Multipronged Projects to Improve Flow and Responsiveness In Receiving

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Declaration

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

Signed. .... (KOH HAN TENG) Date ....

Statement 1

This journal paper is the result of my own investigation, except where otherwise stated. Other sources are acknowledged by giving explicit references. Bibliography/references are appended.

Signed. .... (KOH HAN TENG) Date ....

Abstract

Receiving of a manufacturing facility involves handling of a high variety of items loaded from different suppliers. The process can be complicated as documents have to be processed, quality inspection and test, relabelling, good transportation, warehouse admission and storage, return goods and clearance all happen concurrently. In the absence of proper coordination, receiving can be chaotic and congested, especially during the peak seasons in which inundation of incoming goods from suppliers is common. Another concern lays on the process efficiency in terms of flow and responsiveness, as any delay inevitably expand manufacturing lead time. **Based on the strict sense of lean manufacturing, receiving is considered non-value added but necessary process**. Empirical studies on industry improvements at receiving are scarce in literature. This research **investigated ways to improve receiving process, following the Plan-do-check-act (PDCA) methodology**. The improvement **led to multipronged endeavours mainly to improve the interdepartmental responsiveness**. This **research led to the improved flow of materials in BSM's warehouse, reducing the time for newly received raw materials to be allocated in their final locations in warehouse. This enables sufficient raw materials to be sent into production lines and ensure smoother productions**. This research **provided the practitioner to have a clearer view towards to flow of materials in the warehouse, as well as determining the possible wastes in the flow of raw materials from receiving process to put away processes** (final location).

Keywords: Lean, Warehouse, Receiving, PDCA.

Paper Type: Research Journal.

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Nomenclatures

Receiving = The process in which the raw materials reaches the receiving bay of the BSM and collected by the BSM staffs.

Put Away (PA) = The process of transferring the raw materials into the racks in warehouse by specifically assigned staffs.

Inspection = The process of checking the quality of the raw materials, to ensure these materials' quality conform with the standards set by the BSM.

Goods Receiving (GR) = The paperwork process done by BSM receiving team, by checking with the Purchase Order, quantity, part number, and origin.

1.0 Introduction

In a receiving process, a well-coordinated docking process is essential to achieve a good start in the overall material flows from receiving to put-away process. The **best practice is to make docking appointments and unload every vehicle within labour and dock space [1] (WERC and Supply Chain Visions, 2007).This practice enables a good start for material flow, improves the coordination of security department and receiving team**.

Materials, products and components to be assembled into final product assembly should be inspected upon receipt. This inspection process involves verification of the delivery and checking the compliance with the stipulations of orders in terms of weight, type, trademark, marking and documentation required by the order. After the inspection, materials who passed the inspection will be put-away into warehouse.

Put-away involves the transfer of inspected raw materials or components to the final location in warehouse. It includes physical movements such as from the receiving docks to different storage locations [2] (Rene et al., 2007), performed by receiving team's crew.

As the raw materials moves from receiving to put-away process, the routing and transferring of the materials from one place to another is important too [3] (Ramaa et al., 2012). Appropriate routing and transfer methods of raw materials from one place to another would greatly reduce the receiving to put-away process lead time. This is due to lesser waiting time and unnecessary travelling time.

Successful application of lean techniques enables reduction of lead-time which is the unnecessary time part of the order-to-delivery processes, order picking time, and the time for material handling [4] (Sandeep, 2013). Reduction of the non-value adding activities, and improvement of velocity and flow in the warehouse enables the successful application of lean techniques. Generally, waiting is the most common non-value added activity in a manufacturing facility [5] (Vissier, 2014). Besides regular awareness training and supervision by stakeholders, frequent audit and enforcement of improvements are important.

This paper reported on an industry report aimed to apply visual management to improve coordination between departments and to improve 'receiving to put-away process lead time. The project follows the Plan-Do-Check-Act (PDCA Methodology) originated from lean concept. The paper is organized as follow: Section 2.0 includes the literature review, section 3.0 is the objective, section 4.0 describes the research methodology, company background is listed in section 5.0, section 6.0 includes the case background, describing how the problems were solved using PDCA 12 Steps. Section 7.0 is the discussions and section 8.0 is the conclusion. Finally, reference is located at section 9.0.

In this paper, the focuses are on (i) reducing the congestions at the receiving process of the warehouse and (ii) reducing the receiving to put-away process lead time through improvements in the processes involved from receiving to put-away process.

2.0 Literature Review

Warehouses are an essential component of any supply chain. It plays the role of buffering the material flow along the supply chain by accommodating the variability, having caused by batching in production and transportation [6] (Gu et al., 2006). BSM's warehouse is playing the role as production warehouse, which is used to store raw materials, work in progress and finished goods within a facility [7] (Van et al, 1999). Within these warehouses, lean focuses on assembling the warehouse in the most efficient way, such as minimizing non-value adding activities in receiving and put away [8] (Myerson, 2012). Hence the most important aspects to be considered for defining the lean improvements constructs for warehouse is that these constructs should cover all possible aspects of lean warehousing such as operational, organizational and human resources [9](Mustafa, 2015). According to [10] (Mustafa, 2015), the 5 lean improvement constructs are known as waste control, flow management, quality assurance, human resources management and continuous improvement. In which we will focus on waste control, continuous improvement and flow management in this paper. This is vital as continuous improvements in the design and operations of production-distribution network, it requires warehouses to more performing by having shorter response time [6] (Gu et al, 2006). Improving the flow of materials is a method used to control the waste and non-value adding activities [11] (Ackerman, 2007). Besides, focusing on reducing the receiving errors and inefficiencies we could improve the flow of entire warehouse [12] (Newcastle System, 2015).

