

IPTI

Econo-Pickä

***Watch-Meä Zoneless
Pick to Light System***

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Prior to electronic paperless system availability (pick to light), paper pick lists were used to pick orders. These pick lists generally included the item number (SKU), description, and a quantity for each line of an order. These pick lists were either given to a single picker, who picked the entire order to completion, or were attached to an order container, which was picked and passed down a picking assembly line.

The first picking philosophy (picker picks entire order or batch of orders to completion) had the benefit of maintaining picker accountability, such that if there was a picking error made with that order, management would know who made the mistake. This method also ensured that all pickers were always busy picking as their picking was not dependent on other pickers. This method was inefficient as pickers were frequently picking in the same area and “colliding” with one another as they competed for items from the same or adjacent pick faces and limited pick time because of walk time between pick faces. It also created a situation where pickers had to become familiar with all pick locations in the system or be forced to locate items by matching bin location tags with locations on the pick list, which decreases efficiency and increased the potential for picking the wrong items.

The second picking philosophy utilized the theory of “**zones**” in a pick and pass environment. Zones represent a series of adjacent pick bays in a pick (order assembly) line. A picker is assigned to each zone. Orders are inducted at the beginning of the pick line and are either manually or automatically conveyed through each picker’s zone, where each picker adds only those items required from their zone to the order container. This provided a method to maintain picker accountability, provide order to the line (pickers not competing for same pick faces), and added efficiency by allowing pickers to become familiar with the items in their zone. This method was inefficient in that it required pickers to deal with orders that they had no picks for as orders had to pass through every zone. Depending on the order profile, a picker or pickers may have very few picks from their respective zones while other pickers were inundated with picks. This causes bottlenecks on the pick line and does not fully utilize every picker. This method became the most common method of paper picking.

When pick to light (PTL) technology was developed, the “**zone**” philosophy was maintained because that was the way pickers were used to picking and it was a natural progression to the new technology.

The problem is...even though PTL was inherently more efficient and accurate (pickers no longer had to search for pick locations and could not misread pick lists), many users of the technology actually found that paper picking was faster! How can this be? The answer is **zones**. While zones worked well (not perfect as described above) with paper based picking, they eliminated the very benefits

that PTL systems offered.

Anyone who has watched a pick and pass PTL system operate will notice that some pickers are standing idle while other pickers are backed up. Any picker idle time is lost productivity that can't be recovered. This is due to zone imbalances based on order profiles. PTL vendors (including IPTI) attempted to eliminate the problem of zone imbalance by creating complicated software algorithms that attempted to balance zones and workload by moving SKUs around or re-sizing zones. This involved a lot of line management and rarely really worked, especially today where preprocessing of orders is impossible because of Just in Time (JIT) picking requirements.

After all this rigmarole, IPTI asked..."why use zones at all"? Wouldn't it be nice if every picker could pick to his or her capability all the time? In truth, zoning a pick line is the worst thing one can implement with a pick to light system. All three main benefits of zones for paper picking do not exist with PTL systems.

1. Accountability of pickers by zone no longer exists, because as we've heard from several customers, "a picker can always blame a misspick on another picker walking by and pressing one of his/her buttons". Thus by simply requiring a picker to log into a zone or by assigning a picker to a zone, one cannot enforce accountability.
2. Pickers no longer need to become familiar with the items in their zones. The light tells them what to pick. They don't need to know where the 12oz shampoo resides.
3. Order is maintained, but there are better ways to achieve order on the line that are more efficient.

