Six Sigma Based Performance Measurement of Tax Return Processing Improvement (Case Study: Directorate General of Taxes For Republic of Indonesia)

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Abstract. Directorate General of Taxes for Republic of Indonesia has an internal unit named data processing centre (DPC) that has main duty to process paper tax return delivered from tax office. DPC practically implemented new tax return processing system to replace the old system, however the performance of the new system was not on a par with the old one, at the beginning. Then, DPC made several improvements to increase new system’s performance. This study aims to measure the improvements made by DPC by using Six Sigma approach. The approach is functioned to assess data processing performance through DMAIC concept: i.e. define, measure, analyse, improve, and control. With the DMAIC concept, improvement exposes better result, the average value of six sigma significantly escalated by 0.97 to 2.56.

1. Introduction

The uses of six sigma (S2) approach started on 1980s, and then S2 became more and more well-known when Motorola use it to help the company win the 1988 Malcolm Baldrige Quality Award [1]. The most famous ability of S2 is to reject defects, decrease costs, enlarge a customer satisfaction, and much more. However, the success rate of S2 employment depends on statistical concept called DMAIC: defining, measuring, analyzing, improving, and controlling [1].

On the other hand, regarding a country income, it is mostly arriving from taxes collection. By way of taxes, a country can leverage their people's welfare as the taxes can be used to make some improvements on some sectors of the country, such as public facilities. The effects of tax benefit are not only for people who pay the tax, but it is able to be benefited by all societies. Hence, the tax collection monitoring become very crucial to ensure a country to survive rationally [2].

The research on tax procedure improvement has been conducted by various researchers around the world. In 2016, [4] did a research on the effects of electronic tax implementation by Kenya Revenue Authority (KRA). The study result said that almost 85% tax payers disagree to this system, because of hard user interface usability and some failures to log in to the system. The system makes the users uncomfortable finally. The study recommended the management to improve the system to become easy use. This issue also has been highlighted by [3], he said that the tax authorities need to ensure if the users are able to operate the system without any doubts, and he also suggested the tax authorities to provide the technical support to users.

Based on IT service management perspective in tax administration, ITIL was used for improving incident management process and service desk [4]. Tax evasion of tax administration in 13 European
countries was studied, it is concerning on the impact of its efficiency [5]. And to control the consumption of tobacco, [6] used tobacco taxes as one strategy to increase the county’s income.

Specifically, in Indonesia, directorate general of taxes has a core division entitled data processing center (DPC). The division has a central job to process paper tax return coming from tax office. In DPC, paper-based tax return was technologically digitized by scanning paper of tax return and entering tax return detail into system. Since 2015, DPC developed new system for processing tax return to replace the old one for the business process improvement purpose; however, the total implementation of new system began in 2017. At the beginning, the performance of the new system is not as good as the old system, the number of tax return (as indicator used to measure the performance of system implementation) that is processed not in time (tax return processed not in time called PNIT) is still greater than processed in time (PIT). Tax return must be processed in time because of business commitment; here, the data is required by tax office in projecting tax potential. In 2018 several improvements were made to new system. Several significant performances were upgraded. Thus, this study conducted to measure the improvements made by DPC via S2 to optimize the performance of the new system implemented in DPC.

2. Related Works
S2 method has been used in a lot of sectors and cases. In 2004, [1] has used the S2 method in electronic company in China. This company produced PCBs by placing micro-miniature leaded electronic components to the surface of PCB. They identified defect by screening if there are any solder joints can lead failure, the use of S2 here is to improve the screening process using design of experiments (DOE) method [1]. In 2009, [1] applied S2 to reduce the operation cost of thermal power plants, as they identified the defect on thermal power plants is heat loss and water and chemical consumption are used excessive.