Warehouse performance has 2 types on indicators, internal performance measures and external performance measures, in which the internal performance indicators measure the throughput time or lead time for all warehouse functions [13] (Van Goor et al., 2003). Lead time means from the time of receipt of customer to dispatch [14] (Baker, 2004). Lower lead time can be achieved through efficient flow of materials [15] (Marjan, 2008).

One of the measurement constructs for the performance of warehouse is through materials flow [16] (Sobanski, 2009). Materials flows play a major role in the put-away process. Put-away process is defined as providing the appropriate location for items and transferring them to the specified storage location to wait for demand [17] (Rouwenhorst et al., 2000). The put-away process starts when a receiving list is ready and given items are located on staging area of receiving bay. The employee usually uses a lift truck to move and place the item to a storage location, in which most of the times are wasted on transportation [18] (Blomqvist, 2010). Transportation is one of the 7 major wastes in lean production, in which unnecessary movements occurred due to inefficient routing and work method [19] (Hann et al., 2009). Due to slow and inefficient put away, receiving docks are under-utilized [20] (Newcastle System, 2015). In receiving, the process of unloading the truck, incoming big batches of materials are divided into smaller batches for subsequent processes such as put-away, meaning that the incoming raw materials are allocated at the staging area [21] (Bozer, 2012). Simplification method is used to minimize the total process flow, for example, delivering materials to the point where actual process happens and eliminate any immediate steps [22] (Tompkins et al, 2010). Operations are combined through planning the movements of materials and peoples as well [23] (Tompkins et al., 2010).

Besides this, inadequate working methods also lead to ineffectiveness in warehouse [24] (Mustafa, 2015). For example, inconsistent deliver of items into Incoming Quality Assurance inspections. Hence, certain researchers use several methods solve this problem. Levelling of materials flows such as dividing the equal load of work can help to improve materials flow in warehouse and avoid bottlenecks in advance [25] (Sabonski, 2009) Levelled flow is the concept of creating a balance among movement of materials and workers within work segments and between work stations to manage the work in process [26] (Sabonski, 2009). The pitch or frequency for each material handling is determined to achieve levelling [27] (Sabonski, 2009). This is done due to long waiting time, in which waiting is one of the 7 wastes in lean warehousing, [28] (Haan et al., 2009). Hence reduce waiting time is a method of removing waste in lean warehousing [29] (Meier &Forrester, 2002).

Another measurement constructs of lean warehousing is visual management [30] (Bhasin, 2008). Several common problems occurred in receiving area such as receiving docks are backed up receiving docks leaving trucks idling outside the facility just to wait for an open bay [31] (Newcastle system, 2015). These problems are unseen until we have a visual system to display the real time situations. Visualize the work within the warehouse real-time, so that we could start meetings to discuss about performance, improvement opportunites and potential difficulties [32] (Bozer, 2012). Visual management and control has to be used so that no problems are hidden [33] (Liker, 2004). Visual management helps to improve organizational performance as we see something and we understand it better, it makes important information visible to all workers, in form of visual display units, slogan and etc [34] (Mustafa, 2015). For example, Toyota and Fanuc's production lines uses coloured bins and light signals to control production flow, as visual and colour aids are low costs yet have useful psychological effects [35] (Mustafa, 2015).

3.0 Objective

The targeted conditions of projects are applying visual management to improve coordination between departments and to improve ‘receiving to put-away process lead time’. Based on these targeted conditions, the goal of this project is to reduce ‘receiving to put-away” process lead time from average 33 hours to 26 hours (20%). This target is set by the team as this is a long term improvement, hence we started this improvement journey by taking a small step at a time. In which the team agreed with the improvement of 20 percent at this time.

4.0 Methodology

Methodology is the "general approach the researcher takes in carrying out the research project" [36] (Leedy and Ormrod, 2001). The researcher uses mathematical models as the methodology of data analysis [37] (Williams, 2007) as well as publication research, interviews, surveys and other research techniques. Research methodology is necessary for others to understand what I have done in this research and the reasons of doing so. This can be a reference for future researchers to perform researches related to the topic.

This project is a case study research using PDCA approach. This case study is done by studying the real situation for a period and followed by analysis through investigation and some experimental activities [38] (Woodside, 2010). PDCA concept (or known as Deming Cycle) is originated from Shewhart Cycle. It is a cycle of improvement to reach target condition, based on scientific method. PDCA approach is broken down into 4 stages, P (Plan), D (Do), C (Check) and A (Act). PDCA approach is applied to achieve opportunities to get closer towards target conditions. Rapid and frequent PDCA Cycles are encouraged to achieve improvement kata [39] (Rother, 2009). PDCA method will be used entirely in this project.

The PDCA method is further explained below and each phase consists of a number of steps. Departments and teams involved are: Receiving Team, Put-away team, IQA Team and Security Department. They are also the main stakeholders in this project. Interviews and time studies were conducted on their working methods.

