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The Readiness Identification of PT. XYZ to Produces of Small Caliber Munition 5,56 mm with Analysis of Factors Affecting Production Systems

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Abstract: *PT. XYZ received an order from a small caliber munition (SCM) 5.56 from the Ministry of Defense of the Republic of Indonesia as many as 1.1 billion grains for two years or 550 million grains per year. But to produce a SCM 5.56 every year, PT. XYZ is constrained by a production capacity of only 415.9 million grains SCM 5.56 annually. Based on calculations there is a shortage of 134.1 million SCM 5.56 each year. These constraints are due to the not optimal production system implemented by PT. XYZ so that the productivity of the production system is not optimal. To solve this problem, an internal policy model is needed by improving the special production system of SCM 5.56. It consists of improvements in production line layout, supply chain system, Product Breakdown Structure (PBS) analysis and critical path analysis (CPA). By applying such analysis the resulting production time for 1,000 grains is 132,374 minutes or 2,206 hours. But those results need to be tested by testing the normal distribution statistical hypothesis. It turned out that the test results were PT. XYZ is able to fulfill it.*

Keywords: Analysis of Factors, CPA, PBS, Readiness Identification, SCM 5.56

I. INTRODUCTION

The small caliber munition (SCM) 5.56 is one of the main tools of the defense system needed to support the country's defense system are the universal people's defense system consisting of the main components, namely the Indonesian National Army and the Indonesia Police, supporting components are the government institutions not defense and security, and reserve components are the state civil apparatus.

To fulfill the needs of small caliber munitions 5.56 to support the country's defense system, the Ministry of Defense of the Republic of Indonesia ordered a SCM 5.56 as much as 1.1 billion grains per two years or 550 million grains annually at PT. XYZ. But to produce 550 million item of SCM 5.56 each year, PT. XYZ is constrained by a production capacity of only 415.9 million grains SCM 5.56 annually. Based on calculations there will be a shortage of about 134.1 million grains SCM 5.56 each year.

These constraints are due to the not optimal production system implemented by PT. XYZ so that the productivity of the production system is not optimal. To solve this problem, an internal policy model is needed by improving the special production system of SCM 5.56. It consists of improvements in production line layout, supply chain system, Product Breakdown Structure (PBS analysis and critical path analysis (CPA).

II. RESEARCH METHOD

This research is quantitative research with direct observation to obtain primary data (Creswell, John & Creswell, David, 2018). The subject of the study is PT. XYZ, for research data collected in the form of process time data, production line layout data, machine number data. Furthermore, the data is analyzed with the analysis of the production system.

Some analysis of factors that affect the production system is analysis of production process time to SCM 5.56, analysis of production line layout to see if it is economical, safe, comfortable as to raise the morale of operator performance (Tomkins, et.al., 2010; Kozai, 2018), analysis of supply chains to see if there are obstacles in raw matrials the distribution and supporting materials to be made products that are further distributed to users (IPQI, 2021) For supply chains at the defense industry sector is an economic support for developed countries. The modern defense industry supply chain involves many supporting industries to support the main defense industry (lead integrator) (Antil, et.al., 2001).

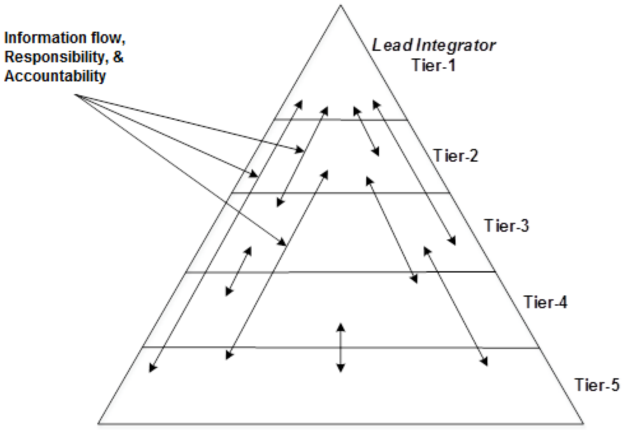

Figure 1. Supply Chain Systems of Defense Industry

Source: IPQI, 2021

Product Breakdown Structure analysis is a tool used for assessment, planning, and displaying the results needed by a project. It is part of a product-based planning technique, and tries to break down all the components of the project or product in as detail as possible until nothing is missed.