The other research on S2 has held by [7] to enhance health effects in caring institution. In their study, they were using S2 to improve customer service and satisfaction values using some sort questioners to the customer to measure the numbers[1]. [8], in 2014, also conducted a case study regarding uses of S2 to leverage the food processing industry. They stated that a business goal is to increase profitability by minimizing packing’s ingredients waste, to do so they needed to identify the root cause of the defect. The defect in here was identified by packing’s ingredients waste. It identified using five-why analysis [8].

The research continued in 2018 by[11]. In their research, they used DMAIC method to analyze the plain yogurt production process and increase the yogurt quality by obtaining the optimum rate of acidity. It was also used to analyze the root cause of low quality yogurt using cause and effect diagram[11]. From all researches have been performed, S2 has lots of uses besides on reducing defect; such as improving the product quality.

3. Literature Review
S2 is defined by [10] as an organized and methodical methods that applied for improving strategic processes and developing services based on statistical and scientific techniques to make meaningful reductions in defects. [13]studied elements in S2 that make effective contribution to measure of quality management besides role structure and focus on metrics. This improvement procedure and concept is known as DMAIC.

DMAIC method of S2 designed in practice and it was developed on ideas from the quality engineering field and integrating concept of statistical quality control and total quality management [12]. DMAIC method was clearly defined by [14] in rational construction of S2 stage as shown in Table 1.
Table 1. Rational construction of S2’s stage structure [14]

| Phase      | Definition                                                                                                                                 |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Define     | Define the problem to be solved and benefit analysis including customer impact.                                                                |
| Measure    | Verify measurement capability and identify the critical-to-quality characteristics (CTQs) of the product or service.                        |
| Analyze    | Understand of root causes and why defects occur and identify key process variables that cause of defects.                                    |
| Improve    | Determine how to impact in the process to significantly reduce the defect levels and design of adjustments to improve the process.          |
| Control    | Adjustment of the process management and make control system in order that improvements has been made and sustainable.                     |

S2 is going to be exploited to measure and review all activities in determining where the points of lack and how to improve the process. The point of S2 is to compute the number of defects. There are several metrics operated to evaluate defects: defects per unit (DPU), defect per opportunity (DPO), and defect per million opportunities (DPMO). DPMO is the ratio of the number of defects in a sample to the total number of defect opportunities multiplied by 1 million. To get value of sigma, the value of DPMO must be calculated and known first, then the value of sigma can be checked thru S2 table (Table 2).

Table 2. Six Sigma Level

| Six Sigma Level | DPMO   | Yield     | Six Sigma Level | DPMO   | Yield     |
|-----------------|--------|-----------|-----------------|--------|-----------|
| 6               | 3.4    | 100.00%   | 3               | 66,807.00 | 93.30%    |
| 5.9             | 5.4    | 100.00%   | 2.9             | 80,757.00 | 91.90%    |
| 5.8             | 8.5    | 100.00%   | 2.8             | 96,801.00 | 90.30%    |
| 5.7             | 13     | 100.00%   | 2.7             | 115,070.00 | 88.50%    |
| ...             | ...    | ...       | ...             | ...    | ...       |
| ...             | ...    | ...       | ...             | ...    | ...       |
| 3.5             | 22,750.00 | 97.70%  | 0.5             | 841,345.00 | 15.90%    |
| 3.4             | 28,716.00 | 97.10%  | 0.4             | 864,334.00 | 13.60%    |
| 3.3             | 35,930.00 | 96.40%  | 0.3             | 884,930.00 | 11.50%    |
| 3.2             | 44,565.00 | 95.50%  | 0.2             | 903,199.00 | 9.70%     |
| 3.1             | 54,799.00 | 94.50%  | 0.1             | 919,243.00 | 8.10%     |

4. Research Methodology
The study stages are depicted obviously in Figure 1. The DMAIC is an approach we followed step by step as our study strategy. This study started by analyzing the case. In the “analysis of case study”, identification of the central problems that occurred is performed. Also, the identification of these problem sources and consequences are obtained. Furthermore, the stage of data collection process is carried out. The data used in this study is the amount of tax return processed in each specified period. Field observation is a method operated here. Also, the amount data of tax return processed obtained by querying the log database process. The data consisted of the processing period (year and month), the number of tax returns that were processed in time, and the amount of such tax return that processed not in time. Period of processing data is taken from 2017 July to 2018 November. The timeframe was taken because, starting in May 2018, several improvements were made which had a significant impact on tax return processing performance.
Figure 1. Research stages.

