# Minimize inventory deviations in the Konimex technical warehouse through the implementation of the DMAIC concept

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**Abstract.** PT Konimex is a manufacturing company that focuses on the pharmaceutical sector and is supported by an Engineering warehouse for machine maintenance during operation. However, during its run, there were problems in the form of discrepancies between the stock stored in the warehouse and those recorded in the company's system which had a negative impact in the form of losses for the company. Therefore, a step-by-step analysis is carried out to provide solutions that are in accompanying circumstances using the DMAIC (define-measurement-analyze-improve-control) concept. The data collection method carried out is carried out directly and produces data in the form of primary data and indirect data collection, which uses the company's historical data and produces secondary data. Data processing using the DMAIC concept then obtained the root of the problem and improvement solutions in the form of container redesign and the application of 5S as well as the addition of warehouse personnel which is expected to reduce the company's stock-taking discrepancies.

## 1 Introduction

For over 50 years, PT Konimex has been a leading company in the manufacture of medicines, natural products, and foodstuffs in Indonesia and Southeast Asia. Their dedication to quality has earned them consumer confidence and outstanding certificates such as ISO 9001: 2015 and ISO 13485: 2016. Through a network of more than 50 distribution branches throughout Indonesia and an increasing presence in Cambodia, Malaysia, and Vietnam, Konimex is committed to providing high-quality products that improve life throughout the region. Konimex recognizes the importance of effective delivery of products across diverse areas and strategically uses warehouses in Sukoharjo, Central Java. These facilities operate as vital hubs within the company's logistics network. They provide safe storage of goods and maintain up-to-date and easily accessible inventory information, thus facilitating smooth cooperation with partners. Essentially, these warehouses operate as central stores, maintaining the production goods and stocks necessary for the smooth flow of products within the Konimex supply chain [1].

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The current warehouse, which plays an essential role in supporting business goals and performance, is preparing for transformation. By reorganizing and equipping the area, Konimex aims to eliminate lost or damaged stock. This will translate directly into cost savings associated with the storage of spare parts within the warehouse. In addition to financial benefits, the Initiative recognizes the critical role of the warehouse in influencing operational efficiency, in particular the movement of products. Optimization of the product can simplify processes and activities across space, thus enhancing the overall performance of the company [2]. The wrong effort of PT Konimex is checking the adequacy of stocks, which can also be called inventory. The inventory of the implementation at PT Konimex is carried out once a year but has no definitive schedule. The inventory is carried out by providing drop samples, and random stock availability of as much as 10% - 20% according to sample deviation rules. A sample of 10%-20% meets the expert agreed rule that for descriptive research at least 10% of the population is required, while 20% is used for relatively small populations. Implementing the PT Konimex warehouse has stumbled on many obstacles, resulting in operational delays. An important issue is the existence of differences between registered and physical inventory. Over 10 cases of this lack of conformity were detected during 2021-2022, affecting over 35 storage elements. These differences between the ERP system and the actual warehouse holdings hampered the smoothness of operations.

This position may be linked to various factors, including errors by warehouse staff and general warehouse conditions. Mistakes due to human errors, prevalent in the industrial sector, can lead to corporate losses by reducing efficiency and effectiveness, thus emphasizing the need to reduce them. Inventory discrepancies may result in a variety of losses to the company, affecting both the physical and financial dimensions [3]. For example, the quantity of inventory recorded is much lower than the actual quantity in the warehouse, indicating that the company's requirements and needs are not adequately met. Therefore, the company may make additional requests for spare parts, resulting in the accumulation of excess stock in the warehouse and increased inventory costs. On the contrary, the extended storage of many elements may lead to a reduction in the quality of goods over time.