4.1) Plan (P) Phase

Core team is formed and kick-started in this phase. Their respective roles and responsibilities are defined. Certain BSM Employees who are expertise in specific areas are ensured that will be available to support the project. Strategic planning was the essential first step in the development of this project and it is defined as the process of addressing the following questions [40] (Schilder, 1997):

Gemba walk is conducted in which the stakeholders go to the place, observe the process and talking with the operators. The details of the process are learnt from operators and it is highly encouraged to discuss with the operators as it increases credibility to the organization's commitment to lean [41] (Mann, 2010). In this phase we will clarify the problem statement and project goals. The current conditions are obtained and presented in flow chart or graph format. Goal defined has to be an observable objective, which is readable and unambiguous. Simple questions are repeated when root cause analysis is conducted [42] (Mann, 2010). Brainstorming is a useful method to determine possible root causes. "5 whys" method is useful to determine the actual root cause. Potential countermeasures are identified, prior to entering the Do phase.

<u>i) Define and breakdown problem.</u>

In this step, the problem to be solved are determined by 2 ways, either through observation or provided by the project champion (the chief person in-charge). As the problem is stated, a core team is set up and consensus is to be reached on the impact statement, which states the implications of not taking any action to solve the problem.

ii) Grasp current conditions.

In this step, gemba walks are performed to observe what is really happening at the area where the problems occurred. This enables the researchers to completely understand the flows of processes and also the possible problems in this flows.

iii) Set a target condition.

In this step, the researchers will determine the target conditions, which are the actions to be taken to solve the problems. Next, the goal are determined according to SMART (specific, measurable, attainable, realistic and time bound). Obstacles that are preventing us from achieving the goal are listed as well.

iv) Conduct root cause and gap analysis.

'5 why' methods are used to determine the root causes of the problem occurred. This enables the researchers to know the most initial source causing the problems and it should be solved to prevent the subsequent problems from occurring repeatedly. Gap analysis is also performed to determine the difference (gap) between current state and desired state and easier to find ways to solve the problems.

v) Identify potential countermeasures.

The root causes determined from "5-why" methods are listed down in a table together with the possible countermeasures, come from the suggestions of core teams. The person in-charge are listed down, together with the starting date and estimated completion date.

4.2) Do (D) Phase

In this phase, potential countermeasures are developed and their first trial performances are recorded. These countermeasures are refined and finalized after eliminating those countermeasures which does not provide satisfying results. Lessons learned, knowledge gained and any surprising results that appeared including failed countermeasures are documented [43] (Gorenflo and Moran, 2009). Finalised countermeasures are implemented and performance is recorded.

vi) Develop and test countermeasures.

In this step, the countermeasures are tested one by one to determine which countermeasure best solves the problems.

vii) Refine and finalize countermeasures.

The countermeasure which best solves the problems is refined and improved. Next, this countermeasure is finalized and ready to be implemented.

viii) Implement countermeasures.

The countermeasures are implemented.

4.3) Check (C) Phase

Performance of these countermeasures are measured and checked in this phase. Suitable tools are used to measure the effectiveness and targeted benefits of these implemented approaches [44] (Sokovic et al., 2010). Percentage of performance is obtained by comparing with goal set in Plan phase. Do and Check phase might be done repetitively, adding in any extra improvements [45] (Hassiotis, 2015).

ix) Measure the process performance.

The performance of the process with new countermeasure are measured to ensure the countermeasure has achieved the goal of the project.

4.4) Act (A) phase

In order to sustain the countermeasures, continuous monitoring of the process performance is essential. This phase has the purpose of acting upon what has been learned through the first three phases [46] (Gorenflo and Moran, 2009). Standardizing, monitoring and follow up continuously are 3 vital steps to sustain the improvement kata. We update the standard work of every project's internal stakeholder. Gain and knowledge are shared together to other teams and departments.

x) Refine, standardize and stabilize the process.

The countermeasure is refined if necessary. It is then standardized with other departments involved. The process is also passed down to each departments' person in-charge.

xi) Monitor process performance.

The process is being monitored constantly by the new person in-charge.

xii) Evaluate results, share learning.

The whole improvement process are shared with other departments so that they can take it as a reference if they would like to perform similar improvements.

5.0 Company background.

BOSE Systems Malaysia Sdn. Bhd (BSM), specializes in producing audio systems and speakers, automobile sound systems, noise cancelling headphones and professional audio system, has an assemblying facilty in Batu Kawan, Malaysia. This Batu Kawan facility mainly focuses more on the assembly process of speakers, amplifiers as well as headphones. BSM's facility uses a design called one way flow in which the raw material entering the warehouse, next into the production and finally shipped out, in a straight line. This reduces the transportation waste greatly, as no excessive transportation are required. However, as the raw materials reaches the warehouse, they have to undergo many processes and paper works before put to stock and ready for production. This causes a chaos in the both warehouse and production line as the raw materials didn't reach the production line and warehouse departments sometimes need to pauses their work sequence, in order to do firefighting, which is to get the urgently needed parts ahead of other raw materials. These fire-fighting is common and always disrupts and confuses the warehouses workers. Besides, the raw materials are undergoing many long and excessive processes such as inspection, waiting, transportation and etc, causing the raw materials taking a long time to be stocked. Hence, we planned to smoothen and reduce excessive activities, to reduce the tie taken for the raw materials to be docked to stock.