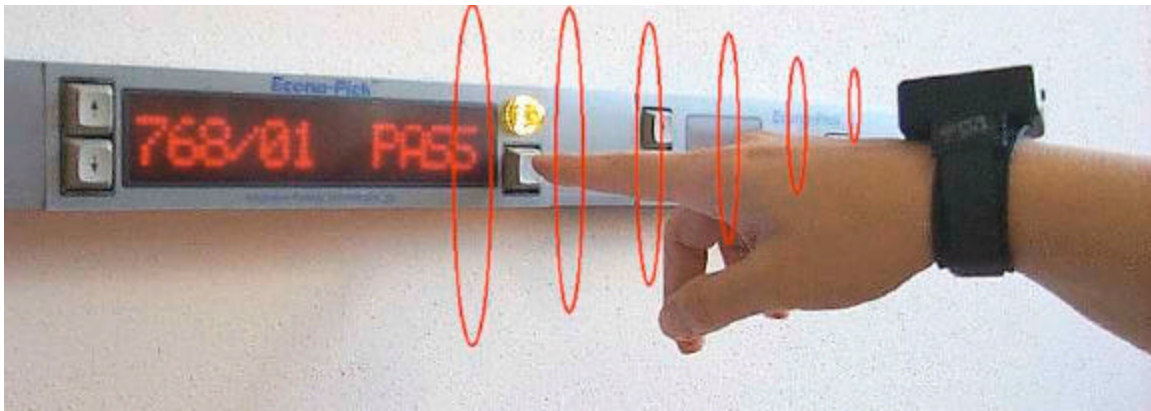
Along came an old philosophy just recently applied to pick to light systems, "**bucket brigade picking**" (see Appendix A in this Document for detailed description of this picking theory). This philosophy solves all problems related to zones with pick to light (and paper pick) systems, but did not provide any form of accountability. Accountability with the standard bucket brigade is on a "team" basis, not an individual basis.

Once discovering the bucket brigade theory, IPTI started implementing the method with its pick to light systems. The method clearly improved pick rates on a system basis with no changes at all required to IPTI's software. The lack of picker accountability was a complaint of the customers using the bucket brigade method.

True to IPTI's innovative history (innovators of the snap-in BUS concept for PTL and innovators of the RF Batch Pick Cart), IPTI created the **Econo-Pick** **WatchMe** **Zoneless Pick to Light System**. This unique system allows the Pick to Light system to track each pick to a specific picker without the need for zone assignments. This feature allows the system to operate in a zoneless

mode, such that any picker can pick from any location on the system. This eliminates the need for SKU profiling and line balancing to equalize zones. When in operation, the Econo-Pick™ WatchMe™ System greatly reduces work in process on a typical pick line. By tracking every pick to pickers, picker accountability is guaranteed, picker productivity is greatly increased, and picker errors are reduced. **With the Econo-Pick™ WatchMe™ System, all pickers can pick at their maximum capability...all the time.**

The Econo-Pick™ WatchMe™ System consists of a special watch worn by each picker (see Figure). Each watch has a unique ID that is assigned to a picker via the control software. As picks for an order are completed, the Econo-Pick™ WatchMe™ System captures the ID of the picker who pressed the task complete button. Any person without a WatchMe™ device cannot pick on the system as the lights will not extinguish in the absence of a WatchMe™ device.



The Econo-Pick™ WatchMe™ System can be utilized with both display based and light based Econo-Pick™ pick to light systems. It can also be used for put to light operations in a similar manner.

Contact IPTI for more information.

Appendix A

Bucket Brigades

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What are "bucket brigades"?

"Bucket brigades" are a way of organizing workers on a flow line so that the line *balances itself*.

Here is how it works. Products on a flow line are progressively assembled as they move down the line toward completion. An assembly line is a familiar example from the realm of manufacturing; but flow lines are found in all types of industries, wherever "products" may be imagined to move along, from worker to worker.

A classic difficulty in the management of flow lines is to balance the line so that it will be maximally productive. This requires precise and time-consuming identification of the work elements and estimates of standard work-content. For example, assembly lines are balanced by teams of engineers, who define task elements and then conduct time-motion studies so that the work can be divided equally among workers. Because bucket brigades are *self-organizing*, the need for centralized planning and management is reduced.

This idea may be found in the social insects, such as ants or bees, which are highly effective at organizing themselves even though without blueprint or management. Instead, global coordination emerges spontaneously, through the multiple interactions of many simple components. Similarly, when workers on a flow line are organized into bucket brigades, they can function as a self-organizing system that spontaneously achieves its own optimum configuration, without special equipment, time-motion studies, work-content models, management, or control systems.

The operation of bucket brigades is simple: Each worker carries a product towards completion; when the last worker finishes his product he sends it off and then walks back upstream to take over the work of his predecessor, who walks back and takes over the work of his predecessor and so on, until after relinquishing his product, the first worker walks back to the start to begin a new product. If, in addition, workers are sequenced from slowest to fastest, then we call the system a *bucket brigade* and the workers will, we have proven, spontaneously gravitate to the optimal division of work so that throughput is maximized.