Ensuring effective implementation of inventory procedures requires a comprehensive analysis of current issues and implementation of corrective actions. The resolution of inconsistencies can be dealt with through concepts such as balance, such as the application of the Six Sigma concept using the DMAIC method. Given that DMAIC is a linear approach, it requires multiple repeat cycles. To enhance analysis and develop solutions for this research, the authors use the SIPOC tool scheme during the initial phase of the improvement process, referred to as the definition of steps (d). In the measurement phase (M), which focuses on data processing to understand the root cause of the problem encountered, the authors use the Pareto scheme method to identify the types of pieces that often face contradictions. During the analysis phase (a), where the root cause analysis is performed, the authors use FTA tools, specifically the error tree analysis. Moving to the stage of improvement (I) is where the solution begins to be conceived and implemented. At this juncture, one of the tools used by the authors is Kaizen 5S. The final step in DMAIC is the control phase (C), which functions as the protection and oversight phase of the solutions program implemented. The objective is to ensure the continued and uniform implementation of DMAIC solutions, with the expectation of resolving the stockpile challenges faced by PT Konimex [4].

## 2. Method

This research journey begins by revealing the fundamental challenges that lie ahead. To achieve this, we are embarking on a two-pronged approach: to engage in relevant literature and field studies in the real world. Through critical analysis of current research and direct observation of the situation, we can begin to understand the complexities of the problem.

This initial exploration will then become the basis for the formulation of a focused research question, which will guide our next steps toward meaningful solutions. The formulation used in this study is "How to analyze and solve the inventory of disconformity solutions based on the Six Sigma concept?". After that, the authors dig deeper into data collection, using both direct and indirect methods. To get the data and know the condition, the authors deal with warehouse staff through interviews and notes. This overwhelming approach allows to gather first-hand information and to see their experiences first-hand. Turning to indirect data collection, we mine valuable information from the company's past inventory records. This process delves into historical trends and patterns. Once gathered, we employ the DMAIC principle - Define, Measure, Analyze, Improve, Control - to meticulously process the data, extracting meaningful insights. These insights then undergo close examination, revealing valuable clues that lead to informed conclusions.

# 3 Results

## 3.1 Results

The processing of data used in this study follows the DMAIC concept. In its implementation, this concept includes a series of methodological stages, namely, the stages of definition, measurement, analysis, improvement, and control.

### *3.1.1 Define*

During the definition phase, the receipt and storage of spare parts is filmed using the SIPOC scheme. This chart serves the purpose of determining the factors affecting the receipt and storage of spare parts. Table 1 provides a visual representation of the SIPOC scheme.

**Table 1.** SIPOC diagram

| Supplier | Input | Process | Output | Customer |
|---|---|---|---|---|
| Machine part supplier | Sparepart | Demand order<br>⬇<br>Input demand order to ERP system<br>⬇<br>Goods receiving<br>⬇<br>Receipt making<br>⬇<br>Stock auditing | Warehouse, spareparts | Internal technician |

### *3.1.2 Measure*

During the measurement phase, phase II, calculations are made to ascertain the differences in most spare parts within the inventory at PT Konimex warehouse. The tool used at this stage is the Pareto, which is quite appropriate to identify those parts with the most significant discrepancies during inventory checks. The Pareto shows the discrepancies in the balance sheet for the period 2021-2022.

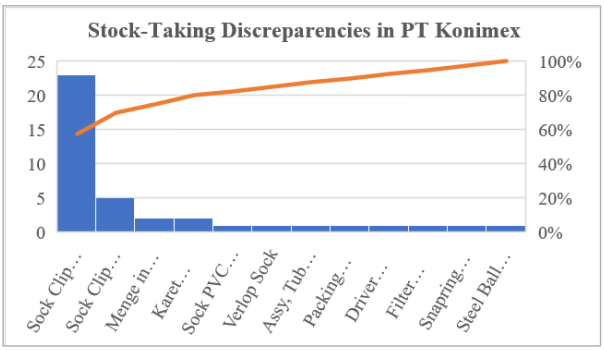


**Fig 1**. Pareto chart of discrepancies

In Figure 1, it is clear that components that show discrepancies in inventory numbers differ each month. As explained in the Pareto, the 25 mm type of Clipsalk and 23 pieces are the most affected parts. This discrepancy may stem from various factors, including the storage conditions of the Clipsalk piece or possible errors made by staff during data collection or inventory recording inside and outside the warehouse.