6.0 Case Study.

6.1) Define and breakdown problem

At the beginning, the project was briefed by the project champion on the several issues occurred at the receiving. First, a high number of trucks often were awaiting at the front gate in particularly every First and last working day of a week. Second, the arrivals of stocks are uneven. Third, raw materials were piled up at the staging area for a long time. Core team was formed with the team members from receiving, put-away, IQA and purchasing. This project is championed by global supplier's manager, and mentored by a senior engineer from continuous improvement department.

6.2) Grasp current conditions

A gemba walk was performed on the warehouse to observe the actual situation and note down potential lead for the issues abovementioned. Study of the raw materials' flow were done, time studies were also performed on each processes involved from receiving process to put-away process. Besides, interviews were conducted on the operators to comprehend the process and gather background information to later guide the search of areas to improve. The finding includes 41% higher number of incoming trucks on the first and last working days. This has resulted proportionally higher incoming stocks (in pallets) on these two days. After discussion with the core team members, the arrivals of trucks and stocks (raw materials) are contributed by uncontrollable external factors such as customs check, traffic jams, ships' delay and etc. The core team decided to improve on the internal processes of the materials' flow to shorten each process's time in warehouse.

Graph of Current Security Lead Time, Good Receiving Lead Time, **Inspection , Relabeling &Verification** Lead Time and PA Lead Time against each day of the week. (For 5 mechanical parts with Q status every day) ***(22/6/2016 – 1/7/2016)***

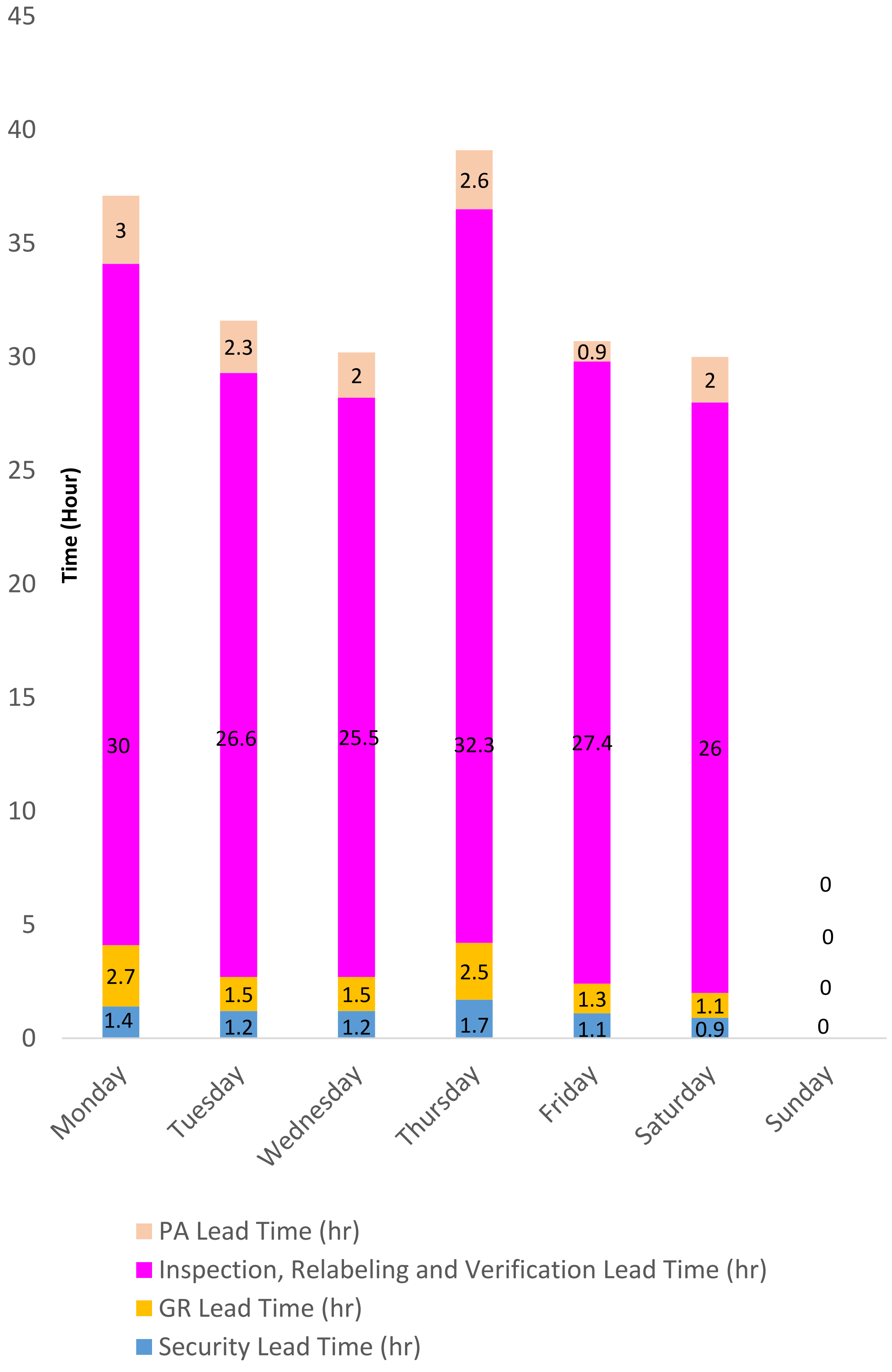

Figure 6.1) The bar displaying current lead time taken by [a)]Security Service Lead Time, [b)] Inspection, Relabelling and Verification Lead Time, [c)] Good Receiving Lead Time and [d)] Put Away Lead Time (Current Condition)

