

ILLINOIS INSTITUTE
OF TECHNOLOGY



Bar-Code and FIFO systems implementation at Shure®

Final Project Report

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1. Introduction

Shure® is a global leader in audio electronics. Shure® makes microphones and audio electronics to help amplify, process, and mix your sound.

They make Microphones, Wireless microphones, wireless guitar systems, Digital signal processors, feedback eliminators, personal (in-ear) monitor systems, Hi-Fi phono cartridges, DJ needles, Portable mixers and digital signal processors.

Shure® makes products that help you define your sound, and takes equipment issues out of the audio equation. Shure® products have been everywhere and seen it all.

As an important company, Shure® runs **SAP**. SAP is the leader ERP (Enterprise Resource Planning) in business.

Bar-Code Issue

The origin of this IPRO comes from the necessity of the company of tracking the items from start to finish.

Due to the nature of the products, they have to pass several quality tests, and it is also important to keep track of which tests have been passed and which ones have not.

Nowadays, all the products have a part number and a bar-code, provided by SAP. The part number contains information of the type of PC Board and frequency to be used. The bar-code is not being used at all. It is not read. It doesn't mean anything.

They have been able to work like this for a long time, but with the growth of the company, the problem grows, and a solution is needed.

The managers of Shure® came up with the proposal that the implementation of a bar-code would be the best solution. So, even though the group knew that there were other alternatives to solve the problem, we focused in that one: **Bar-Coding**.

FIFO Problem

The managers of Shure® complained that old items remain too long in inventory. So, they asked for the implementation of a **First In First Out (FIFO)** system. It means that the oldest item in inventory should be gone next.

Even though *Bar-Coding* can help with the FIFO system, the group found necessary to create one team focused in the FIFO problem.

The problem observed lies in the way items are stored, organized and retrieved prior to packaging and shipping. Due to space and time constraints, there is no first in first out system used currently. The employees who scan items from the Work In Process area and place them inside a cage, simply put them in the designated areas wherever there is space. They may stack items, stuff new items into half-filled boxes inside the cage, etc. So when the packagers who are responsible for picking up items from the shelves come to get what they need, it may not be possible for them (even if they wanted) to pick up the oldest manufactured batch of an item.

The other issue is that the packagers themselves do not have the time to sort through the stored boxes of items to find the oldest ones first. This is creating a big problem as older

items may just sit and gather dust, while the newly manufactured items are sent out well before.

A final problem they are facing is lack of traceability in the cage. Since the batches of the manufactured products are simply not organized in terms of manufacturing date (no FIFO), it is not possible to pinpoint where a particular manufactured batch is. For example, if it is found out later that the batch manufactured in March 2005 is faulty, there is no other way but to take all the batches of that particular item and rework them.

2. Objective / Goals

The main objective for both teams is the same: **save money** for the company.

This objective can be divided in more specific goals:

- Improve Inventory Control – raw materials and finished goods
- Error Proofing
- Ease Shipping and Receiving
- Find a better way to handle storage and retrieval of Work-In-Process components
- Minimize loss, excess handling, potential damage
- Make it easy so anyone could use the system to locate and retrieve components

3. Development & Solutions

Bar-Code

During the development the group faced the following tasks:

- Visit the company, map the process
- Find out specific requirements
- SAP Interface requirements
- Research on alternative systems
 - Software compatible with SAP
 - Hardware requirements including computer, scanner capability, range, accuracy, etc.
 - Visit system suppliers/integrators and possibly system purchasers if within the area

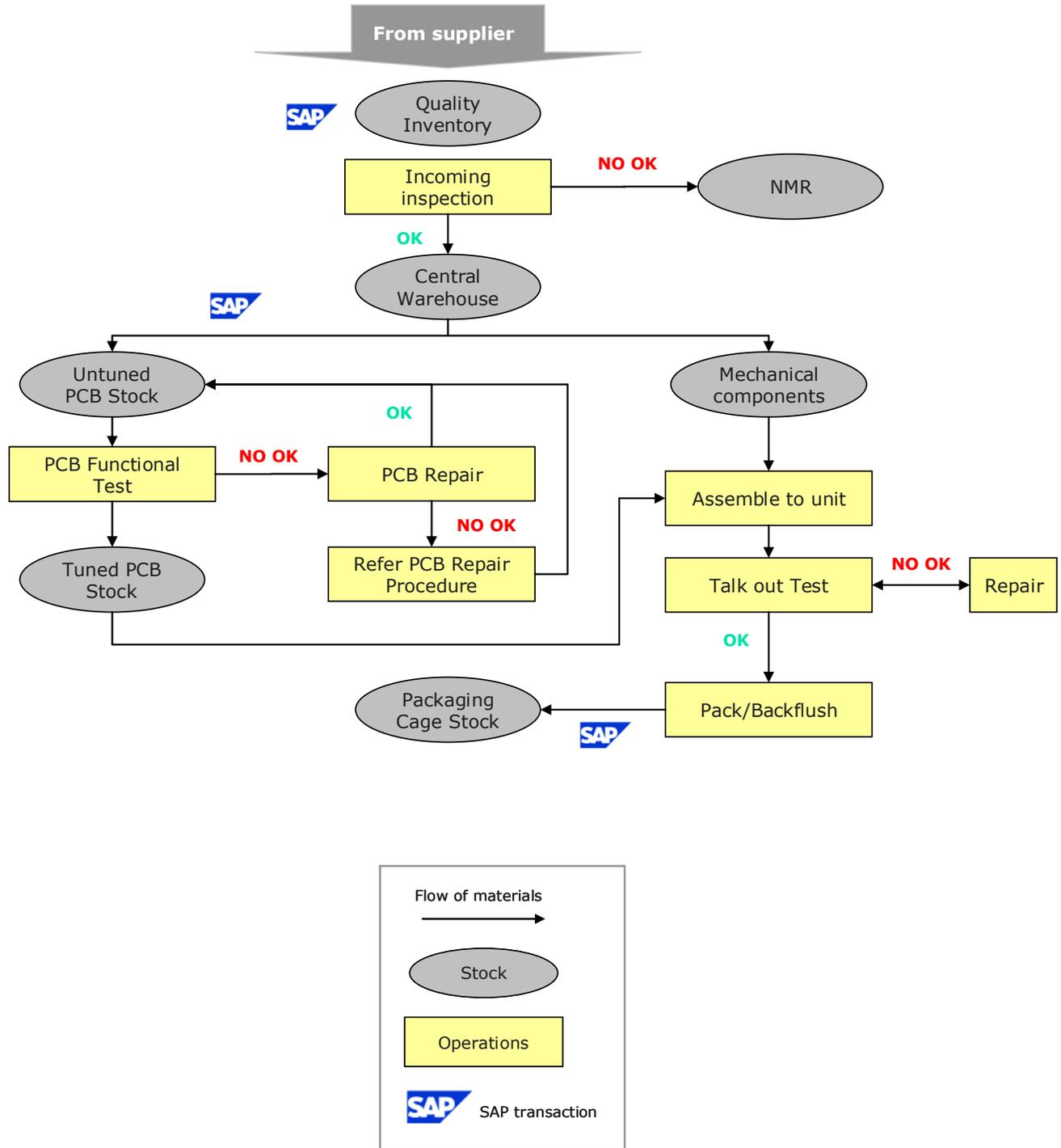
First thing the group did was visit the company (September 9th).

