makes the company have a total production capacity of 8,002 pcs of t-shirts per month or per period.

The total production capacity of the regular and overtime system as much as 8,002 pcs of t-shirts has not been able to meet the highest number of requests ever obtained by the company as many as 9,760 pcs of t-shirts in May 2017. According to the data above, the amount of PT Indo Trisula Karya's production shortages is still in numbers -1.757.5 pcs of t-shirts, or if rounded there is still a deficiency of -1.758 pcs of t-shirts.

Production costs for overtime systems are more expensive than regular system production costs. The cost of producing overtime system per unit is IDR24,750.00 while regular system production is IDR21,000.00 per unit. Because companies must pay wages per employee overtime by 1.5 times more than regular production wages per unit. The wage per employee for regular system production per unit is Rp.7,500.00, while the wage for overtime production per employee per unit is Rp11,250.00.

The total production cost for overtime per month is IDR 55,687,500.00. So, the regular system production costs Rp.126,000,000.00 per month + the monthly overtime system production costs Rp55,687,500.00 + other company operational costs per month Rp13,000,000.00, the total production cost of the regular and overtime system is Rp194. 687,500.00 per month or per period.

Simulation of Subcontract System Production Modeling

Fig. 8. Simulation of the Application of Regular and Subcontracting System Production
Source: Author's Processed Results (2018) with Vensim Software Version PLE 7.2

The figure above is a series of dynamic system modeling simulations at PT.

Indo Trisula Karya with the application of regular system production coupled with the application of subcontract system production. The production capacity of the subcontracting system owned by PT Indo Trisula Karya's partners is 1800 pcs of t-shirts per month.

Time (Montl	"Status	Status Kekurangan Produksi
1	Kekurangan	-2140
2	Produksi"	-4280
3	Runs:	-8560
4	data	-17120
5	data 1	-34240
6	DATA	-68480
7	SIMULASI	-136960
8	VENSIM	-273920
9	FINAL	-547840
10		-1.09568e+06
11		-2.19136e+06
12		-4.38272e+06

Fig. 9. Status of Production Shortages, Regular Production System and Subcontracting of PT Indo Trisula Karya

Source: Author's Processed Results (2018) with Vensim Software Version PLE 7.2

By implementing regular system production coupled with subcontract system production, PT Indo Trisula Karya has a total production capacity of 7,620 pcs of t-shirts per month or per period. This number has not been able to meet the highest number of requests ever obtained by the company, namely as many as 9,760 pcs of t-shirts in May 2017. In accordance with the data above, the total production shortage of PT Indo Trisula Karya is at -2,140 pcs of t-shirts. The subcontract system production costs per unit are more expensive than the regular system production costs and overtime system production which is Rp. 45,000 per unit. This happened because the partner company PT Indo Trisula Karya provided profit margins for the company from each unit it produced. Although the production of subcontracting systems has higher costs, this system still has an important role and provides alternative solutions for PT Indo Trisula Karya in meeting the demand. The total production cost of the subcontracting system per month is Rp.81,000,000.00. So, the production cost is a regular system of IDR 126,000,000 per month + monthly production costs of a subcontracting system of IDR 81,000,000 + another company's operational costs per month of IDR 13,000,000.00. So, the total cost of regular system production and overall subcontract system production is Rp. 220,000,000.00 per month or per period.

Simulation of Overtime Production Modeling and Subcontracting System Production
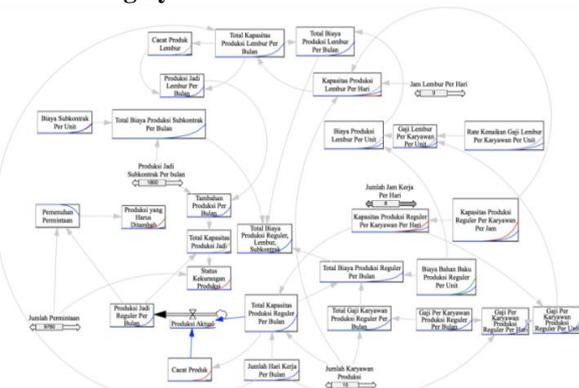

Fig. 10. Simulation of the Application of Regular, Overtime and Subcontracting System Production

Source: Author's Processed Results (2018) with Vensim Software Version PLE 7.2

The figure above is a series of dynamic system modeling simulations at PT Indo Trisula Karya by applying 3 production systems, namely regular, overtime, and subcontracting production systems simultaneously in one production period.