6.3) Set a target condition

2 Target conditions were decided based on the current conditions, which were (a) applying visual management such as excel VBA, notice board and sound notification system to improve coordination between departments and (b) improve ‘receiving to put-away’ process lead time. However, there were obstacles for us to overcome in order to achieve the target conditions, which were (a) no visual management to coordinate actions between departments and teams and (b) less effective communication between department and department. The goal of this project was to reduce “receiving to put-away” process lead time from average of 33 hours to 26 hours (20%) by the end of August 2016.

6.4) Conduct root cause and gap analysis

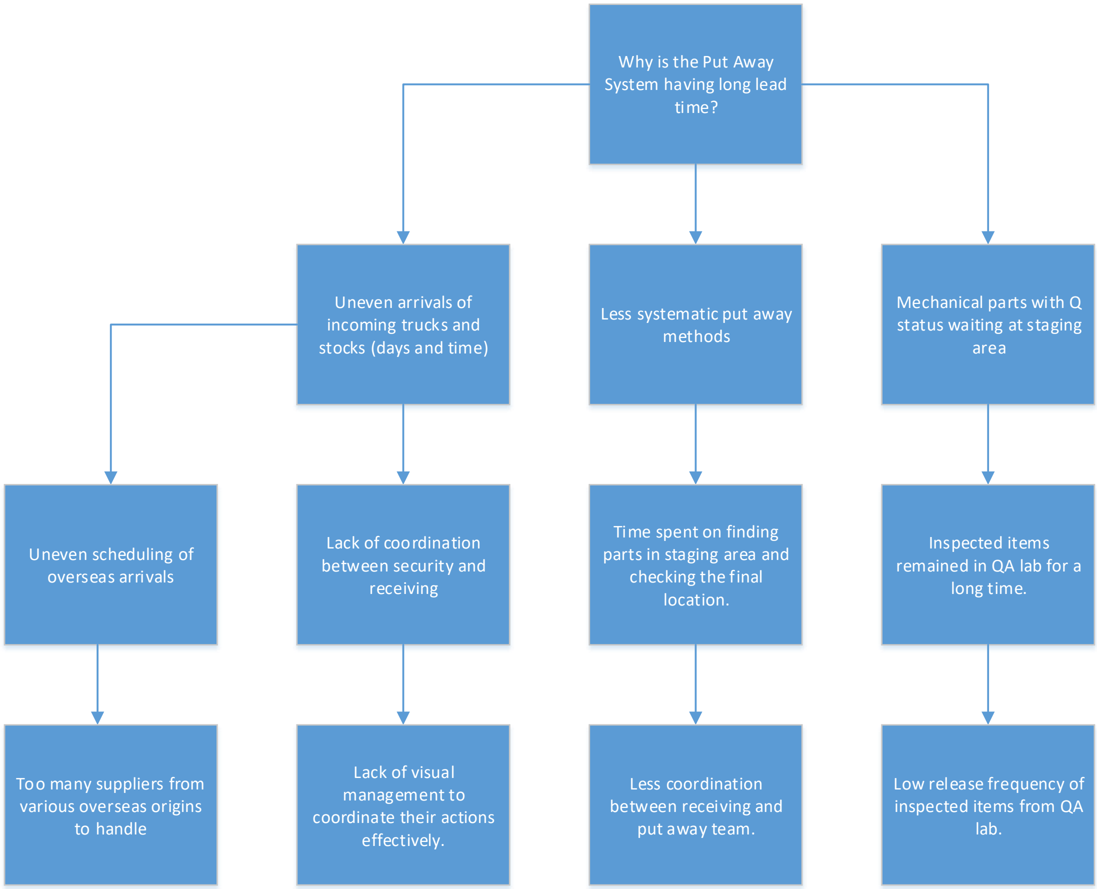

Figure 6.2) "5 whys" method was used to determine root causes of the problems stated in problem statement section. 4 root causes were determined and they were (a) Lack of visual management to coordinate their actions effectively (b) Less coordination between receiving and put-away team (c) Low release frequency of inspected items from IQA Lab (d) Too many suppliers from various overseas origins to handle.

6.5) Identify potential countermeasures

As the root causes had been determined, potential countermeasures were determined, with core team members assigned to the countermeasures based on respective job scopes. Starting date and also estimated completion date were also determined, to ensure that the team has sufficient time to do improvements.