The group met with the managers of Shure® at Wheeling and talk about what expectations they had from us and we tried to find the specific requirements.

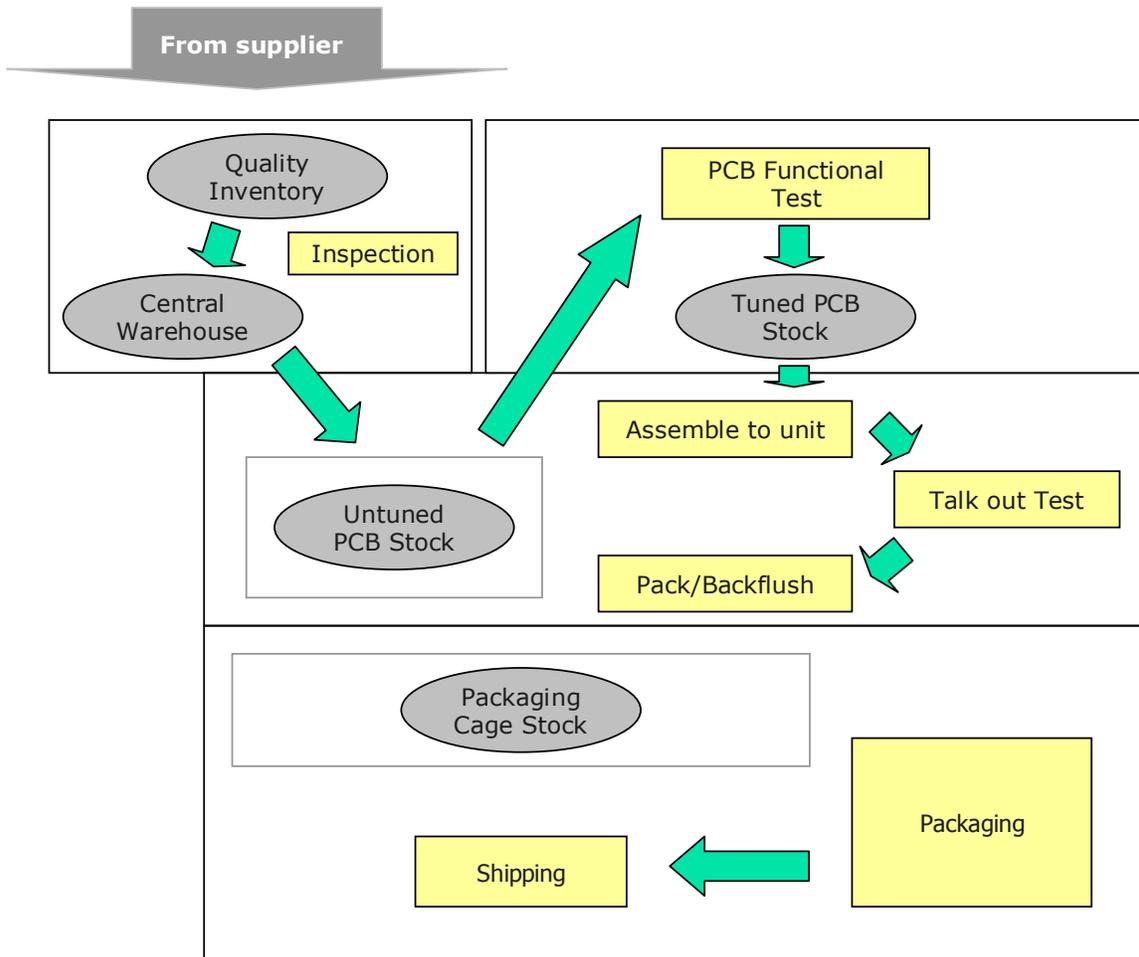
Since the company is working with SAP, this was one of the first requirements at the beginning for the bar-code team: find a solution SAP compatible.