At the last, the DMAIC is methodically functioned. In the define phase, the determination of the problem and objectives to be achieved in solving the problem are carried out. In addition, to the analysis of what benefits of the improvement in tax return processing system can be obtained, if the problem can be solved. In measure phase, comparisons between tax return being processed on time and those processed not on time and measuring six sigma level processing system are made. Then, in the analysis phase, fishbone diagram and root cause hypothesis are used to conduct analysis to provide an understanding of the problems that occur in the tax return processing. While, in the improvement phase, the modification of process to improve tax return processing performance is done. Finally, in the control phase, plans to sustain the improvement in tax processing system are also made.

5. Result and Discussion

**Define** - Starting in 2015, a new application for processing tax return has been developed that will replace the old application. However, the large implementation began in 2017. At the beginning of the implementation of the performance of this application it is still not as expectation, because based on the data processing amount of PNIT is still more than the amount of PIT. All processed tax return is expected to be PIT because they are related to the data required by tax office in exploring tax potential. With the timely submission of tax return data in the core tax system, the activities to explore tax potential at tax office will be effective and efficient.

**Measure** - At this measure phase, the timeline data of tax return processing is collected. Based on the data obtained in each period, there are more tax return that are not processed on time than compared to those that are processed on time. Tax return that is not processed on time is stated as a defect in the processing of tax return. After obtaining a tax return processing defect in each period, then the initial six sigma level is calculated to obtain the current conditions of tax return processing based on the six sigma level.

Figure 2 shows a comparison of the number of PIT and PNIT for 1 year from July 2017 to June 2018. In that period, the number of PNIT is more than PIT. Based on Table 3, sigma level fluctuates in each period, this condition influenced by the condition of application, server and database of tax return processing. There is no control to sustain the performance of the processing system. In Table 3, the sigma level at the start of the implementation is 0, as all tax returns was PNIT, so all of these are considered defects.
Figure 2. Number of tax return processed.

Table 3. Data summary (before implementing new system).

| Period   | PIT  | PNIT | Total | Opportunity | DPO  | DPMO | Sigma Level |
|----------|------|------|-------|-------------|------|------|-------------|
| 201707   | 0    | 3,845| 3,845 | 1           | 1.00 | 1,000,000 | 0.00        |
| 201708   | 0    | 1,013| 1,013 | 1           | 1.00 | 1,000,000 | 0.00        |
| 201709   | 3,152| 8,775| 11,927| 1           | 0.74 | 735,726   | 0.80        |
| 201710   | 402  | 1,798| 2,200 | 1           | 0.82 | 817,273   | 0.50        |
| 201711   | 0    | 4,601| 4,601 | 1           | 1.00 | 1,000,000 | 0.00        |
| 201712   | 447  | 3,108| 3,555 | 1           | 0.87 | 874,262   | 0.30        |
| 201801   | 2,115| 738  | 2,853 | 1           | 0.26 | 258,675   | 2.10        |
| 201802   | 10,898| 5,620 | 16,518| 1           | 0.34 | 340,235   | 1.90        |
| 201803   | 14,199| 11,331| 25,530| 1           | 0.44 | 443,831   | 1.60        |
| 201804   | 17,888| 22,990| 40,878| 1           | 0.56 | 562,405   | 1.30        |
| 201805   | 30,868| 43,454| 74,322| 1           | 0.58 | 584,672   | 1.20        |
| 201806   | 9,215 | 4,670 | 13,885| 1           | 0.34 | 336,334   | 1.90        |
**Analyze** - In this phase, identification of the factors that affect the processing of tax return is done. In this study, fishbone diagrams are used to identify factors that influence the speed of tax return processing which can be seen in the Figure 4. Then, the root cause hypothesis is used to determine the most influential factors including necessary of bigger storage, running many unnecessary services for processing, necessary of query indexing and tuning. Storage capacity only 3 terabytes, when the space is full, it will interfere the system performance. Database server only have 16 gigabytes memory, this memory capacity is still not comparable compared to tax return processing capacity.