Notice that workers must maintain their sequence: No passing is allowed and so it can happen that one worker is blocked by his successor, in which case we require that he simply wait until he can resume work, after his successor has moved out of the way. (This waiting is not necessarily bad because it is the means by which the workers migrate to their optimum locations.)

Benefits

- There is a reduced need for planning and management because bucket brigades make the flow line self-balancing.
- Production becomes more flexible and agile because bucket brigades "tune" themselves, without time-motion studies or the other cumbersome endeavors of assembly-line balancing.
- Throughput is increased because bucket brigades spontaneously generate the optimal division of work.
- Secondary labor is reduced and quality improved because bucket brigades operate with the absolute minimal work-in-process.
- Training and coordination are simplified because it is easy for workers to know what to do next.

Who is using bucket brigades?

As of this writing, bucket brigades are used mostly in distribution warehouses to organize order-pickers, in the apparel industry to organize garment-sewers, and in simple assembly processes.

We believe bucket brigades to be more widely applicable but feel that the greatest economic significance is in order-picking, which is very labor-intensive. A typical high-volume distribution warehouse employs hundreds of workers to pick orders and the work must be rebalanced daily, and sometimes more often.

Here is a list of some current users of bucket brigades. (Note, however, that implementations of bucket brigade sometimes differ in local ways depending on the context, so not all of these operate strictly "by-the-book" as we have described.)

- **McGraw-Hill:** Order-pickers in distribution centers
- **The MusicLand Group:** Order-pickers
- **Time Warner Trade Publishing/Little, Brown:** Order-pickers
- **Bantam-Doubleday-Dell Distribution:** Order-pickers

- **Harcourt-Brace:** Order-pickers
- **Blockbuster Music:** Order-pickers
- **Coach Leatherware:** Much sewing is done by bucket brigade
- **Champion Products:** All sewing is done by bucket brigade.
- **Subway:** Corporate headquarters now recommends to their 13,000 franchises that they assemble sandwiches by bucket brigade.
- **Tug Manufacturing:** Manufacturing airport tractors.
- **Mitsubishi Consumer Electronics America:** Assembling large-screen televisions, packaging cellular phones.
- **United Technologies Automotive:** Assembling automotive harnesses.
- **Revco Drug Stores, Inc.:** Order-picker in their national distribution center increased pick rates by 34%.
- **Anderson Merchandisers:** In a two-week trial order-pickers increased production rate by 20% and reduced variance in pick rates by 90%. Furthermore, each order-picker set a career best.
- **Readers Digest:** Order-pickers realized an 8% increase in pick rates and a 35% reduction in errors.
- **Wawa Convenience Stores, Inc.:** Their (unionized) distribution center has just begun using bucket brigades in an operation that picks full-cases to pallet jack. Order-pickers averaged a 25% increase in pick rates the first week.
- **Ford Customer Service Division:** The most popular products have been moved out of carousels and into flow rack, which is picked by bucket brigade. The pick rate has increased over 50% and is still rising in this new implementation.
- **The Gap:** The Gap Distribution Centers supply three chains of retail stores in the US: Old Navy, The Gap, and Banana Republic. They achieved a 25% improvement in throughput by using bucket brigades in their pick modules.
- **Mother Nature:** Amazingly, some species of ant have recently been reported to use bucket brigades to coordinate the transfer of food to the nest!

Bucket brigades in the warehouse

Below we have summarized common questions and attempted to give guidance based on our experience and that reported by others. We invite contributions.

Applicability

How can I know whether bucket brigades will work in my warehouse?

A nice thing about bucket brigades is that you can try it out on a slow day. You need no special equipment. We have found workers pick up the idea quickly.

In general, if you are currently using zone-picking to progressively assemble orders, you should consider changing to bucket brigades. If you are currently doing broken-case picking from flow rack with a pick-to-light system you are almost certain to benefit from conversion to bucket brigades.

Bucket brigades work best when pick-density is high and the items to be picked are small. Also, the waves of order-releases should be of sufficient duration to allow self-balancing.