### *3.1.3 Analyze*

During the analysis phase, a thorough examination is conducted to determine the root cause of the problem of the discrepancy in inventory. Once the underlying problem has been identified, it is expected that the most appropriate solution will be applied to the specific problem at hand. The tools used in the analysis phase include the FTA and work sampling scheme. Use FTA tools for analysis as the error tree analysis (FTA) provides a detailed error analysis that allows for tracking the potential causes of the problem. Through the use of the Free Trade Agreement, the aim is to conduct a comprehensive study of the reasons for discrepancies in the assessment of the updated inventory, which extends to its historical records at the warehouse [5]. Labor sampling tools are used to ascertain whether there is an unequal workload in the warehouse affecting workers ' efficiency. Subsequent analysis uses the FTA method to determine the most variable balance within PT Konimex.

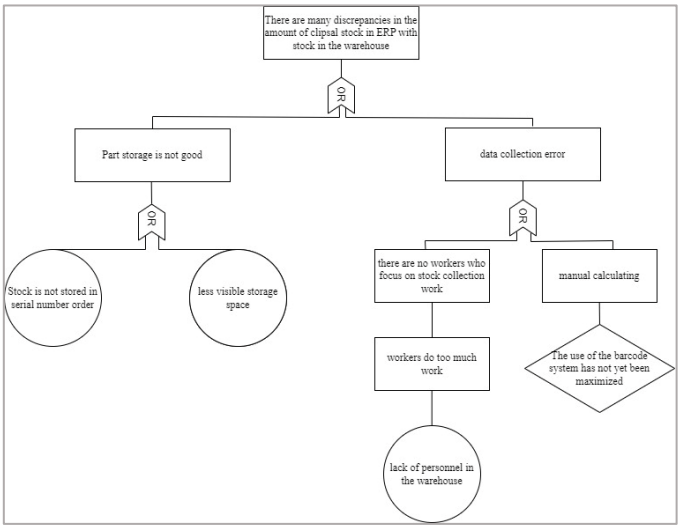


**Fig 2.** Fault tree analysis

Figure 2 shows that the issue of discrepancies in stocks arises from two main factors: insufficient storage of human parts and errors in data collection. Each factor is examined

further, which reveals that one of the causes of stock imbalances is storage practices that lack proper compliance with the less visible serial numbers and storage containers. Moreover, the problem of workers stems from the shortage of staff in the data collection warehouse. These three basic reasons will be advanced to the subsequent stage of determining the most appropriate corrective solution.

To assess whether the unequal workload affects warehouse workers, thereby reducing performance, an analysis is done through the job sampling method. Examples of accounts are presented with the Warehouse Supervisor as the designated entity in Table 2 and Table 3.

**Table 2.** Frequency of the head

| Activities | Day Frequency- | | | Qty |
|---|---|---|---|---|
| | 1 | 2 | 3 | |
| Productive | 47 | 42 | 47 | 136 |
| Nonproductive | 0 | 1 | 0 | 1 |
| Qty | 47 | 43 | 47 | 137 |
| PP | 100% | 98% | 100% | 99% |

**Table 3.** Frequency of the admin

| Activities | Day Frequency- | | | Qty |
|---|---|---|---|---|
| | 1 | 2 | 3 | |
| Productive | 46 | 52 | 47 | 145 |
| Nonproductive | 7 | 5 | 6 | 18 |
| Qty | 53 | 57 | 53 | 163 |
| PP | 87% | 91% | 89% | 89% |

Based on the calculation of the percentage of workload, the core workload of the warehouse is set at 101%, while the administrative workload is 90%. Each of these workload values exceeds the appointed maximum of 80%. The established labor management principle suggests that workers must be assigned tasks up to a maximum of 80% of productive activities. Therefore, improvements in the workload of warehouse staff are recommended to enhance their overall performance.

### *3.1.4 Improve*

Given this improvement, several recommendations are made for improvements to address discrepancies between the number of parts of the ERP system and those stored in the warehouse, to minimize discrepancies in inventory. An effective way to address this problem involves the implementation of the 5S methodology, with a particular focus on the organization and storage of parts. In addition, an additional initiative to reduce the workload of warehouse workers includes the proposal to add staff with job descriptions tailored to their specific requirements. Suggested improvements that the authors may provide are set out below.

a. 5S method
   The components of the 5S method consist of seiri, seiton, seiso, seiketsu and shitsuke. The proposed application of the 5S is specific to the storage location of spare parts in the warehouse to reduce the losses or errors in storage that may result in a mismatch of the number of stocks in the ERP with the amount in the warehouse.