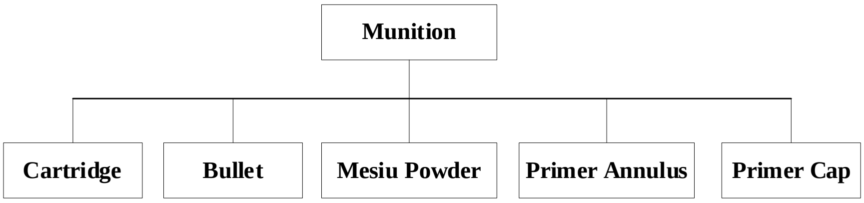

Figure 2. Product Breakdown Structure of munition

The critical path analysis is a method that utilizes network to work the preparation of work completion planning (Production or Project) so that the work can be completed optimally based on the calculation of time and cost (Bishnoi, 2018; Soe, et.al., 2018).

With the analysis of factors that affect the production system, one of them is the time of production process of SCM 5.56 set by PT. XYZ (PT. XYZ, 2020). To test to PT. XYZ is ready and able to produce 550 million item of SCM 5.56 each year, tested using the two-way normal distribution statistical test hypothesis (Johnson, 2018; Walpol, et.al., 2017). With the above analysis and test, researchers can make improvements so that the productivity of the production system to optimal.

III. Literature Review

A. Product Breakdown Structure (PBS)

Product Breakdown Structure (PBS) is a tool used to assess, plan, and display the required results of a project. This is part of a product-based planning technique and tries to break down all the components of the project - in as much detail as possible so that nothing is missed. The Product Breakdown Structure (PBS) is the hierarchical breakdown of the products such as hardware items, software items, and information items (NASA, 2007). The purpose of the PBS is to dissect a complex project into smaller, manageable parts. This is different from the Work Breakdown Structure (WBS) in that it outlines products to be built or bought instead of work to be done. The PBS should give project teams a clear understanding of each product, its components, and requirements of those components (Product Breakdown Structure, n.d.). The lowest level of the PBS should contain products for which a specific engineer is responsible.

A deliverable-oriented WBS defines project work in terms of the components (physical or functional) that make up the deliverable. In this case, the first word in a given WBS element is a noun, such as, Module A, Subsystem A, Automobile Engine, Antenna, etc. Since the nouns are usually parts of a product, this WBS type is sometimes called a "Product Breakdown Structure (PBS). Deliverable-oriented WBS structures are the preferred type according to PMI's definition.

B. Critical Path Analysis (CPA)

Critical Path Analysis (CPA)/Critical Path Analysis is a method by utilizing the use of a Network (Network) which functions to prepare work completion plans (Production or Project) so that work can be completed optimally based on time and cost calculations. In addition, to analyze that the network used in completing the work is optimal, the Critical Path Method (CPM) can be used as a monitoring tool. CPM is a method that focuses on time to determine work or project scheduling, which is deterministic (right). With the use of the CPM method in completing a job/project, it is expected to be able to control multiple activities in one job/project simultaneously, so that work is completed on time so that the company is assisted in procurement, planning, and project control activities (Soeharto, 1998).

A job/project will be successful if it is able to meet the needs of the scope of work so that the work/project will be completed on time from the planned time simultaneously. Critical Path Method (CPM) provides an identification mechanism approach for critical conditions on the basis of job/project uncertainty. By using this method, it is possible to anticipate uncertain conditions and the variability that may arise in the work (PMBOK, 2013). Problems that arise as a risk of scheduling problems on projects that are the subject of research in this paper, are expected to be reduced or even eliminated by applying one method or project scheduling analysis. One method that can be used is Critical Path Analysis (CPA) (Schwalbe, 2013). Critical Path Analysis can also be used to find out how serious the problem is from a risk (Marchewka, 2003).Critical-Path Method (CPM) or Critical-Path Analysis (Schwalbe, 2013), categorized as a traditional method (Shurrab, 2015), is a technique developed for planning and scheduling, where aspects related to this method include: Problem solving in business practice, required modern mathematics, required large computer resources (at the time), and this technique was already practiced (James. E. Kelley Jr., 1957).

C. Supply Chain

The definition of supply chain/supply chain in manufacturing industry activities is changing raw materials and supporting materials into a product which is then distributed to users. If defined in detail then what is meant by supply chain is a cycle of activities consisting of coordination, scheduling and control for a procurement, inventory control, production, and distribution/delivery of products or services to users whose scope consists of administrative, operational, logistics, as well as managing information systems starting from users to vendors (suppliers) (Indonesia Productivity and Quality Institute (IPQI), 2021). Basically a supply chain consists of three main streams, namely goods, money, and information that must be managed properly, from upstream/upstream to downstream/downstream, of the three streams, information flow is the most important flow in building superior supply chain management. Because the flow of information must be managed appropriately and transparently, in order to create a good flow of information and communication, so that interested parties can control and monitor an appropriate plan. When the supply chain synergizes to achieve the level of user satisfaction, efficiency and benefits and competitive advantages will be obtained (Jay Heizer and Barry Render, 2014).