Issue (Root causes)	Countermeasures	Person In-Charge	Date
Low release frequency of inspected items from QA lab	**Improvement on release frequency of inspected items from IQA lab using visual management**	**HT Koh R. Vijendranathan K. Vimalan**	**Started: 13- July 2016 Estimated completion date: 25- August 2016**
Less coordination between receiving and put-away team	**Receiving team will transfer parts which are ready for put-away from staging area to final locations**	**HT Koh KW Tan CO Chan**	**Started: 13- July 2016 Estimated completion date: 25- August 2016**
Lack of visual management to coordinate their actions effectively.	**Apply visual management system to coordinate actions between receiving and security more effectively.**	**HT Koh KW Tan M.H. Abdul Rahman SS Lin**	**Started: 13- July 2016 Estimated completion date: 25- August 2016**
Irregular arrival of trucks and stocks on each day of the week.	Scheduling with the purchaser to achieve levelled arrival of trucks and stocks on each day of the week.	HT Koh SS Lin	Started 13- July 2016 Estimated completion date: 25-August 2016

Table 6.1) List of issues, with respective countermeasures, Person-In-Charge and Important Dates.

6.6) Develop and test, refine and finalize, implement countermeasures.

6.6a) Improvement on release frequency of inspected items from IQA lab.

The first modification made is the runners will record Material Document Numbers, quantity, number of pallets and time of samples collected. Second modifications is a set of doorbell is used by IQA inspector to notify the IQA runners that the inspected items are ready to be released, this increase the responsiveness of the IQA runners to collect the released inspected items. The third modification is to standardize the conditions to release the inspected items from IQA lab, if there are 3 items in the Inspected items' trolley, then release of inspected items has to be made. Sometimes there are special conditions such as the 2nd items out of 3 items are undergoing a longer period of inspection and this tend to drag the release time of the first item, this situation is solved by setting a time limit (90 minutes) for the inspected items to stay in the IQA lab. The fourth modification is to request the IQA runners to refill the IQA trolley with 3 new samples after returning from IQA lab. This proves to be a more systematic way of working for the IQA runners can be more focus on their own work right after preparing 3 items for the next trip to IQA lab.