- Seiri
  The first aspect obtained in the application of the 5S method is Seiri. Seiri means sorting items that are not necessary on the site. In the PT Konimex warehouse, several proposed activities that can be carried out to meet the seiri aspect are the grouping of goods in the warehouse that are less important or rarely sought after with important goods.
- Seiton

The subsequent element derived from the implementation of the 5S method is known as seiton. Seiton includes the maintenance of clean storage sites for equipment [6]. One of the activities recommended to achieve the seiton side of PT Konimex warehouses is to arrange parts in storage containers based on their serial numbers. The aim is to simplify workers ' tasks when searching or collecting data on the completeness of the parts ' stock.

- Seiso
  The third element derived from the application of the 5S method is seiso. Seiso includes keeping the site clean, with specific reference to cleaning the warehouse itself [7]. Proposed activities to address the seiso side of PT Konimex warehouses include ensuring the cleanliness of warehouses and verifying spare parts showing rust marks.
- Seiketsu
  The fourth element achieved through the implementation of the 5S method is seiketsu. Seiketsu involves appropriate care of goods and equipment to ensure storage of equipment and spare parts [7]. Recommended activities for the treatment of Sekitsu include regular inspections of stocks stored.
- Shitsuke
  The fifth element derived from the implementation of the 5S method is Shitsuke. Shitsuke includes the habit of positive workplace practices, where the achievement of a well-maintained workplace through the 5S method requires consistency with the habits of the audience [7]. Several of the activities proposed to achieve the Shitsuke side include socialization and continuous supervision of warehouse workers to continuously integrate the 5S culture. In addition, the provision of 5S posters in warehouses can help workers consistently implement the 5S concept principles.

The redesign efforts of spare parts storage containers, in line with the Seiri, Seiton, Seiso, Seiketsu, and Shitsuke principles, are as follows.


**Fig 3.** Redesign of container

Figure 3 illustrates the results of the refurbishment of spare parts storage containers. The left-hand side depicts the original form of the storage container before refurbishment, while the right-hand side presents the prototype for the storage of spare parts. Table 4 provides a comparison of container designs before and after refurbishment.

**Table 4**. Comparison

| Before | After |
|---|---|
| Storage container in the form of a regular block | Lightly trapezoidal-shaped container prototype |
| No stock card | There is a stock card stored inside the container, which facilitates the task of warehouse agents when collecting stocks |

b. Personnel Additional

Using the sampling method from previous work, calculations reveal that the workload of both warehouses exceeds the maximum limit - up to 101% for the store manager and 90% for the warehouse manager. Consequently, additional staff are required to achieve a balanced workload, ensuring the proper implementation of all warehouse functions. Table 5 summarizes a proposed plan to strengthen the detailed division of labor in the warehouse.

**Table 5.** Job descriptions

| Position | Sum | Job Details |
|---|---|---|
| Head | 1 | • Supervising and controlling goods leaving and entering the warehouse according to the SOP<br>• Control the operations of the warehouse<br>• Verify the goods received according to the SOP |
| Admin | 1 | • Respond to commodity requests<br>• Create PP products<br>• Manufacture of PPBs for receiving goods<br>• Submit goods requests to the ERP system of the company |
| Staff | 1 | • Assist in the service of the commodities request<br>• Logging of the entry and exit of the merchandise<br>Verify the quantity and condition of the goods |

### *3.1.5 Control*

The control phase is the critical phase in the implementation of the DMAIC method. At this stage, there is an ongoing effort to maintain and oversee the improvements implemented. The aim is to ensure consistent application of the proposed improvements, thus maximizing results. Some of the activities undertaken during this phase are as follows:

a. Before starting every mission, workers receive socialization sessions and briefings at the warehouse, providing them with specific details about their responsibilities.
b. Assess every job process periodically, for example, once a week at the end of the work day.

Several of these initiatives are being implemented to address the discrepancy between the quantity of stocks stored in the warehouse and the inventory recorded in the corporate system.

