A Comprehensive Analysis of Keg Tracking Technologies For Brewing Industry Decision Makers

Introduction

When Keg Hounds decided to try and solve the problem of keg tracking, the initial evaluation was technologically agnostic. We were not locked into any preferred technology so we compared multiple technologies to determine which would integrate into the current supply chain with the least amount of disruption, the most affordably priced tracking device, and the ability to scale from brewery to distribution to retail.

The technologies we investigated were barcodes, passive and active RFID, Bluetooth, WAN, and GPS. All had advantages and disadvantages, but passive RFID became the clear winner.

Chain of Custody

When evaluating and comparing technologies, it is important to understand the value and relevance of establishing a *chain of custody*. It helps to know the location of each keg, but without knowing how a keg arrived at a specific location, or who is responsible for delivering a keg to a specific location, the information is not as valuable as it would appear:

- What would a brewery do? Send someone out to collect these stray kegs? How much will that cost? Will there be a risk involved in showing up at someone's house and trying to collect for their new barbecue?
- If someone wants to steal a keg with a GPS tag, they can easily remove the tag making the keg invisible. How do you find that keg and determine who is responsible for removing the tag and/or stealing the keg?

By establishing a chain of custody, the brewer easily can identify kegs that have been missing for 6-12 months approach the last known responsible party- whether it's a retail account or a 3PL- and ask:

- "Where is my keg?"
- "I sent it to you on "X" date, and it was filled with "Y" product"
- "It has been missing for 6-12 months"

The chain of custody is a critical element in determining the best way to track kegs, and it can only be achieved if the tracking system has the ability to isolate and scan individual kegs.

Technology Analysis

There are multiple technologies being promoted by numerous keg tracking suppliers, and each one has advantages and disadvantages. The challenge is determining which technology offers the best combination of accuracy, ease of use, and affordability. We've outlined the pros and cons of each below:

Barcodes

Advantages

- Easy and affordable to apply to new kegs and retrofit old kegs ($.30 each)
- Affordable readers ($100 each)
- Ability to use camera phones to scan
- Ability to establish "Chain of Custody"
- Universal standards across supply chains

Disadvantages

- Scanning takes too long (10-20 seconds on kegs that are a few years old), increasing labor costs
- Light, dirt, and other conditions can impede or prohibit scanning
- Barcodes get scratched or dirty and become unreadable- serial numbers must be entered manually
- Can't scan kegs without down-stacking pallets
- Difficult to scan in bulk without adding extra steps in the brewery
- Line of sight required in order to scan
- Limited amount of data can be stored on the keg
- Easily duplicated
- More human errors recorded during testing

Keg manufacturers have been putting barcodes on new kegs for almost 10 years. If there was a minimally viable tracking solution that used barcodes and could be deployed by breweries, 3PL's, and retailers, it would have been adopted by now.

Passive RFID

Advantages

- IOS global standards are in place
- Can be read at longer distances than barcodes
- Easy and affordable to apply to new kegs and retrofit old kegs (<$5 each)
- Easy to scan in bulk
- Can be made "invisible" in a brewery setting, operating without the need for human input (increased accuracy)
- Able to isolate individual kegs
- Ability to establish "Chain of Custody"
- No line of sight required to scan

Disadvantages

- Requires special reader to scan kegs
- RFID tags are more expensive than barcodes

Active RFID

Advantages

- IOS Global standards are in place
- Can be read at longer distances than barcodes or passive RFID

- Easy to scan in bulk
- Can be made “invisible” in a brewery setting, operating without the need for human input (increased accuracy)
- Able to isolate individual kegs
- Ability to establish “Chain of Custody”
- No line of sight required to scan

Disadvantages
- Requires special readers to scan kegs
- Cost substantially more than barcodes and passive RFID tags
- Requires batteries, giving active RFID a shorter shelf life

Bluetooth

Advantages
- Tags/kegs can be scanned by any smart phone with the appropriate Bluetooth hardware and an app
- Less line of sight required to read

Disadvantages
- Chain of custody cannot be established without performing an extra step
- Tags require batteries, giving Bluetooth tags a shorter shelf life
- Tags are more expensive ($10 each)
- Requires connection a Bluetooth gateway or smartphone app in order to function
- Individual tags are difficult to isolate
- Large tag populations in close proximity can cause interference and degrade read rates