IV. RESEARCH RESULT AND DISCUSSION

For layout is the most important thing in a production system, for now the layout of the production line for small caliber munitions of 5.56 mm at PT. XYZ can be seen in Figure 3 below.

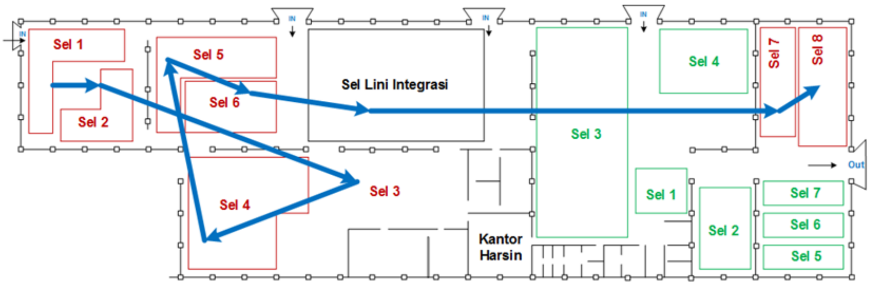

Figure 3. Layout of SCM 5,56 Production at PT. XYZ

Source: Soe, et.al., 2018

At this time the supply chain system implemented by PT. XYZ specifically for small caliber munition 5,56 mm products can be seen in Figure 4 below.

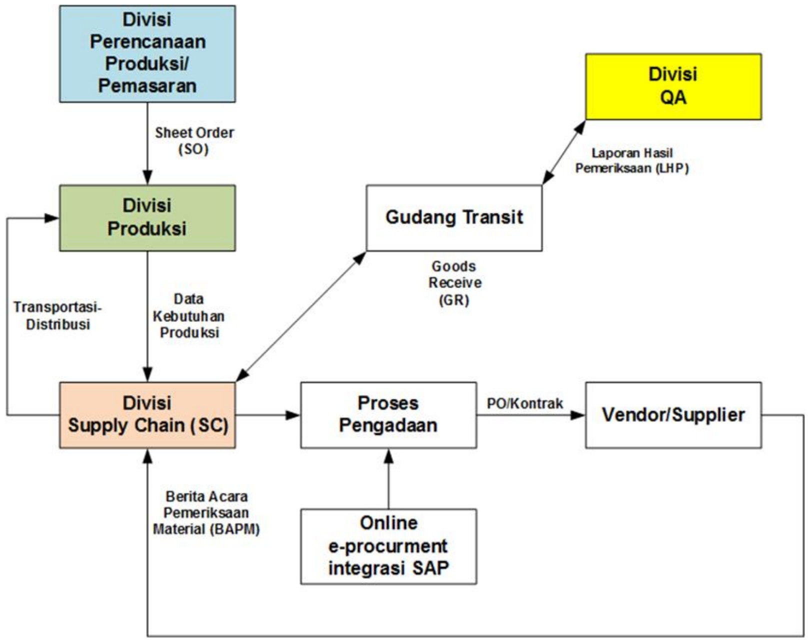

Figure 4. Model of Supply chain of PT. XYZ

Source: Soe, et.al., 2018

To measure the production time of a SCM 5.56 based on the Product Breakdown Structure. The measurement is made with a sample number of 1000 grains, with the results of the measurement can be seen in Table 1 below.

Table 1. Measurement Result of Production Process Time to SCM 5.56

No.	Working Processing	Work Process (minute)
1.	Tin Core Production Process	9,837
2.	Steel Core Shape	8,774
3.	Prame Cup Process	2,839
4.	Assembly of Bullet	40,497
5.	Cartridge Production Process	79.713
6.	Munition Assembly Process	44,175
7.	Munition Packaging Process	8,486

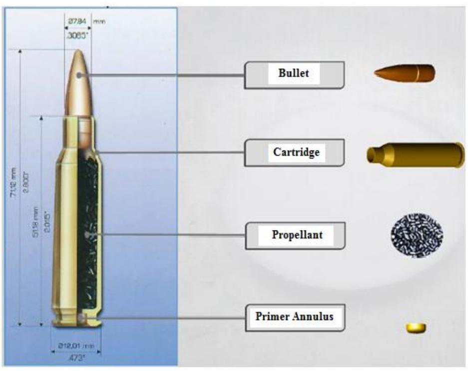

Figure 5. Product Breakdown Structure to SCM 5,56

Source: Soe, et.al., 2018

Next the Table 1 data as a basis for creating and calculating critical path analysts. Furthermore, the calculation of the critical path is in Figure 6 below.