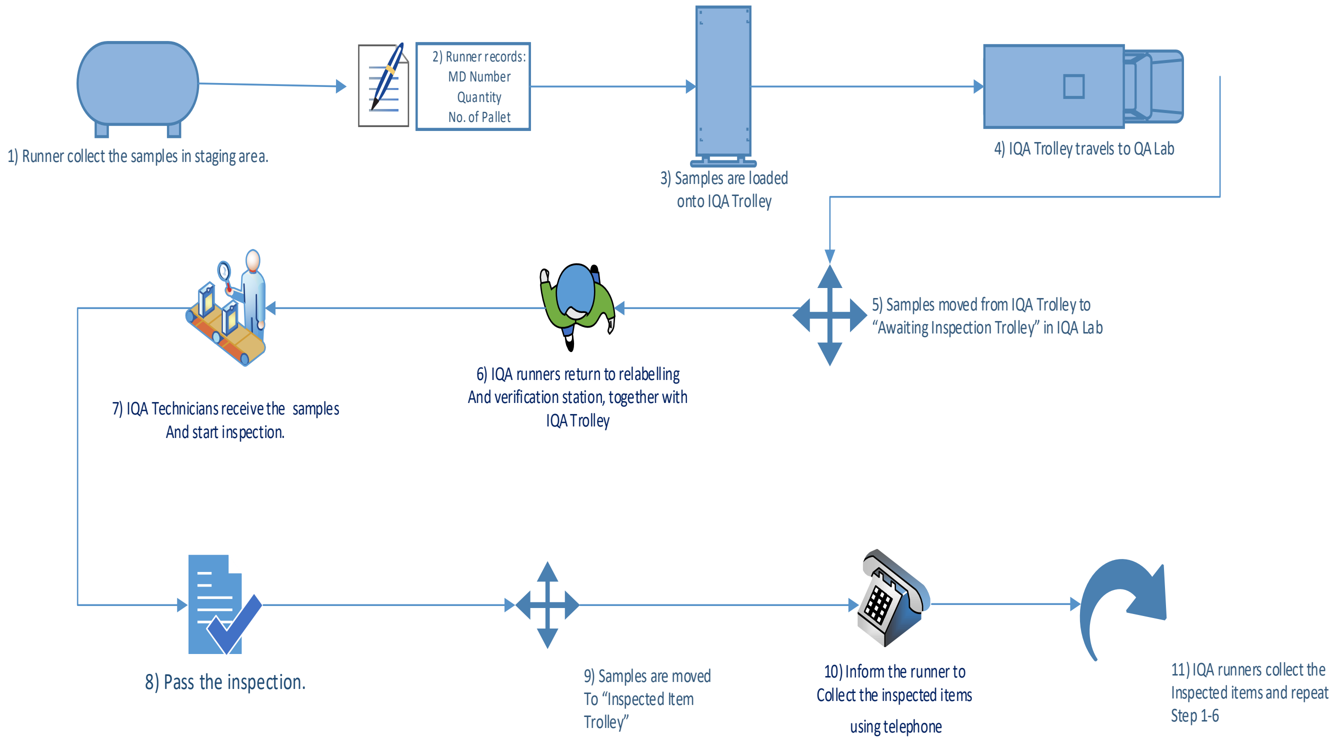

Figure 6.3) Flow of process before implementing countermeasure 6.6a

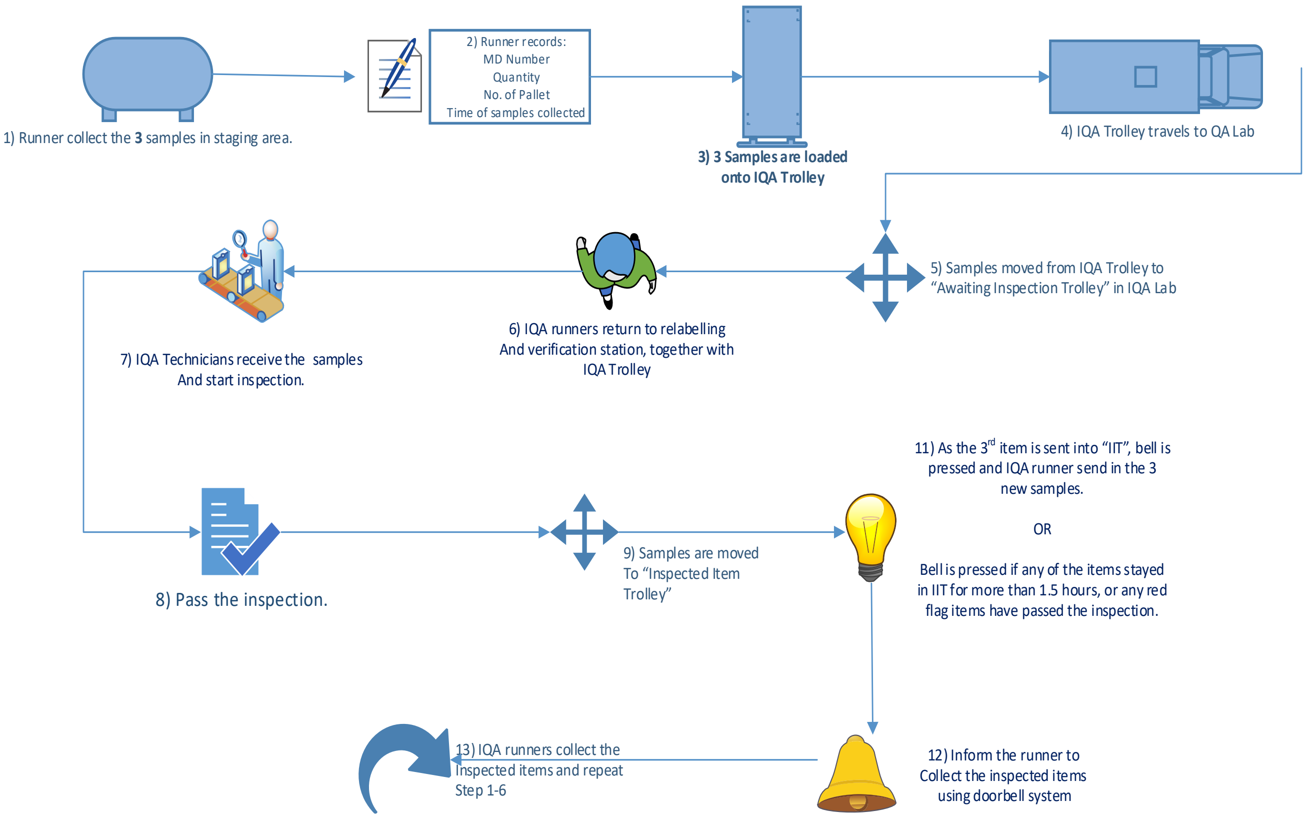

Figure 6.4) Flow of process after implementing countermeasure 6.6a

6.6b) Receiving team will transfer parts (raw materials) which are ready for put-away from staging area to final location.

Previously parts (raw materials) which are ready for put-away process were transferred from staging area to final location by the put-away team members. These put-away team members will then stack the raw materials into the shelf. This causes more time consumed as limited manpower has to search for the parts in staging area, transfer to final location, perform first-in first-out (FIFO) arrangement to make sure the newer parts are put at inner locations compared to older parts. The modifications made are that the receiving team with more manpower than the put-away team will transfer the parts from staging area to final location. This modification saves a lot of time as the put-away team members only focus on FIFO and stacking the parts onto the shelf whereas the rest of the works are handled by receiving team.