Time (Montl	"Status	Status Kekurangan Produksi
1	Kekurangan	42.5
2	Produksi"	85
3	Runs:	170
4	data	340
5	data 1	680
6	DATA	1360
7	SIMULASI	2720
8	VENSIM	5440
9	FINAL	10880
10		21760
11		43520
12		87040

Fig. 11. Status of Production Shortages, Regular System Production, Overtime, and Subcontracting of PT Indo Trisula Karya

Source: Author's Processed Results (2018) with Vensim Software Version PLE 7.2

By implementing 3 production systems simultaneously in one period of production, namely regular, overtime, and subcontracting production systems, PT Indo Trisula Karya was able to meet the highest demand the company had ever obtained in May 2017 with a total demand of 9,760pcs of t-shirts. The data description above does not indicate a lack of production, the result is (+) 42.5. This means that companies by implementing 3 production systems simultaneously, are able to meet the highest demand and still have more than 42 pcs of t-shirt stock.

So, the production cost is a regular system of Rp.126,000,000.00 per month + overtime production costs Rp55,687,500.00 per month + subcontracted production costs per month of Rp.81,000,000.00 + other company fixed operational costs per month of Rp13,000,000.00. So, the total cost of regular, overtime, and subcontracting production costs is Rp.275,687,500.00 per month or per period.

Research Implications
Theoretical Implications

Referring to the research journal by [1], it is proven that the application of the dynamic system method can assist companies in increasing the amount of production capacity through modeling simulations.

After analyzing and processing data using Vensim software, the best proposed strategy that can be applied by PT.

Indo Trisula Karya in meeting the highest number of requests (in May, 2017) of 9,760pcs t-shirts is to implement 3 production systems simultaneously in one time period of production namely regular system production plus an overtime system production approach and subcontract system production, according with research objective number 1.
The following are the results of the comparison before and after applying the dynamic system method.

Regular system production is run in conjunction with the overtime, subcontracting system production approach, and a combination of overtime and subcontracting to increase the company's production capacity within 1 month or 1 production period in accordance with research objectives number 2 and 3:

Table-III: Comparison Results of the Production Capacity of Overtime, Subcontracting, Overtime and Subcontracting Systems

Production Deficiency Status	Regular & Overtime	Regular & Subcontracting	Regular, Overtime & Subcontracting
Before Application	-3,940pcs *t-shirts*	-3,940pcs *t-shirts*	-3,940pcs *t-shirts*
After application	-1.757,5pcs *t-shirts*	-2,140 pcs *t-shirts*	+ 42,5pcs *t-shirts*

Source: Author's Processed Results (2018)

Production of regular and overtime systems, as well as regular and subcontracting system production after implementation for a period of one month or one period has not been able to meet the number of requests. The processed product still shows that there is a shortage of production amounting to -1.757.5 and -2.140 pcs t-shirts, respectively. This means that if the company only applies one system, which is regular and overtime or regular and subcontracted, then both of them are still unable to meet the total demand.

But if the company combines the implementation of three production systems simultaneously within one month or one production period, namely regular, overtime and subcontracted system production, then the production shortage is no longer there. The processed product shows that by implementing the three production systems simultaneously within one month or one production period, PT Indo Trisula Karya is able to have a total production capacity of 9,802 pcs of t-shirts. Here are the details:
1. Regular Production System: 5,820pcs t-shirts per month
2. Overtime Production System: 2.182 pcs of t-shirts per month
3. Subcontracting Production System: 1800pcs of t-shirts per month

Of the total production capacity of 9,802pcs of t-shirts to meet the highest number of requests in May 2017 of 9,760pcs of t-shirts, PT Indo Trisula Karya still has an inventory of finished products of + 42pcs of t-shirts at the end of the simulation.