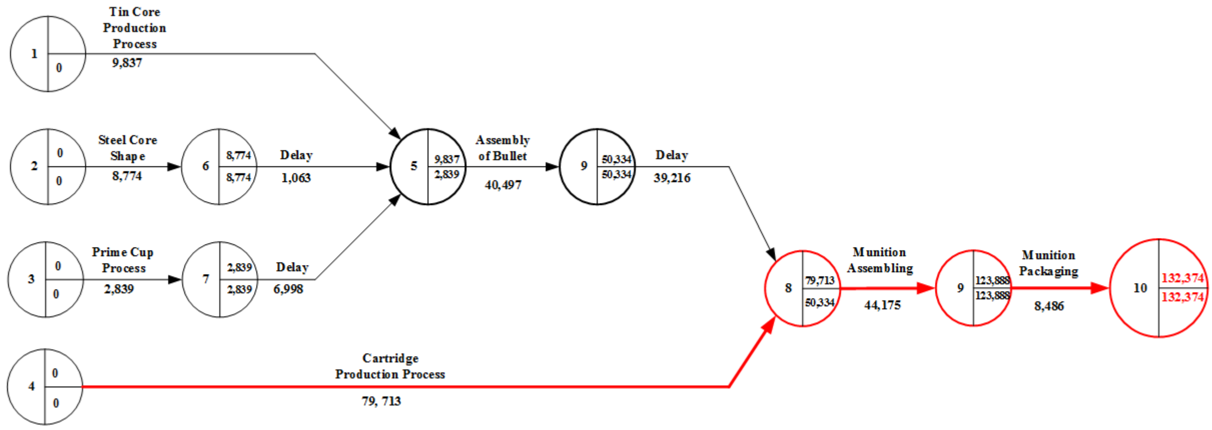

Figure 6. Critical Path Analysis to SCM 5,56 Production

The result of calculating to the production process time based on critical path analysts for 1,000 grains to SCM 5,56 is 132,374 minutes or 2,206 hours.

To test the hypothesis of the production capacity capability of PT. XYZ in producing small caliber munitions of 5.56 mm. Taken 2 (two) samples of process elements, namely: (1) Cartridge Production Process, and (2) Munition Preparation Process, 1000 grains to SCM 5,56.

Average time of cartridge production process is μ_0 (Given PT. XYZ) = 79,712 minutes, standard deviation σ_x=0,0060, n = 30 and $\bar{X}$=79,713 minutes.

Test:

- H_1:μ_0 =79.70 and H_2:μ_0 ≠ 79.70.
- With a significance level of α = 5% for a two-way test, the critical value is $Z_{\frac{\alpha}{2}} = Z_{0,025} = 1{,}96$ (see of standard normal distribution table).
- Test statistics: $Z = \frac{\bar{X}-\mu_0}{\sigma/\sqrt{n}} = \frac{79{,}713-79{,}712}{0{,}006/\sqrt{30}} = \frac{0{,}001}{0{,}006/5{,}477} = \frac{0{,}001\ x\ 5{,}477}{0{,}006} = 0{,}912$
- Decision-making criteria:
  If $Z_{calculates} < Z_{table}$ then H_1 is accepted
  If $Z_{calculates} > Z_{table}$ then H_1 is rejected or H_2 is accepted

Average time of munitionasssembly process µ0 (Given PT. XYZ) = 44,173 minutes, standard deviation σ_x=0,006, n = 30 and $\bar{X}$=44,175 minutes.

Test:

- H_1: μ_0 = 44,173 dan H_2: μ_0 ≠ 44,173
- With a significance level of α = 5% for a two-way test, the critical value is $Z_{\alpha/2} = Z_{0,025} = 1{,}96$ (see of standard normal distribution table)
- Test statistics: $Z = \frac{\bar{X}-\mu_0}{\sigma/\sqrt{n}} = \frac{44{,}175-44{,}173}{0{,}006/\sqrt{30}} = \frac{0{,}002}{0{,}006/5{,}477} = \frac{0{,}002\ x\ 5{,}477}{0{,}006} = 1{,}923$
- Decision-making criteria:
  If $Z_{calculates} < Z_{table}$ then H_1 is accepted
  If $Z_{calculates} > Z_{table}$ then H_1 is rejected or H_2 is accepted

Based on the results of the hypothesis test, with the current condition: PT. XYZ is able to produce 1.1 billion grains of SCM 5.56 per two years.