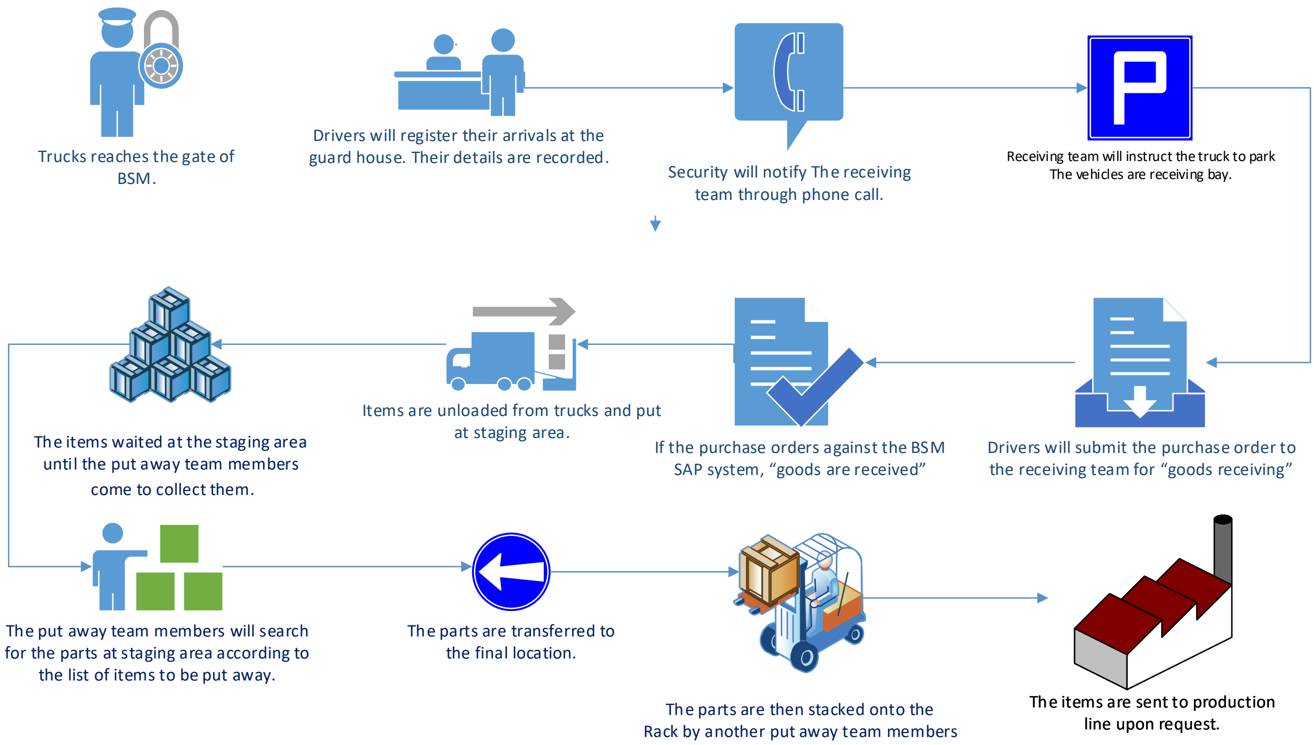

Figure 6.5) Flow of process before implementing countermeasure 6.6b

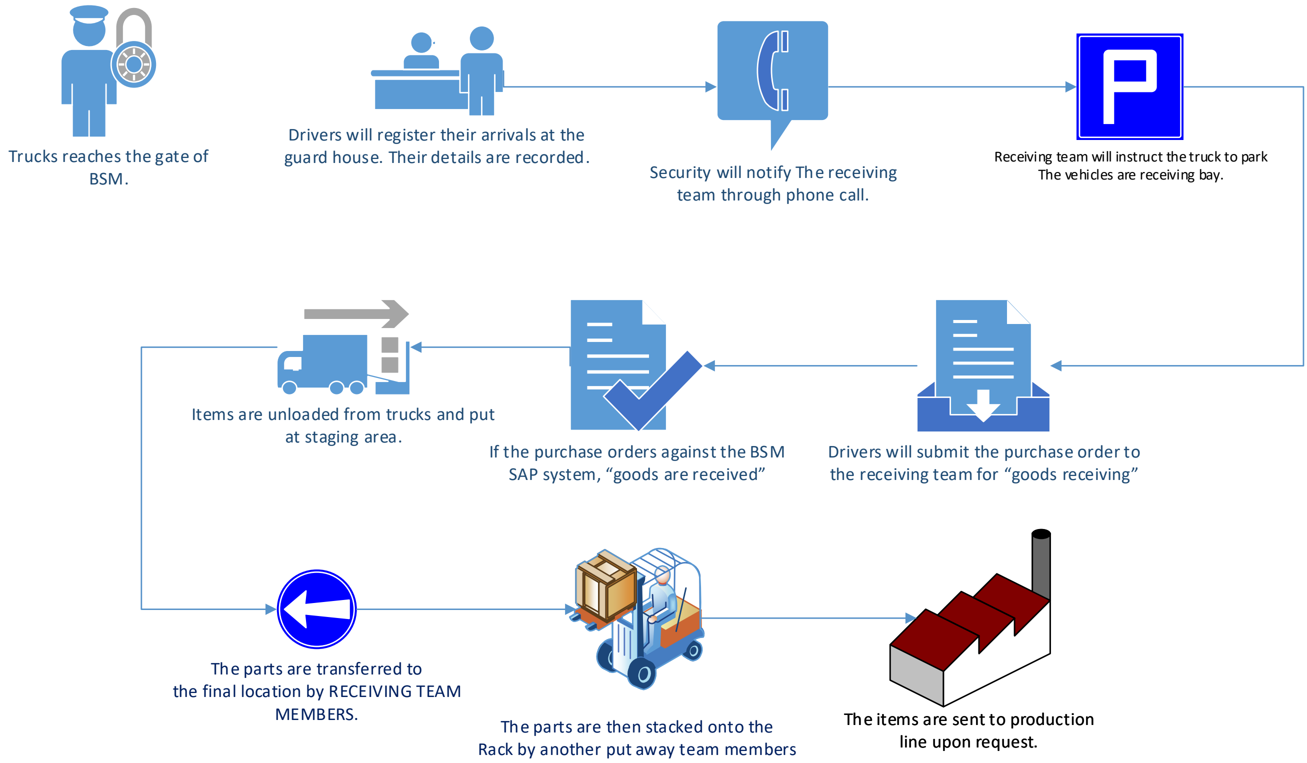

Figure 6.6) Flow of process after implementing countermeasure 6.6b