During the visit at Wheeling the group made a first trip through the plant, and observed the process.

This is the flowchart drawn by the group of the process as is nowadays:



The process and distribution at the plant of Wheeling is shown in the next picture:



Once we figured out the map of the process and the initial requirements, the bar-code group started a **Research** on alternative systems:

- Software compatible with SAP
- Hardware, including computer, scanner capability, range, accuracy, etc.
- Visit system suppliers/integrators and possibly system purchasers if within the area

The capabilities that the system should accomplish were:

- 1) Capture information at different points
- 2) Handle transactions and quantity changes
- 3) Identify product – revisions, descriptions
- 4) Tie into SAP
- 5) Handle a variety of barcode configurations (both incoming and internal)
- 6) Link part numbers to bar code
- 7) Separate database

This is the list of the companies that the group contacted:

- 1) Barcode Integrators, Inc
- 2) iTech Automation
- 3) Miles Technologies Inc
- 4) Aurora Barcode Technologies
- 5) L-Tron Corporation
- 6) Peak Technologies

Just a few members of the group had a little experience in this area, so we decided to bring one of these companies to class and get some knowledge from experienced people in the business.

Jackie Weber from Peak Technologies came to visit us and gave us advice of how to face this integration.

We got really good ideas from her, and we realized that we needed more information from Shure.

Professor Maurer set up a meeting with the managers on November 4th. That was our second visit to Shure.

The group came up with some questions to ask in that meeting:

- Do you follow batch management?
- Serialization – Are the serial numbers bar coded?
- Are you interested in capturing the serial number at the end of production so you can track it forever? Is the serial number turned on in SAP?
- Are you using inventory management (IM) or warehouse management (WM) module in SAP?
- Is KANBAN really turned on in SAP?
- T.O.s or deliveries for picking?
- System Design – Is the next scheme what they want?

- (1) Receive inbound MIGO, print and label
- (2) Put product away (Need to know if inventory managed or warehouse managed)
- (3) Do you issue to product (pick against work order/product order)
 - a. Use KANBAN replenishment (auto replenishing of bin)
- (4) Receipt from product MB31 tied to a backflush (put to finish goods and pick later?)
 - a. Put away
 - b. Pick by serial number (forced to pick a serial number or capture serial number)
- (5) How do you POGI (post goods)?

In that meeting, the managers of Shure, besides of answering these questions, they were interested in doing a **benchmarking**, so they asked us to do it for them.

The benchmarking consisted on contacting some companies that have been involved in bar-code integration during the last year. The aim of the benchmarking was to learn about:

- How long did it take to implement?
- What did cost?
- Benefits:
 - % savings
 - What got better?
- Training:
 - Any?
 - What kind?
 - How many people?
 - How long?
- What kind of scanners and printers were used? Are you happy with them? Why?
- What are you able to do now, that you could not do before?
- How compatible to what you had before?
- Within your implementation:
 - What went well?
 - What went wrong?

To know which companies to call to, we contacted again Peak Technologies and they gave us a list of companies from different industries that have implemented RF, barcode printing and either the *PEAK S/3 Interface*, *Web Application Server Solution* or *SAP Console*.

Industries such as:

- Electronics Manufacturing
- Food Manufacturing
- Chemical Manufacturing
- Manufacture Construction Equipment
- Public Utilities Provider
- etc.

These are some of the projects that Peak Technologies did in companies from the Electronics Manufacturing industry:

- SAP Version 4.6 - 3 sites-Texas, Colorado, Pennsylvania
Peak provided consulting on warehouse process and layout to ensure the maximum benefit from implementing RF.
- SAP Version 4.7 - Illinois
The company had no previous experience with RF data capture.
Improved user efficiency and increased product throughput.
Large amount of process consulting on bar coding, radio frequency scanning equipment, and integrated printing solutions.
- SAP Version 4.6. Upgraded to 4.7 - Illinois
Recommended areas within their business that would benefit from bar code related projects. Implemented a data capture solution to their legacy system approximately 5 years ago. When the customer was ready to implement SAP, Peak recommended WM configuration and migrate their RF solution to R/3. *PEAK S/3 Interface* is the latest project to go live.

FIFO

Abstract: One of the main problems facing Shure Microphone is how items are organized in the cage, and retrieved from the storage areas for shipping. Ideally, the company would prefer that their products be shipped out in the order they were manufactured, that is, the older manufactured items should be shipped prior to the newer ones. However, due to a lack of a system which organizes items in terms of manufacture date, and due to the large number of items processed, this is not possible. The problem thus is a lack of a functional first in first out system.

SHURE VISIT: In order to get a better grip and understanding of the situation, a team was created called the FIFO team. We in the FIFO team visited Shure and were given a demonstration of the work process employed in the cage, and in other relevant areas. We also took interviews of some workers to get at the heart of the FIFO issue. The following is what we learned from the interviews:

Interviews

We interviewed the packing supervisor and a packer. They work in the cage – which is where the assembled items are stored prior to packing and shipping. This is what they had to say:

At the entrance to the cage, each finished product (every microphone, every transmitter, etc.) comes in a packet with a bar-code label. There is a computer terminal with SAP, and an employee scans the bar-code and check the frequencies. The items have a secret date code, but this is small, hard to decrypt, and are often found inside the packaging.

Then they take these items into the cage and according to the bar code label text (same info represented by bars), they keep the items in the shelves with the same labels. Much of the time, due to the high volume, they keep the items in whichever way suitable. They do try to remember which are the older items but this is not possible due to the different shifts, 20 people in each shift, etc.

