

Modeling of Fastener Kitting Logistics for Boeing Wide Body Airplanes

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ABSTRACT

At Boeing's commercial aircraft production in Everett Washington, the organization that supplies parts to the factory floor (known internally as Company 625) is revising their methods. A new process will deliver parts in kits that correspond to the installation plans used by the mechanics. Several alternative methods are under review. The authors used simulation methods to evaluate and compare these alternatives. This study focuses on the category of parts known as standard fasteners ('standards'). Through direct observation, interviews with experts, as well as time and motion study, the process flow of the kitting operation was mapped. A simulation model was created using the simulation software ARENA to examine two scenarios: the current kitting operation in the factory cribs and the proposed centralization of kitting operation in the Company 625. Additional features within the model such as information about the resources, the total amount of parts, or the waiting time, may be useful in leaning out the process.

INTRODUCTION

In the Everett factory, each aircraft model -- 747, 767, 777 and 787 -- have dedicated parts kits cribs that assemble the parts corresponding to the installation plan. The factory wide parts organization called Company 625, routes parts to these kitting cribs. An alternative process is under consideration. In this new process the factory wide 625 organization will assemble the kits, then route the kits to the appropriate airplane model production.

The 625 organization receives parts from suppliers and routes them to the appropriate factory crib.—This study

focused on a specific kitting crib on the 777 production called M10 and the interaction with the factory-wide 625 parts department. This crib assembles both standard kits and bolt boards.

In the M10 crib, the kits are loaded with twice as many standards as needed for each job with an additional 10% overage for errors and defects. Consequently, the M10 crib always maintains a standard inventory supply for 56 days of flow.

It takes at least 36 hours to replenish a kit at the M10 crib.

The crib also controls the standards supply in the standard rack located on the factory itself. If a mechanic needs additional or different types of standards, he or she can obtain standards at this WIP rack. The mechanics do not have to waste time waiting on the ordering procedure. Although, the front end of the process, the counter pick in factory cribs or Company 625 can replenish an order in less than 15 minutes, only 50% of all emergent orders get back to the mechanics within 30 minutes, and the other 50% of the orders are delayed even longer. This significant delay happens due to failure in the tube system, queue in delivering process, miscommunication and human errors. Therefore, this rack is useful to avoid delays.

There is, however, a complication with this system: some mechanics take more standards than they need. This is a significant problem for Boeing, since the unused standards that have been taken are considered waste. Standard scrap bins are placed within the factory so that all the unused standards can be tossed away in those bins to be recycled. Periodically, a designated team will gather all standards. These standards will then be sorted and returned to the racks if the part type

can be identified. Otherwise, they are sent to a recycling company.

Considering the enormous amount of excess standards in each kit and the standard scrap within the factory, the current kitting process could be improved. Both reduction of waste and excessive inventory are the primary objectives of this study. In addition, the delay time and holding cost can also be improved from the current kitting process.

LITERATURE REVIEW

Improving the efficiency of a kitting process of a manufacturing company has been the subject of many studies. Some researchers have tried to find highly structured ways to improve the efficiency of a kitting process by performing critical analysis of the current situation and using programming software such as ARENA to create different scenarios to find the best way to do the kitting process.

In a case study titled "Lean Kitting" by Ranko Vujosevic, Ph.D. from the University of Texas, Vujosevic discusses kitting, explains ways to eliminate waste in different phases of kitting, and illustrates lean kitting using a case study conducted in a major contract manufacturer site. He modeled the current process and ran different scenarios using ARENA software.

CURRENT PROCESS

The current process in fastener kitting logistics for Boeing wide body airplanes is organized into four stages: parts receiving, counter pick, kitting in factory cribs, and delivery process. Appendix A shows the flowchart of the current process.

Receiving

The company 625 process begins with the receipt of parts from the vendors at the Local Receiving Area (LRA). Material Processor Requirements Facilitators (MPRF) staff the LRA.

When parts arrive at the LRA, MPRFs break down the pallets and separate the parts based on their groups, box sizes, and whether it is a Shop Out-of-Stock (SOS) part. SOS parts will have an SOS sticker on the boxes, and will have the highest priority.

The incoming parts are identified by both packaging slips and labels. The next step is to verify these two identifications are a match. If both of them match, they will enter the barcodes into the scanner gun (Intermag gun). Most parts can be scanned in with the barcode, but occasionally, some of them need to be entered manually. If the identification does not match, the part is sent to the 'grief' process to be processed by the Supply Chain Analyst (SCA). The grief process has a 24 hour flow cycle. However, if there is grief work for an SOS

part, MPRFs will call SCA to work on the SOS parts immediately.

After the barcodes are scanned, MPRFs will load the data from the Intermag gun to the computer to print out new Boeing labels for all the parts. These new labels indicate whether the parts need to be inspected. The parts that need to be inspected are sent to the inspection pallet.

There are two types of inspections, VSA Non-Cord and VSA Cord. VSA Cord requires laboratory tests in addition to visual inspections. When people in the inspection area are ready, they will come and pick up the parts that need to be inspected. However, in case of SOS parts, MPRF's people will deliver the parts to the inspection area.