![Fishbone Diagram](image)

**Table 4. Root cause hypothesis.**

| Possible Root Cause | Root Cause Hypothesis | True or False? |
|---------------------|-----------------------|----------------|
| Application Query   | Need more indexing and tuning to most used query in application | TRUE |
| Storage Size        | Need more RAM and storage to increase capacity | TRUE |
| Service             | Running many unnecessary services for processing | TRUE |

**Improve** - Based on the results of the analyze phase, improvements were made to the factors that most affected system performance in processing tax return. Improvements made including adding indexes to the database tables that are most often queried and tuning the most frequently called queries, adding storage to the database, adding RAM to the database server and disable unnecessary services in tax return processing application. The results obtained from the improvements that have been made include increase of the level of six sigma to 3.3 and increase of number of tax return processed in time. More detailed results can be seen in Figure 6 and Tables 5. In Figure 5, can be seen that after several improvements were made in May 2018 there was a significant increase in the number of tax returns that were processed on time compared to the SPT processed not on time.
In figure 6, shown that there was an increase in sigma level six after May 2018. On average from July 2017 to June 2018 compared to July 2018 to November 2018 there was a significant increase in the average six sigma level as can be seen in Figure 7. Table 5 shows the details of the SPT that were processed on time and not on time. Bold font periods show periods where several improvements have been made which have resulted in an increase in the six sigma level.
Table 5: Data summary (before and after implementing new system)

| Period | PIT | PNIT | Total | Opportunity | DPO | DPMO | Sigma Level |
|--------|-----|------|-------|-------------|-----|-------|-------------|
| 201707 | 0   | 3,845| 3,845 | 1           | 1   | 1,000,000 | 0.00        |
| 201708 | 0   | 1,013| 1,013 | 1           | 1   | 1,000,000 | 0.00        |
| 201709 | 3,152| 8,775| 11,927| 1           | 0.74| 735,726   | 0.80        |
| ...    | ... | ...  | ...   | ...         | ... | ...     | ...         |
| 201807 | 12,061| 4,260| 16,321| 1           | 0.26| 261,013  | 2.10        |
| 201808 | 16,564| 9,315| 25,879| 1           | 0.36| 359,944  | 1.80        |
| 201809 | 14,878| 1,966| 16,844| 1           | 0.12| 116,718  | 2.60        |
| 201810 | 46,143| 9,315| 55,458| 1           | 0.06| 61,696   | 3.00        |
| 201811 | 23,463| 815  | 24,278| 1           | 0.03| 33,569   | 3.30        |

Control - The control phase is performed to ensure that improvements that have been made will be maintained in the long term to increase the performance of the tax return processing system. During this phase database storage capacity user per period and server utility for database servers and application servers will be monitored.

6. Conclusion and Further Works
Six Sigma is a measurement method that great in removing defects in the product. This study aims to measure the improvements that have been made on DPC to increase the performance of new systems that are implemented to replace the old system. Measurements using six sigma indicates that there is a significant improvement of the system seen from the increase in the average six sigma level from 0.97 to 2.56.

For future work, measurement can be done from the perspective of human resources, what problems are there in the tax return processing operator, what improvements have been made to increase the performance of the operators and what controls have been implemented to maintain the performance of these operator facility.

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