Finally, to make bucket brigades most productive you should commit to building and sustaining a team-oriented work environment.

Why should I give up zone-picking?

Because it fails to balance the work as well as bucket brigades and therefore is less productive. Furthermore, because it is based on only a static idea of balance, it requires constant management attention to *re-balance* work during the day.

It is impossible to balance the work by a work-content model because work-content is only a guess based on time-motion studies and the assumption of some standard worker. It is always wrong because workers are not standard and the model cannot foresee the inevitable disruptions of the day. Furthermore it solves the wrong problem: Zones try to give each picker the same amount of work *in total, over the day*; but this does not mean that the work is balanced *from order to order*.

In contrast, bucket brigades spontaneously and dynamically reallocate work based on how long it actually took specific workers to pick specific orders. This means that bucket brigades get better balance, and therefore better productivity, and with less management.

What is likely to be the biggest difficulty in implementing bucket brigades?

Accepting the fact that you may not need the elaborate work-content and load-balancing model you built or bought.

Can bucket brigades work with paper pick-sheets? With pick-to-light? With RF devices? With in-the-aisle/pick-to-cart? Etcetera.

There are only a few essentials to support the effective operation of bucket brigades. One is that the handoff must be quick, which requires that a worker know exactly where she is and what needs to be done next when she takes over the work of another. We have found paper pick-sheets work fine as long as each picker clearly indicates her progress, such as by putting a check mark beside completed pick-lines.

Pick-to-light supports bucket brigades especially well because it is easy to see what needs to be picked next: Just look at the lights! This makes hand-offs very efficient. It also reduces any lost time due to one worker blocking another: The blocked worker can see what needs to be picked and help the blocking worker finish picking so she can move on, out of the way.

When picking with RF devices, pickers can simply pass the RF device with the work.

We have found that improvements due to bucket brigades have been less dramatic when the team picks in multiple aisles. Part of the problem is that pickers can lose team focus and intensity when they cannot see their team mates. Another problem is that, if you are doing in-the-aisle picking, you might not have sufficient pick density to support order-picking by bucket brigades.

Bucket brigades have been used successfully in case-pick-to-pallet operations (25% increase in pick rate); but there are some additional challenges. For example, some workers felt frustrated at having to take over someone else's partially-completed pallet because they had a different style of building pallets.

My customers average only (for example) 2.3 lines per order; can I use bucket brigades?

Possibly, but you must make some adjustments to increase the pick density so that workers do not catch up with one another often ("pick-density" = picks-per-linear-foot of aisle). The easiest way to do this is to batch orders. Under bucket brigades you can ask the first worker to start two orders (instead of one) or three or... . This is easy to adjust. The only thing that can go wrong is that you start so many orders that congestion becomes a problem.

I tried bucket brigades and they did not work: pickers kept catching up with each other and getting in each other's way.

You must ensure that there is always work to be done between any two workers. There are two main ways to accomplish this: Batch orders (see above); or use fewer workers on the line (which could be compensated for by higher rate of production).

Management

Do the workers walk more in a bucket brigade?

The amount of total walking under a bucket brigade is no more than that under a zone pick operation, although the walking will not be split equally among the workers. To understand this first note that with a bucket brigade each batch is walked forward the length of the line, and this forward walking is split among the workers. And, under a bucket brigade the total length of the line is walked again after each batch is completed --- this walk back is also split among the workers.

For a zone operation the same holds. Each batch is walked forward the length of the line as each worker picks the order within her respective zones. Also, after each worker completes the picks of a batch within her zone she walks back the length of her zone; and thus, in total, for each batch completed the entire line is walked back.

The main difference between the two is that under a bucket brigade the walking is not divided equally among the workers, nor will the amount of walking for each worker remain the same from batch to batch. This leads to a misperception of the workers and management that there is more walking in a bucket brigade operation. Perhaps this is because workers remember more vividly those occasions at which they had to walk farther than usual; or perhaps it is because the faster workers will indeed walk farther in a bucket brigade. But this is exactly what *should* happen: The faster workers will take on more of the load.

Won't the workers complain about the walking?