During an order process, the packers go about the shelves bringing all the stuff they need, but they cannot always pick out the oldest items first. If they have free time, then they may rearrange the items in the shelves according to FIFO. This is difficult though.

Due to high amount of pressure and tiredness, the packers sometimes get the items that are easy to grasp, even though those may be the newest products made. So there is no FIFO. They had tried a color code system with red as no pick, and green as pick, but this caused problems in rearranging the items according to this code.

In the present bar code system that is used at Shure, there are no serial numbers to identify individual products within the company. So you cannot track the dates of the items using bar codes.

Packers look at the order sheet, then go to the shelves and bring a bunch of items from them. They do not pick up boxes usually (just the items they need). Empty boxes are turned sideways. They have worked there for years and know the location of items at the back of their heads.

The packers would prefer more space in the cage, but this is ruled out by management.

They have certain overflow locations, where if they have too many of a particular item type, they'll keep those there and label them with overflow.

Packers do have a general idea about which are the older items and which items are newer, but due to the problem of moving around items/rearranging, especially when people literally run around to keep up with time, FIFO takes the rearmost seat.

In the cage, boxes are not removed. One box can contain items that were manufactured in different times.

We saw the person checking items at the cage gate put them onto shelves. However, he was putting them in the easiest way possible without caring about FIFO. This was in order to save time.

In the packing line, there are two people: one who brings the items to be packed from the shelves, put them in boxes, put the bar-code and send it on the line. The other person checks that everything is fine in the box, and then puts it in box for shipping.

Because the first person has to do so much – find the items in shelf and put them in boxes, he/she does not look into FIFO.

SAP System, Practical Demonstration of Work in Cage Area

A crucial thing that the FIFO team had to observe was how the current system at Shure processes orders and tracks items. What we found that the cage and the work in process areas are inventory managed. The Shure employees know how much of each type of item is in the inventory, but that is basically it – not much additional info. The current system uses the software called SAP for most operations – processing orders, tracking warehouse inventory, etc. The Shure management gave us a demonstration of how the SAP system works. The hope was that we can develop our FIFO system keeping in mind how the items are currently tracked – what are the drawbacks in the current system in this regard, and therefore what can be improved.

The SAP system keeps track of orders, and maintains the safety amount. This system is used to place orders, update the quantity when the items enter the cage, and again update the quantity once the order is packed and shipped.

Order is placed by the sales team. Order may also be placed by the cage employees when the safety stock is low – in this case the SAP system notifies them. Safety stock is predicted from sales forecasts.

Orders are processed using this system also. In each case, every computer operator must put his ID/initials, so that the people responsible for particular work orders can be tracked.

The main problem with the current SAP system is that is the bar-codes used currently do not have any serial numbers. For the FIFO team, it means that the current SAP database system has no way of telling us when the items were manufactured. Thus, information that would allow us to organize items in the cage systematically based on manufacturing date is hard to get from the current SAP.

The FIFO Team's Recommendations

The FIFO team came up with several recommendations for the FIFO system. Each member of our team researched and wrote a report about one system. We presented our findings (summarized in this part) to the Shure Management. Our goal was to educate them about possible alternatives to the current system that hope to solve the problem at hand and enable a FIFO based product management system. As mentioned, we gave the Shure management a choice of several different possible solutions. However, **they showed greatest interest in the FIFO Rack solution.**

Before we describe the solutions that we researched, we feel that it is prudent at this point to look into the problem details, and to state the objectives and requirements of what the FIFO team had to do.

Problem Description:

The problem that we observed lies in the way items are stored, organized and retrieved from the cage prior to packaging and shipping. Due to space and time constraints, there is no first in first out system used currently. The employees who scan items from the Work in Process area and place them inside the cage simply put them in the designated areas wherever there is space. They may stack items, stuff new items into half-filled boxes inside the cage, etc. So when the packagers who are responsible for picking up items from the shelves come to get what they need, it may not be possible for them (even if they wanted) to pick up the oldest manufactured batch of an item.

The other issue is that the packagers themselves do not have the time to sort through the stored boxes of items to find the oldest ones first. This is creating a big problem as older items may just sit and gather dust, while the newly manufactured items are sent out well before.

A final problem they are facing is lack of traceability in the cage. Since the batches of the manufactured products are simply not organized in terms of manufacturing date (no FIFO), it is not possible to pinpoint where a particular manufactured batch is. For example, if it is found out later that the batch manufactured in March 2005 is faulty, there is no other way but to take all the batches of that particular item and rework them.

Requirements:

A system must be developed that makes the job of retrieving (for packaging purposes) the older manufactured items before the newer ones. The system must be simple, efficient in terms of time, and capable of handling the large volumes required by Shure. The same system should make possible the tracking of all manufactured batches.

This solution cannot take up more than the available space. It should also take into account that products come in a variety of shapes and sizes.

Compilation of Solution Abstracts

The section following this one looks into the solutions in rather detail. However, for the casual reader, we have compiled a list of abstracts for the various solutions. The casual reader may simply read these abstracts to get an idea about the suggested solution. In any case, the abstracts are repeated later for easy reference.

Drawers:

Most cases when there an issue to resolve, we forget to consider simple methods first. In this case, we thought we should look into simple approaches before we get into complex ones. We can use drawers. Why? These are the reasons:

- 1) Easy to take out items from drawers.
- 2) The employee may not be able to grab items while looking at items beside. In order for an employee to get what they are looking for, they will have to pay attention to the labels on drawers. The drawers system is meant to minimize or stop grabbing behavior without following FIFO system.