After the parts are inspected, they are rescanned and checked for further inspection requirements. The new label also indicates if the part is new. If it is a new part, MPRF will need to create a new head box for the part, and enter the information to the computer and put the head box in the service rack.

Next the parts are sorted again according to the box size. The smaller box will be placed in the service rack and ready for pick. If the box is full, they will put it in the overflow rack. Bigger parts go directly to the overflow rack.

There are two 8 hour shifts each working day. The first shift of the MPRF is the main shift that does all the processes. On the second shift, there is only one MPRF and he or she only does put away.

Counter pick

The current counter pick in the Company 625 consists of three shifts of MPRFs. The first shift is responsible for the emergent orders, sales orders, and transfer orders from all internal and external Boeing Companies. The second shift is responsible for handling the rack service order to feed all the kitting cribs in the factories. The third shift delivers the rack service order. Even though each shift handles different kinds of orders, the working process flow is identical.

The Company 625 counter picking area has improved replenishment time from more than 20 minutes to 15 minutes maximum. The first shift now is subdivided into three small groups:

- Two designated persons to pick up overflow orders.
- One person is assigned to pick up sales and transfer orders.
- Four to five persons are working as counter pickers for emergent orders.

The Company 625 has a designated printer for emergent orders. The printer itself has been included with a



thoughtful implementation of visual control using a piece of cardboard for recognizing new orders. The colorful cardboard will be pointing upwards when there is no new order, and will be pushed down automatically by the incoming paperwork of orders. Therefore, The MPRF has a visual clue of an incoming order. MPRFs take all orders that are available at the printing station, and process these requests. The printer generates two copies of an order in one paper, so half of the paper will be placed inside the plastic bag, and the other part will be retained by the Company 625 for database.

The next step is to clock in all the paperwork. The time registration machine is located next to the printer, so the time recorded as the processing start time will be almost equivalent to the time when the order is picked up at the printing station. Once the MPRF are done clocking in, the part picking begins.

To pick the parts, each MPRF uses a cart that is equipped with a scale and sealable plastic bags for the parts. There are enough carts to allow each MPRF to work with a specific cart without sharing with others. Also, the carts have been carefully chosen to match the height of the MPRF. Moreover, a small scale is provided in each cart. This scale allows the worker to measure the weight instead of counting parts to get the amount of parts ordered. This is a more efficient method of pulling large numbers of small parts. In these ways, 625 has considered the human factor aspect in designing the work station, especially part picking.

Once the MPRF is equipped with a cart and paperwork of orders, the size of parts requested determines the rack location to walk to, either the regular size part or the oversize part. The way the Company 625 organizes these two types of parts is by designated a specific areas for standard sizes and oversize parts. These two areas are located next to each other, so it is convenient to go back and forward when needed.

After the MPRF walks to the specific location, the next step is to determine the bin location. The racks are organized using the military style, alpha-numerical order. For each location code, the alphabetic and numerical symbols have to be evaluated one character at a time to determine the order. For example, in the inventory sector containing the series of parts from ABC110 to ACC109, bin ABC101 appears before ABC99. This is a common source of confusion and is one of the reasons for incorrect parts being delivered to the factory.

At each part bin, there are four possible rack tags that determine how the MPRF should respond:

- Overflow tag: the MPRF should put the paperwork in a specified blue bin for the overflow worker to pick and continue processing
- White freeze tag: the MPRF should bring the paperwork to the counter and contact the SCA in charge as mentioned in the tag to get

approval. If approved, MPRF will continue processing, if not, then they have to notify the shop that they could not issue that part.

- Green freeze tag: the MPRF is able to pick parts from this bin just as the regular bin without any tags.
- Pink freeze tag: this order could not be completed, so SOS request has to be created to supplier.

After the MPRF completes part selection, the order documents are time stamped to document completion time. This step is then followed by the selection of delivery methods:

- Hand pick: the MPRF has to put the parts on the counter for the mechanics to pick up.
- Tube system: For those parts sent via the tube system, a decision whether to use pads or not has to be made by the MPRF depending on the parts themselves. Pads insure that heavy parts do not break the tube during transmission to another place.
- Buckets: All parts that are too big or too heavy will be put in the grey coded buckets based on locations. Later, drivers from each factory arrive, pick them up and distribute them to the point of interest. This is one of the reasons for delays in floor receiving.
- Delivery to shipping building: for all the sales orders, all parts need to be delivered to the shipping building to be sent to the customers all over the world.

When cribs run out of standards, rack service orders are created to 625. For all Rack Service orders, there exists the delivery process where all orders are waiting for the third shift worker to come and deliver all the orders to the factory crib. Since it is only be done by the third shift, the accumulated waiting time and processing time has been one of the processes within the process flow that takes the longest time (bottleneck).

The long waiting time for the Rack Service orders cause the high number of Work In Process for Rack Service order in 625 counter pick workflow.

The accumulated walking time to pick parts could be a significant contribution to the long processing time. When there are two places to pick parts -- the 625 and factory cribs -- the amount of time spent for each part is doubled.

Within the current process, the utilization for overflow part picker is low, as well as the sales and transfer part pickers. Also, when there is no more rack service order, there will be no task for shift 2 and shift 3 part pickers. Therefore, one suggestion is to relocate the worker