Looking at the current condition of the layout from production line to SCM 5.56, there needs to be a re-layout. In the layout of the production line, for red cells are the line to produce cartridges while green cells line to produce of bullet. With these conditions for cartridge production lines there is a waste of transfer time between cells, especially from cell 6 to cell 7 and cell 8. That requires distance and transfer time that is considered inefficient so it will reduce productivity (Hartrampf, 2019). With the re-layout is expected to reduce the distance and transfer time between cells in the Cartridge production line so that it can reduce of processing time.

V. Conclusion and Recomendation

Based on the analysis of the layout of the production line, supply chain analysis, analysis of product breakdown structure, measurement and calculation of production process time, critical Path Analysis, as well as hypothesis test that PT. XYZ is able to produce 1.1 billion grains per two years, with a critical track time for 1000 grains SCM 5.56 is 132,374 minutes or 2,206 hours. Although PT. XYZ is able to produce 1.1 billion grains for two years. But there are some conditions that must be improved, especially the layout of the production line that must be rearranged in order to reduce the distance and transfer time between cells, especially for cells on the production line to make SCM cartridges of 5.56 mm. To optimize the production of SCM 5.56 must make breakthroughs regarding the independence of the supply chain by using local materials to replace imported materials in order to reduce dependency whose impact can reduce the cost and time of ordering materials, so as to accelerate the target order specified.

VI. Acknowledgments

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References

[1] Creswell, W. John & Creswell, J. David. (2018). Research Design, Qualitative, Quantitative and Mixed Methods Approaches, Fifth Edition. *SAGE Publication, Inc*

[2] Tompkins, A., James, Ehite, A., John, Bozer, A., Yavuz, Tanchoco, J.M.A. (2010). Facilities Planning Sixth Edition. *John Wiley & Sons, Inc*.

[3] Kozai, Toyoki. (2018). Smart Plant Factory. *Springer Nature Singapore Ple Ltd*.

[4] IPQI. (2021). Inhouse Training Supply Chain Management. *IPQI Favourite Training*

[5] Antil, D. Peter, Moore, M. David, Neal, J. Derrick. (2001). IPTs (Integrated Project Teams): the way forward for UK DefenceProcurement. *Cranfild Ceres*.

[6] Bishnoi, Nisha. (2018). Critical Path Method (CPM): A Coordinating Tool.*Journal of IRJMTS*.

[7] Soe Hein, Paing, Htike Min, Rhein, 2018. Critical Path Analysis Programming Method Without Network Diagra*m*. *Journal of MATEC, Vol. 1 No. 1.*

[8] PT. XYZ. (2020). Small Caliber Munition 5,56 mm Production System.

[9] Johnson, A., Richard. (2018). Miller & Freund's Probability and Statistics for Engineers Ninth Edition Global Edition. *Pearson Education Limited*.

[10] Walpol, E., Ronald, Myers H., Raymond, Myers, L., Sharon. (2017). Probability & Statistics for Engineers & Scientists Ninth Edition Golabal Edition. *Pearson Education Limited.*

[11] National Aeronautics and Space Administration. (2007). NASA Systems Engineering Handbook.Washington: National Aeronautics and Space Administration.

[12] Soeharto, I. (1998). Management Proyek dari Konsep Sampai Operasional. Jakarta (ID): Erlangga.

[13] Project Management Institute. (2013) Project Management Body of Knowledge (PMBOK Guide). 5th Edition, Publishing House of Electronics Industry, Beijing, 309-312.

[14] Schwalbe, K. (2013). Information Technology Project Management. Boston, MA: Cengage Learning.

[15] Marchewka, J. T. (2003). Information Technology Project Management: Providing Measurable Organizational Value. Wiley.

[16] Shurrab, M. (2015). Traditional Critical Path Method versus Critical Chain Project Management: A Comparative View. International Journal of Economics & Management Sciences, 4-9.

[17] James. E. Kelley Jr., M. R. (1957). Critical-Path Planning and Scheduling. 1959 Proceedings of The Eastern Joint Computer Conference (pp. 160-173). New York: The collection of the Computer History Museum.

[18] Heizer, Jay, Render, Barry. (2014). Operations management : sustainability and supply chain management (11th ed. Global ed.). Tokyo: Pearson Education.

[19] Hartrampf, D. (2019). Modern Facilities (Factory) Planning. *Bookboon The eBook Company*.