Flip-Box:

The proposed system will use boxes similar in size to the ones being used with two different colored lids on opposite ends. Only one box with one of the lids removed will gets filled and one box with the other color lid removed emptied; the other boxes will have both lids on them so the employees will know not to take items from them. When a box gets full it gets covered then flipped so the items placed first on the bottom will be on the top. When a box gets emptied the oldest box will be opened.

Flow Racks:

Carton Flow Rack is a high-density type of Storage and Picking System. It utilizes a first-in/first-out rotation of cartons by using gravity flow to bring product from the stocking aisle to the picking aisle of the System. The products of same frequency can be loaded on the same lane from the back so that the oldest product is always in the front of the lane.

Special FIFO Racks:

This system intends to use small width racks near the packaging lines. These racks will contain the oldest of the items – only these can be picked by packagers. The shelves in the racks need to be constantly restacked (based on order sheets) by employees who will pick items in a FIFO way from the rest of the racks.

Now we shall look into the different suggested FIFO solutions in detail.

Recommendation: Drawers
By Bachum Mataruke

DRAWERS

Brief abstract of system:

Most cases when there an issue to resolve, we forget to consider simple methods first. In this case, we thought we should look into simple approaches before we get into complex ones. We can use drawers. Why? These are the reasons:

- 3) Easy to take out items from drawers.
- 4) The employee may not be able to grab items while looking at items beside. In order for an employee to get what they are looking for, they will have to pay attention to the labels on drawers. The drawers system is meant to minimize or stop grabbing behavior without following FIFO system.

Detailed implementation Description:

Apparently the company is using boxes that are open on top. When employees need to pack a certain number of products that are equal to the number in a box, they just grab the box. This is the easy part. However, if they need only few items from the box, they get the number of the items they need and leave the box where it was. In both cases, they don't pay attention to the FIFO system. The left over products are not always the next to be sent out. In addition, during the Work in process, employees bring new products and stack them on top of the left over. Due to this handling issue, some of the products have been in the storage for more than five years, management reported.

We believe that using shelves that are neither removable nor open on top could be helpful. This system should follow the same procedures the existing one has. The only difference will be drawers. We recommend that areas for the items to remain the same so that it won't become confusing. The integration of barcodes, labels and use of SAP shall remain the same. In order to implement this system successfully, we recommend the company to have intensive training and if possible award those who will show their excellent job on following the procedure. This system is going to involve additional cost since it will need new drawers. For this system, employees will not be able to take anything until they pull out the drawer. Therefore, it could help them to pay attention and make sure they follow FIFO procedures. If necessary, color codes could be added as a part of the labels for the drawers, but big size printed date tags should be sufficient.

Additionally, the oldest items should be kept in drawers close to the packaging line to save employees' time.

Details on how color codes will work will be discussed later after initial approval of this idea. Also, at this time, we have not decided whether the drawers should be steel or wood made. Based on feedback that we might get from our professor or company management, we could get into details on sizes, material costs, and labor costs if necessary.

Critical issues:

Two issues have been predicted to occur: One being running out of drawers for dated items, and another being employees' error. Since employees will not be allowed to stack new items over the old ones, more drawers might be needed while the space is limited. Also, employees might get more items from the drawers than they need to pack, and end-up misplacing the remainders in the wrong spot.

Resolving the Critical Points and Feasibility:

Based on these two issues, the system may not work well. Something can be done to address those issues. For example, employees should pay attention to all drawers that become empty and put another date appropriately. We may not be able to guarantee if the space will be enough for drawers for all possible dates. The solution is as follows:

- 1) For each drawer, put a range of manufacturing dates for the particular item stored.
- 2) Then within a particular drawer, make adjacent rectangular storage areas, and further sub-divide items in terms of dates.

As far as employee error regarding the return of extra items, it would take time to do so. This time of course can be minimized if the oldest items' drawers are closer to the packaging lines so employees do not have to walk too far. Then employees would be more willing to take time to find the right drawer to re-store the extra picked items. And also, the small volume of extra picked items to be returned – say maybe 5% - should not make the remaining error possibility significant.

In conclusion, our goal is to minimize the FIFO issue at the lowest possible point. Human error is inevitable regardless.

Recommendation: Flip-box
By Baroukh Ovadia

FLIP BOX SOLUTION

Abstract of the system:

The proposed system will use boxes similar in size to the ones being used with two different colored lids on opposite ends. Only one box with one of the lids removed will get filled and one box with the other color lid removed emptied; the other boxes will have both lids on them so the employees will know not to take items from them. When a box gets full it gets covered then flipped so the items placed first on the bottom will be on the top. When a box gets emptied the oldest box will be opened.

Detailed Implementation Description:

The current system has designated space for different items on its shelves, and it currently has many of its items in boxes. The proposed system will replace the current boxes with custom boxes that can be opened from two sides with different colored lids. Items that don't currently get placed in boxes can start to be placed in boxes. The custom boxes will be padded so they would be able to be flipped without damaging the products inside. Only one box with one of the lids removed will get filled and one box with the other color lid removed emptied; the other boxes will be full and have both lids on them so the employees will know not to take items from them. This should save space because there will be a bunch of full items and only two boxes that aren't full instead of a bunch of boxes that were not completely full.

The way the order of boxes being opened to take out the items can be done in many ways. This can be done using one of the other methods such as a flow rack. One of the ways that could be done is labeling the boxes with the date they became full and removing the label after the box became empty. Then the person looking for the next box to open could use the labels to see which box is the oldest.

A simple solution that may take up more space could be to have the next box to be filled placed to the right of the box that was just filled. If that box was next to a wall or area where the box would not fit, then the next available space would be on another shelf or the same shelf to the far left. Then the next box to be opened would be to the right of the empty box.