## 3.2 Discussion

### *3.2.1 5S solution*

In the proposed implementation of 5S, the design of the payload and subsequent re-engineering after simulation resulted in a significantly improved research time compared to the pre-repair situation. Figure 4 presents a variation in the time of simulation of partial searches of the warehouse before and after reconstruction.

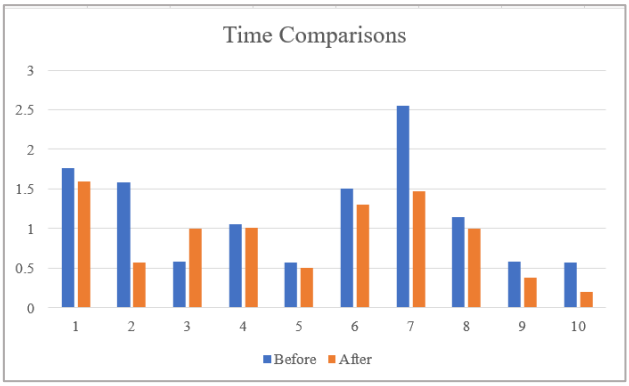


**Fig 4.** Comparison chart

When examining the time comparison table between simulations performed before and after the container's redesign, it is clear that almost all of the results of the post-repair time indicate a significant acceleration. This temporal improvement is facilitated by various factors, such as staff knowledge of warehouse planning, which contributes to their efficiency in locating stored parts. Furthermore, the timer used to simulate data retrieval affects the speed at which staff simulates the recovery of goods. However, there is a simulation result where the time required to locate elements after repair is significantly longer, specifically 2 seconds longer than it was before the repair. This contradiction can be attributed to different factors, with human error being one of them.

In short, given the simulation results that indicate a decrease in search time and inventory accounts for warehouse workers, it can be concluded that the proposed improvement concept, represented by methodology 5S, demonstrates its effectiveness in implementation. However, maintaining coherence and monitoring are essential to ensure that these improvement efforts are implemented with the best results.

### *3.2.2 Additional Personnel Analysis*

Proposals have been made in the form of additional staff to alleviate the stockpiles that have so far been unbalanced. The increase in the number of employees occurs through a variety of approaches, which include comparison with the warehouses of other companies. The excessive workload and contradictions in job descriptions can adversely affect both the company and its employees.

This position can arise because of the excessive workload that reduces their performance, leading to factors such as fatigue and lack of focus, leading to suboptimal results. In such cases, problems may arise in functions such as inventory accounts and procedures for receipt and storage of goods in the warehouse. Hence, the imbalance in workload leads to losses for

the company. The introduction of solutions, such as additional staff, has not been conclusively demonstrated because of time constraints and other factors requiring further investigation.

## 4. Conclusion

Ideas from data processing and analysis allow us to draw many conclusions. Instead of relying exclusively on serial numbers and suboptimal storage containers, it is recommended that the analysis continue through the use of the fault tree scheme. (FTA). This approach, based on the results obtained from the processing of data using the scheme and representative samples, will reveal many of the root causes that contribute to the volatility of the stock resulting from uncontrolled storage. Another aspect affecting workers is the shortage of staff in the transport home, which leads to a significant workload, including tasks such as data collection and inspection of goods that become difficult to manage.

Based on the results of data processing, recommendations were obtained for improvements to address these disparities through the implementation of the 5S concept and the addition of additional staff. The 5S concept emphasizes the organization and redesign of storage tanks, intending to make them cleaner and easier to assemble. Possible actions include the classification of goods by type, the processing of the Seiton side through the regulation of parts in warehouse containers based on ad hoc serial numbers, the ensuring of Seiso through regular checks of the physical condition of spare parts, the investigation of Seiketsu through routine inspections of warehouses, the realization of the Shitsuke side through continuous socialization and labor force control in the consistent implementation of 5S. Apart from proposing various activities to implement the 5S concept, improvements have been made in the form of redesign of some storage containers. In addition, a proposal was made to maximize the use of the staff warehouse by involving as many personnel as possible to offset the workload within the staff of the labor camp. This approach aims to prevent errors resulting from the enormous workload, which could affect the accuracy of the registration and endanger security in the camp.

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