GPS

Advantages
- Tags/kegs can be located anywhere if attached to wi-fi or cell ular (WAN)
- Tags/kegs can be scanned by any smart phone with the appropriate app
- No scanning required
- No line of sight required to read

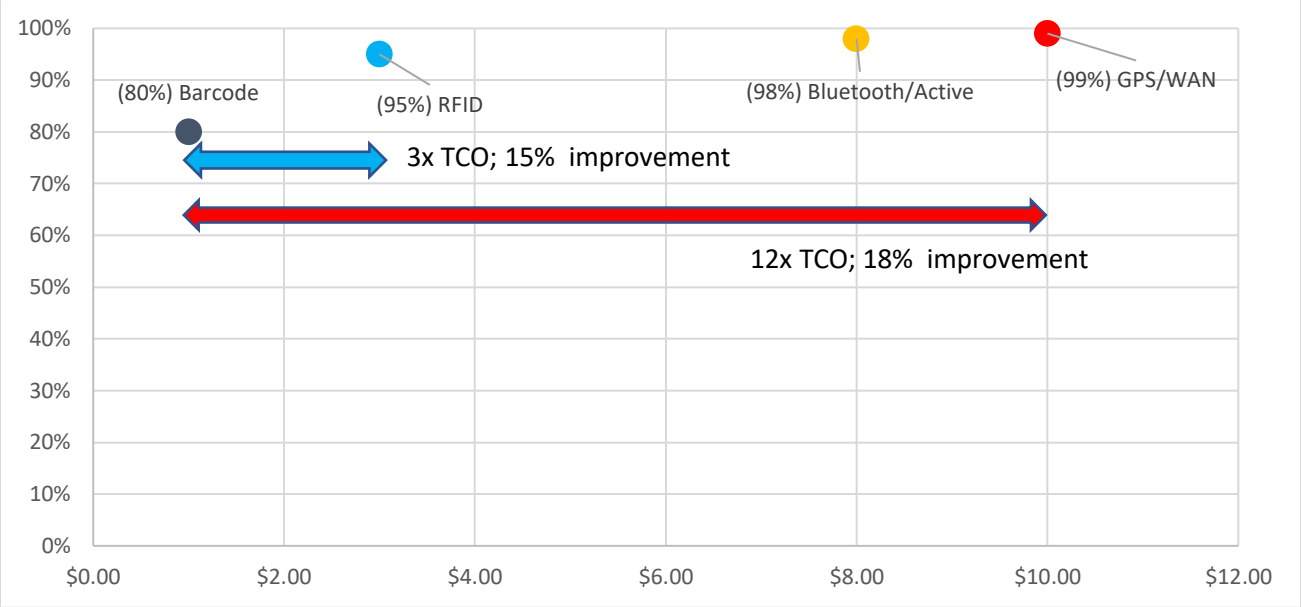
Disadvantages
- Chain of custody cannot be established without performing an extra step
- Tags require batteries, giving GPS tags a shorter shelf life
- Tags and annual service are expensive ($10 per tag, $9 per year for service)
- Requires wi-fi or cellular connection in order to function
- Individual tags cannot be isolated

Summary

It costs more to achieve higher levels of accuracy and decrease user interaction. For example, moving from a scenario where no tracking is taking place to a scenario where kegs are being tracked using barcodes provides a large jump in accuracy for a modest investment. However, there are limits to

barcode accuracy due to durability and scan speed. As you add more kegs and your keg float ages, the labor cost for barcode tracking goes up and accuracy goes down. Passive RFID was designed to overcome the challenges of barcode scanning while still remaining cost effective. Active RFID, Bluetooth, and GPS/WAN can add 3x the cost per keg for an increase of few percentage points of accuracy. It can also introduces other challenges such as maintenance, scanning of individual kegs, precision of scans, automation, etc. Passive RFID provides a very high rate of accuracy while keeping capital investments and labor costs manageable.

The chart below illustrates the relationship between TCO- Total Cost of Ownership- and accuracy of different technology platforms.



Solution Components

The Keg Hounds solution was developed by experts in multiple disciplines, including software and hardware development and manufacturing, brewing and packaging, distribution, keg manufacturing and maintenance, and logistics.