Critical Issues:

One of the key issues is if there space for all of this; because the system uses the same amount of shelf space and maybe less, it is definitely a space efficient solution. Another issue is how error proof it is; the system is fairly error proof because the people can still take wrong objects by mistake but they will not take newer objects by mistake because the only available objects are the oldest ones or the newest ones but the newest ones look different because the different color cover is off.. Another issue is how employees' errors can influence the system. If an employee accidentally takes one too many items or the wrong type of items those items can be placed back in the box used to remove items.

Feasibility:

The solution has to be feasible. This solution is not the most feasible solution partly for the reasons that the two sided boxes would need to be custom made. But the cost for this system would be a one time flat fee. Also the feasibility of putting the larger and heavier items in a box and then rotating it may not seem feasible. This can be overcome by placing a small number of those items per box. The large items may not have to be rotated then because there would be a few numbers of Items in the box. Also this solution would not work well with stacking the boxes so it may need more shelves.

The two sided boxes would be boxes that can be opened on both sides. These would resemble something like the picture shown below except they wouldn't have anything in the middle dividing the stuff.



FIFO ISSUE AT SHURE
Recommendation: Flow Racks
By Hassaan Bin Nasir

FLOW RACKS

System Abstract

Carton Flow Rack is a high-density type of Storage and Picking System. It utilizes a first-in/first-out rotation of cartons by using gravity flow to bring product from the stocking aisle to the picking aisle of the System. The products of same frequency can be loaded on the same lane from the back so that the oldest product is always in the front of the lane.

Implementation

A possible solution to this problem is replacing the static shelves with Carton flow rack. High velocity items often require multiple cartons of storage in order to ensure constant availability. A method that provides excellent storage density combined with picking efficiency is carton flow rack. This system utilizes a track of wheels or rollers installed at an angle of approximately 3/8" per foot. The product is loaded in the back and flows via gravity to the front, where it is picked. Most gravity flow racks are 7'-10' deep, permitting multiple cartons or totes of the same product to be stored in each lane on a first in, first out (FIFO) basis. This automatically eliminates the current problem of having to go through stack of boxes to sort out the oldest items. As soon as a carton of products is filled it is loaded from the back on the appropriate lane that can be organized on the basis of frequency like in the current system.

If flow racks replace the static shelves then a couple of additions/changes have to be made. A stocker can be hired to make sure that flow racks are loaded and unloaded correctly. His job would be to remove empty cartons from the front/picking side and release filled cartons from the back. Alternatively the current stocking staff can be trained to make sure that the flow racks are loaded/unloaded appropriately. The warehouse supervisor can make sure that the packers grab the products from the front end only. The most frequently shipped products can be placed at the most accessible height to save time. There can be clips/lock holding the cartons behind the first carton so that they wouldn't slide abruptly if the front carton was removed. Another advantage of this system is that if the packer picks up more items than he requires he can always put it back in the appropriate lane without having to worry about FIFO as the oldest items are always in front.

In order to make the system efficient the storage and picking methodology can be altered. Product stored in a forward pick area can be placed in a different storage medium than product used as backup storage. Forward pick areas have high degrees of picking activity, so the storage medium must compliment that. Backup storage tends to be handled in larger unit volumes and therefore have lower and different storage needs. The items for which FIFO is not a concern can be stored in static shelves so that space and money is saved.

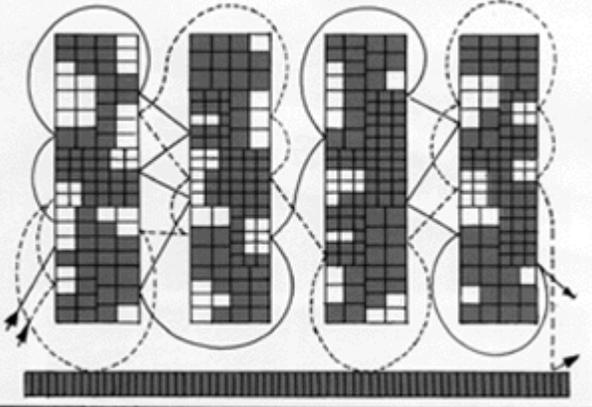
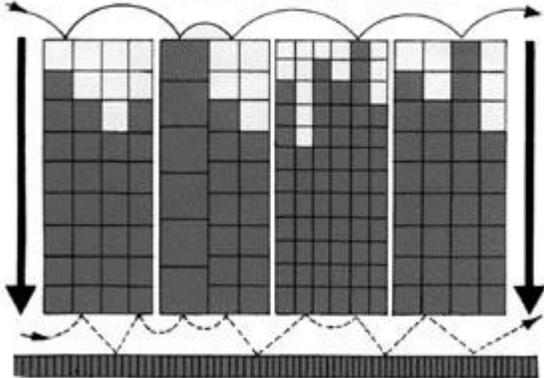
A number of things need to be considered before implementing a flow rack system. The area currently available inside the cage has to be measured to see how many flow racks can be placed in the available space. We also need to estimate the number of cartons a flow rack can store in comparison with the current shelves. Since all items placed on flow racks have to be stored in cartons we need to take into account the different sizes of products stored and change the size of cartons accordingly. Although the problem of FIFO in the current is of a physical nature, its integration with barcodes or RFID can make the system

more efficient. A computerized picking system can maintain a better inventory and traceability of items throughout the cage. However, implementation of such a system is more expensive and requires thorough feasibility study. In the current situation gravity flow racks can prove to be a productive upgrade.