V. CONCLUSION

Based on the results of dynamic system modeling simulation at PT Indo Trisula Karya, this research can be concluded as follows:
1. PT Indo Trisula Karya can apply the dynamic system modeling simulation design that has been created by researchers using this Vensim software as an appropriate modeling simulation proposal for PT Indo Trisula Karya by implementing regular system production with overtime system production and subcontract system production simultaneously in one production period. Before the application of dynamic system simulation with overtime system production and subcontract system production, PT Indo Trisula Karya at the highest demand conditions in May 2017 amounted 9,760 pcs of t-shirts, the company experienced a shortage of production of -3,940pcs of t-shirts with a total production cost Rp.139,000,000.00 per month or per period. After applying the dynamic system simulation by implementing regular system production coupled with overtime system production and subcontracting system production simultaneously in one production period, the shortage of production has been overcome, leaving a total inventory of finished products as many as 42 pcs of t-shirts, with a total production cost of Rp275 .687,500.00 per month or per period at the end of the simulation.
2. Before the application of dynamic system simulation with overtime system production, PT. Indo Trisula Karya, at the highest demand condition, in May, 2017 totaling 9,760 pcs of t-shirts, the company experienced a shortage of production of -3,940 pcs of t-shirts with a total production cost of Rp139,000,000.00 per month or per period. After the application of dynamic system simulation by applying regular system production coupled with the production of overtime systems simultaneously in one production period, the total production shortage was only -1.757.5pcs of t-shirts, with a total production cost of Rp194,687,500.00 per month or per period at the end of the simulation.
3. Prior to the application of dynamic system simulation with subcontracted system production, PT Indo Trisula Karya had the highest demand conditions in May, 2017 totalling 9,760pcs of t-shirts, the company experienced a shortage of production of -3,940pcs of t-shirts with a total production cost of Rp139 .000,000.00 per month or per period. After applying the dynamic system simulation by applying regular system production coupled with the production of subcontracted systems simultaneously in one production period, the total production shortfall was -2,140 pcs of t-shirts, with a total production cost of Rp 220,000,000.00 per month or per period at the end simulation.

SUGGESTIONS

1. PT. Indo Trisula Karya is advised to apply dynamic system simulation methods, to be able to meet the demand in each period through the application of regular system production together with overtime system production and / or subcontract system production by adjusting the required variables and their values, so as to increase the efficiency of activities company operations. In addition, companies can also adjust the values of the following variables so that operational efficiency can be maximized:
   • Cost of raw materials per unit of production
   • Profit margin per unit

• Overtime production costs per unit
• Subcontracting costs per unit
• Reducing the percentage of product defects

2. If the company applies overtime system production, the things that must be considered are:

• Pay attention to the physical and mental conditions of workers while running the overtime production system. The continuous implementation of overtime system in the long term can negatively affect the level of work productivity, and trigger health problems due to physical and mental fatigue.

• Supervise the performance of overtime workers, to avoid mistakes in the production process that cause product defects or work accidents that can harm workers and the company.

• Fulfil the rights of overtime workers in accordance with predetermined provisions, namely applying a maximum overtime time of 3 hours every day on working days, as well as providing overtime production wages per worker, which is 1.5 times more than the regular work production wage.

3. If the company applies a subcontracting production system, the things that must be considered are:

• Ensuring that partner companies that will produce subcontracted systems can meet production demand capacity in a timely manner so that there are no delays in each production period.

• Ensuring that partner companies that will produce subcontracting systems can meet the quality standards set by PT. Indo Trisula Karya. So that PT. Indo Trisula Karya gets output that is in accordance with the plan.

• Establish good relations with subcontract company partners.

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