The Tag

Design

When Keg Hounds decided to tackle the global keg tracking problem, the tag is the first thing we addressed. Experience told us for a system to work, millions of kegs would need to be retrofitted with RFID tags, because any other tag that required welding or adhesives would not work due to the additional labor, cost, and lack of reliability. The tag, designed by Keg Hounds and manufactured by Omni-D, does not require welding or adhesives to apply and they are not susceptible to damage from extreme heat, cold and/or caustic chemical compounds to which kegs are often exposed.

The most common tag in the brewing industry (until now) was developed by HID. It requires the user to weld it to the top dome of the keg, and the design has not changed in 10+ years. In addition to the prohibitive cost of welding, the location of the HID tag makes it vulnerable to damage or removal as a result of the rough handling that kegs endure throughout their life cycle. If the design of the HID tag was ideal for the industry, it would have achieved wide-spread acceptance long ago.

HID tag welded to top dome.

HID tags can get knocked off when kegs are stacked, even if the welded attachment device does not get removed.

HID tags can get knocked off when kegs are stacked, including the welded attachment device.

When Keg Hounds had finished designing the new tag, they approached Omni-ID, the world's leading on-metal tag manufacturer, to help them fine-tune it. With Omni-ID's help in optimization, the Keg Hounds' tag has a read range comparable to any other tag on the market. They have also partnered with Keg Hounds to produce the tag, ensuring the demands of any customer, regardless of size, will be met. Add to that, the Keg Hounds tag is more cost effective to purchase and install; is waterproof; has 7+ year life-span; doesn't require batteries, and it won't get knocked off in the market, making it the new clear choice for the brewing industry and a smart investment for every brewery.

Read Range vs. Precision

Our team believes one of the biggest mistakes made by brewers is the focus on read range vs. precision. Read range is only one property tag manufacturers use to differentiate their tags, but any claims of read range are based on tests that occur in a lab under optimal conditions. Read range is important, but in most brewery environments, there are dozens or even hundreds of kegs in close proximity. The greater challenge is identifying the single keg you want when the keg you want is surrounded by others.

The ability to read a specific tag surrounded by numerous other kegs is not just a function of the tag, it is also a function of the hardware and software- more specifically the *optimization* of the tag, hardware, and software, and their ability to perform cohesively.

The Barcode

Every Keg Hounds RFID tag has a barcode with a human readable serial number attached to it. While the RFID capabilities are the primary feature, some levels of the supply chain will not manage a large enough volume of kegs to justify the investment in an RFID reader. For these outlets- mostly small restaurants and bars- the users can download an app and use a camera phone to scan barcodes to communicate with the system. Unlike other barcodes, Keg Hounds' barcode, as well as the entire tag, is protected in a waterproof and scuff-proof PET case..

Hardware

Keg Hounds has partnered with global leaders for leading-edge IT and RFID technology. Partners include Honeywell, Prisma, Texas Instruments, Omni-ID, Xerafy, and Nordic ID.

The Readers

An effective keg tracking solution requires a combination of handheld and fixed readers to scan kegs. The ability to integrate different types of readers allows our team to integrate seamlessly with any supply chain environment.

In most cases, the larger the brewery, the more opportunities exist to use fixed readers. The advantage of fixed readers is they are "passive"- they operate with little or no human interaction. Typical locations for these would be on filling lines, at dock doors, and on a palletizing/shrink wrap machine, but fixed readers can also be placed on forklifts, trucks, and other vehicles. In the case of a fixed reader on a fill line or at a dock door, the user would be required to enter what product is being put into the kegs, where kegs were being shipped to, or where they were being returned from. No other interaction would be necessary. In the case of a fixed reader on a filling line, palletizing machine, or vehicle, there would be no human interaction required.

Fixed readers at dock doors

Fixed readers with antennas and routers

In circumstances where processes are performed manually- in breweries, during distribution, or at retail- handheld readers make the most sense. In addition to being mobile, handheld readers allow users to adjust power settings (adjusting read range) and read kegs in limitless configurations and locations.