A possible arrangement of flow rack system is shown below:



Comparison

<p>STATIC STORAGE</p> <p>Static storage is inefficient and labor intensive. It typically requires 2 to 4 times more pickers, and twice the floor space than gravity flow systems. This can cause inventory control, stock rotation and picking accuracy problems.</p>	<p style="text-align: center;">STATIC STORAGE</p>  <p>----- Order Picking ——— Stocking</p>
<p>GRAVITY FLOW RACK</p> <p>Flow rack saves time, labor and space. Less time spent walking and searching for items means fewer pickers with less supervision. Floor space is saved because fewer aisles are needed to reach the same amount of products. A first in, first out stock rotation is always achieved.</p>	<p style="text-align: center;">GRAVITY FLOW RACK</p>  <p>----- Order Picking ——— Stocking</p>

Recommendation: Special FIFO racks
By Tanim Taher

SPECIAL FIFO RACKS

Abstract of the system:

This system intends to use small width racks near the packaging lines. These racks will contain the oldest of the items – only these can be picked by packagers. The shelves in the racks need to be constantly restacked (based on order sheets) by employees who will pick items in a FIFO way from the rest of the racks.

Detailed Implementation Description:

The current system has designated spaces for different items on its shelves, and it currently has many of its items in boxes. The packers pick up from these spaces, and the large area means it may take a packer some time to go to the area he/she needs to pick up the items. In the proposed system, the pick up area for the packer will be right beside his/her packaging line.

The pick up area will consist of small width racks the same height as the other racks, but with more shelves allowing more items to be placed on them. The small width is to save the limited space available in the cage. An alternative to buying these small new racks is as follows:

- a) Designate a small area of the existing racks as the pick up area.
- b) Mark out this area nearest to the packaging line in each row of racks.

Some employees need to be designated as stackers for these pick-up racks. Let us call them FIFO guys. Their job will be to look at the order processing sheets every few hours. Say for example, there is an order to ship 100 wireless speakers, another order for 1000, etc. Each package needs a speaker, battery, case, etc. – several items in all. The FIFO guys will go to the shelves and get enough for say 1150 packages and place them in the pick up racks, well before the order packaging is started.

What is crucially different from the existing system is that the FIFO guys will not just randomly pick items from the storage areas. **Rather, they will pick them up in FIFO order.** That means the items in the pick-up racks will be the oldest items, and if they are shipped out each time, it means that a FIFO system has been successfully implemented.

The other difference from the existing system is **the FIFO guys pick up in bulk.** Right now packagers pick up items prior to order packaging, but they do it each time for their individual orders. If we have FIFO guys collect enough for several orders at the same time for the same type of products, it would save employee time overall.

Elaborating on the time saving, if only a few employees (FIFO guys) walk around in the cage picking up items, instead of all packers doing this, it means that an individual packer's time is saved. That means we can have a few lesser packers, and designated them as the FIFO guys. Thus overall labor expense is about the same, or maybe slightly higher.

Now the question is, how will the FIFO guys know which came before and which came last. Here we need a new system: bar codes, and big printed dates or color date codes.

Bar Codes: We can use portable bar code scanners as the one shown in the following figure. The FIFO guy scans the bar code, and the portable scanner tells him if this is the oldest item in storage. To do this, the bar codes (new system that needs to be installed) must hold the following information:

- a) Item Code (say 5 digits)
- b) Manufacturing Date Code (say 6 digits)
- c) Serial number for that date code (say 4 digits)



Portable Bar Code Scanner

Date Labels/Color Codes: We do not want the FIFO guys to scan all the bar codes they see, so we need visual date indicators to make their task quicker. So we put big date labels/color codes (the details of which can be decided later) outside the boxes that houses the batches of manufactured items.

Now it is also important to designate particular pick up racks in a systematic manner. For example, we could designate a packaging line for a few particular packaged products, and the pick-up rack beside it will hold components for those particular products only. This makes sure that we do not have a jumble of items within the pick up racks, and also makes the whole system systematic and less time consuming. This way too, we can customize the size of the pick-up racks depending on what is most feasible for a product package.

Critical Issues:

One of the key issues is if there space for all of this. If there not enough room for new racks, then we use part of the existing racks as suggested before.

Another issue is how error proof is. Nothing can be 100% error proof, so we use the bar codes, and the date codes to reduce the chances of error while increasing the speed. If a FIFO guy picks up more items than is needed, then the extra items simply stay in the pick-up racks since the pick-up racks will be designated for orders of like products. So for the next order, the remaining items will be used.

Feasibility:

The solution is feasible. Very few things need to be bought – a few small racks in this case. By reassigning tasks since the time of the packers will be saved, the extra labor cost is not significant. The only extra things are the bar code and date labels. Well, the bar codes will be installed as part of the other project, so the bar code team can also take into account the date field within the bar code. Also, date labels are very cheap to print.

The benefits of this system are of course:

- 1) Cheap
- 2) FIFO problem solved.
- 3) By putting the date field in the bar codes, the problem of traceability is solved. Now all batches of items can be tracked, indeed each item can be tracked separately thus leading to tremendous cost savings in the case when batches need to be repaired.

The disadvantage is that other than in the pick-up rack, the problem of physically moving/rearranging items in the racks still exists for the FIFO guys. But since they would know the manufacturing dates, it should be possible for them to rearrange the items in the regular racks in a systematic way.