Possibly. We have found that, after an initial period of adjustment (about a week), the workers prefer it. They like the rhythm and predictability of it: After picking intensely down the aisle, a worker gets a "break" by walking briskly back upstream, changing field of vision, and greeting his team mate as they hand-off work.

Note that you can reduce walking by increasing the number of orders carried by each worker. If each carries two orders then workers will walk half as much as if each carries one order.

How do I handle underachievers?

We have found that peer pressure by team mates generally handles such problems; but you need to give your teams some authority to manage themselves.

In one implementation, the first, slowest worker never moved beyond the first section of shelf. (A nice thing about bucket brigades is that everyone's productivity tends to be reflected in the distance they cover.) Everyone could see this; there could be no dispute. The team captain asked whether that slowest worker could be removed from the team because the remaining workers could produce as well without her (and split the team incentive n-1 ways).

How can I track the picks of individual workers?

Perhaps you should re-think why you want to. If you are concerned with tracking individual productivity, then you should reconsider. The customer does not want picks; the customer wants his order. Perhaps you should be tracking order-completions, which is the natural way of measuring productivity of bucket brigades: What has the team accomplished?

By measuring individual pick rates you merely reward the accumulation of work-in-process. Instead, you should be rewarding teamwork that leads to order-completions. This also encourages the team members to assume their own managerial "house-keeping".

That said, IPTI has developed a pick-to-light system for gravity flow rack which supports order-picking by bucket brigade but also allows you to track the pick rates of individuals.

If you want to track individual picks so that you can enforce accountability for pick accuracy, this is still possible under bucket brigades. One simple way is for each picker to mark her first pick, for example, on the pick ticket (if picking-to-paper); or on an additional piece of paper that is carried with the order (if picking-to-light). However, we feel that it is better to enforce team rather than individual accountability. If you establish an effective team environment, teams will police themselves to enforce accuracy. The idea is that each team member should do a quick accuracy check when taking over an order. That way quality is "built-in" as the order is assembled, rather than "inspected in" at the end of the process, when it will be more expensive to reconcile exceptions.

How large should a team be?

In our experience 3-8 works best. As teams grow larger than 15 it becomes harder to maintain "team spirit" and so they lose that productive boost.

How should I pay team members?

This seems to be very site-specific and we have no authoritative answers. One scheme that has worked for others is to provide some incentive based on team productivity, to be shared equally among team members. This is in addition to components of pay based, for example, on seniority or skill level or quality or attendance.

How should I form teams?

Again, this seems to be site-specific. We have found that teams are more likely to be successful if they are allowed to form on their own. Unfortunately the best workers may tend to group together, leaving underachievers leaderless. In this case you may need to step in. In any event you must make it clear that each team is expected to help train new hires and temps (and you may need to protect their incentive pay during such times).

Some sites have allowed teams to interview prospective new hires. This encourages them to take a stake in getting new workers quickly up to speed.

For what it is worth, in our experience females seem to perform better under bucket brigades than males.

Operations

How do I start up the line in the morning? How do I close it down?

There are many ways. One that has worked well for us is the "shotgun start", which we used at a site where each picker carried four orders: Initially each picker carries one order; at the next walk-back the first worker introduces two orders, until everyone has two orders; then three orders; and finally four orders.

You can close the line down in a similar way. For example, when the first worker introduces the last orders she can signal to the last worker (team captain); then at the next walk-back the team captain can take only, say, two of her predecessors four orders.

What happens if some worker other than the last first finishes an order?

The worker who has finished an order can push it off and start a walk-back. If it is required that orders be completed in the order in which they were released, the picker can push it down to her next team mate to carry along.

Sometimes a worker catches up with the next worker and then is blocked; isn't this wasteful?

Yes, but this should be only temporarily, while the line balances itself. If it persists, then either the workers are not slowest-to-fastest; or else you may

have too much variability in work. Reduce variability by asking each worker to carry an additional order or more.

Incidentally, if you are using a pick-to-light system then the blocked worker can help the busy worker finish picking that section of shelf so she (the busy worker) can move on out of the way.

Will I have to re-warehouse my skus?

Probably not, unless your pick density is very low and batching orders is not an option. In this case, you could move your most popular sku's to the start of the line.

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