Handheld reader

Fixed reader mounted on forklift

The Software

The Keg Hounds software is a web-based interface that works on any device (computer, tablet, or mobile) without any special installations. It uses a fast, stable, and scalable software platform that has been proven in mission critical deployments. The technology stack (the languages, tools and frameworks that developers use to create web and mobile apps) employed is also used by leading technology companies such as Amazon, Google, Facebook, Twitter. This approach serves to future-proof performance and ensures any new improvements are available for adoption within our system framework. The system provides reports, analytics, alerts, and notifications of keg movements. Reports can be viewed in the web application or emailed to users. The software offers REST-based API, allowing for custom integrations to either import data from a third-party system or export data to a third-party system.

Keg Hounds has also created an app that is available from the App Store (coming soon) or on Google Play (available now). It is designed for remote use, particularly by portions of the supply chain that don't manage enough kegs to justify the investment in RFID readers.

Activation

Keg Hounds partners with global leaders in keg sales, leasing, management, maintenance, and logistics. We can deploy our first-in-class tracking system at any location on any continent, always using the most qualified local experts for support. Whether it's tag application, reader installation and maintenance, or software support, Keg Hounds can support any requirements from any brewery or 3PL.

Solution Benefits

The Keg Hounds software was originally designed to answer four main questions for breweries:

- "How many kegs do I actually have? I know how many I've purchased, but how many do I still have?"
- "Who is losing my kegs?"
- "How fast am I turning each keg?"
- "Which kegs will require maintenance soon?"

The information provided by answering these questions within seconds can be used by multiple groups within each brewery:

- Inventory- RFID allows a brewery to scan dozens of kegs in seconds, significantly reducing the time required to perform inventory audits.
- Logistics Optimization- Improve logistical efficiency with the ability to evaluate turns based on keg size, SKU, retailers, wholesalers, and 3PLs.
- Maintenance Data- Allows the brewer to identify "at risk" kegs before they fail in the market, reducing lost sales due to "leakers".
- Forecasting- Plan future purchases with confidence by matching keg purchases with sales forecasts, kegs currently in the float, and average turn times.
- Accounting- Manage deposits by quickly and accurately tracking shipping and return data

Typical reports include:

- Asset population
- Aging reports- how many kegs at each location and their age
- Cycle times- based on SKU, package size, and delivery location
- Fill Session history- based on Batch and/or dates
- Shipment history- based on delivery locations and dates
- Maintenance schedules
- Inventory- Time stamped inventory based on different locations within the brewery

How It Works

Primary Functions

Keg Hounds can adapt and design a system to integrate seamlessly with the established processes and ERP system of any brewery or 3PL and minimal participation by users is required to achieve this. With

user input we can capture specific events that establish the chain of custody, keg movement throughout any and all facilities, loading and unloading activities, and other ROI-generating data.

- Keg Origination- Kegs must be added to the system either by scanning or by data import. The information assigned to each keg can be modified based on user/owner preferences, but the base information is keg size, barcode serial number (if applicable), RFID serial number, and date of manufacture.
- Keg Filled- Tracking Fill Sessions allows the user to track product, batch, and fill date for each keg.
- Keg Transfers- Allows the user to track the inventory of kegs within a single location.
- Keg Shipments- Allows the user to track which kegs are at which retail account, wholesaler, or 3PL. The user can know which kegs are being "lost", who is losing them, and how long the kegs have been "lost".
- Keg Received- Allows the user to determine how many empty kegs are in the brewery, and it shows the average of how long they stay empty until they get cleaned and filled.

Conclusion

Ubiquitous keg tracking is inevitable. The Brewers Association estimates each US brewery loses between 3%-5% of its kegs each year. Keg loss rates are similar in other developed markets. With an estimated 20M kegs in the US, and an average cost of $100, US brewers are losing between $60M-$100M annually. With an estimated 100M kegs globally, loss is estimated between $300M and $500M annually. Kegs are one of the largest investments a brewery will make, and few breweries have a clear idea of how these valuable assets are being utilized.

After extensive research with experts in the brewing and technology industries, Keg Hounds has determined passive RFID technology provides the best combination of ease of use, accuracy, cost, and scalability. Barcodes are too unreliable and too labor intensive to serve as the primary identifier of a tracking system. Active RFID, Bluetooth, and GPS/WAN can all be effective, but there are issues regarding identifying specific kegs, and they are cost prohibitive. With Keg Hounds' passive RFID system, brewers, distributors, and retailers can finally maximize the value of their keg floats.