Abstract: The following are other methods we looked at. They may not be the most promising, and therefore have not been mentioned in the Powerpoint presentation

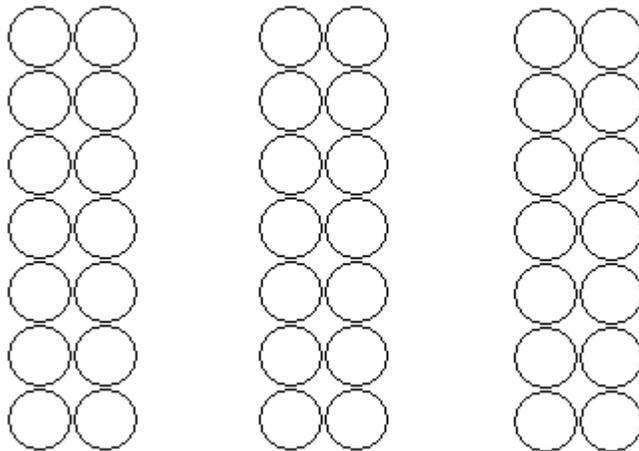
Outside of the Box Solutions by Baroukh Ovadia

The FIFO problem is a physical problem, so it needs physical solutions. I have come up with 3 different solutions that would allow a FIFO process. Unfortunately some of these products are not very common.

1. Rotational Shelves
2. A vertical flow rack system

Rotational shelves: These would be round shelves that would be able to rotate along the center. The oldest items would be in an open box and all the boxes to the right of it would be closed or covered and newer. The newest items would also be in an open box to be loaded and would be the furthest to the right. Other ways of distinguishing the older boxes from the newer boxes could be simple like a Velcro tag that would distinguish between them when a box becomes full it gets covered and another box gets placed and the Velcro moves from the full box to the new one. Also if the shelves are big enough then there would be different products separating.

The layout of the area could look something like this. Instead of having long rows of shelves there would be rows of rotational shelves which would take up more space but be able to hold more.



Positives

- May save space - something that is needed
- Solves Fifo
- Simple system

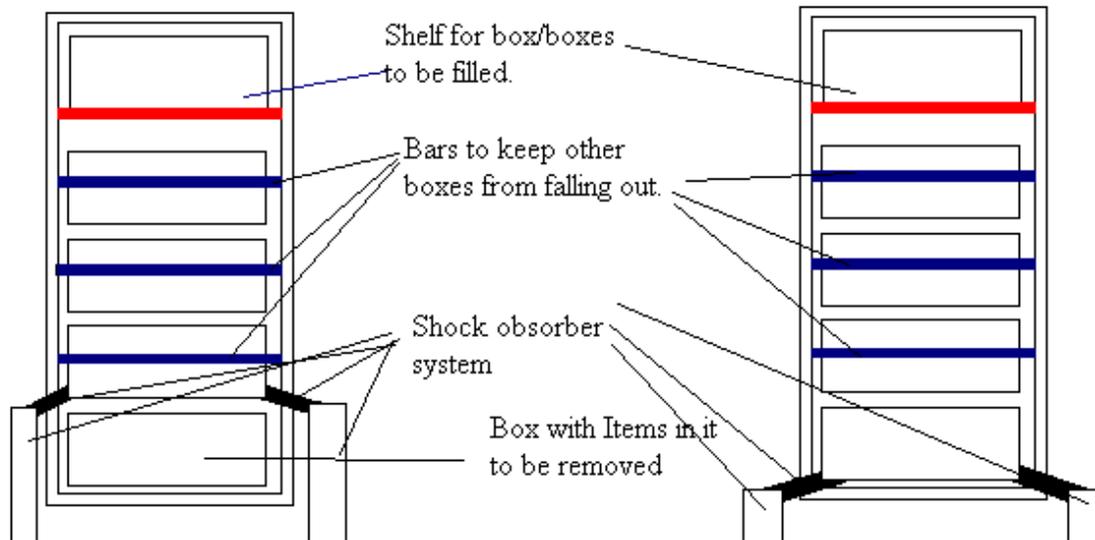
Negatives

- Couldn't find any shelving systems like this out there.
- Problems arise if the number of Items to go in the shelves is too many for a shelf to hold. May lead to wasted space.
- If two Items go on the same shelf then they would need approximately the same outflow rate.

Vertical Flow Rack System: A vertical flow rack system would be another idea. It would be a set of shelves or boxes where the bottom shelf could be completely removed when empty and all other boxes or shelves would fall down into place or just part of it could be removed so Items could be taken out. After it is removed a shock absorber would slowly allow the items to fall down into place and then it would be removed and put in place of the next Item. The boxes to be filled would go on a shelf above the flow rack part. It would resemble something like the figure below.

Before Box removal

After Box Removal



Positive aspects

- May save space. May be stackable.
- Solves FIFO problem
- Simple

Negative aspects

- Couldn't find any shelving systems like this out there.
- May have to bend down in order to get the things - not ergonomic

TWO AREAS FOR ALL ITEMS – PLACING, RETRIEVING

by Martin Yongji Kim

One solution is to hire a person who could arrange the FIFO instead of the packers. Using a new layout system only this hired one person could access and organize for the packers. Some cages (like racks with cages instead of shelves) are created for each item that SHURE has. These cages are also separated to put-in cages and retrieve item cages. In the put-in cages, new items are placed by stacking on top of the older ones. The one hired person is responsible for putting items in this cage. He also puts the required quantity into the retrieve cage by taking them out from the lowest stack (the oldest items) in the put-in cage. Only the retrieve cages are accessible to the packers. Also the put-in cage needs to be locked to make sure nobody except the controller person has access to it.

Positives

- FIFO taken care of
- The one person knows the items layout and keeps track of FIFO's items.
- Could be cost effective to SHURE.

Negatives

- It could be more time consuming.
- They have only certain feature items that could follow this solution.
- Packers have to depend on only this one person.

Of course more than one person can be hired for this task making it easier, but the drawback is the added labor expense.