McAllister's Law of RFID Mandate Compliance: The Key to Wide Spread RFID Adoption

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McAllister's Law states that mass compliance with retailer tagging mandates will not occur until the cost of encoding and applying an RFID tag is less than the cost of the tag itself.

Retailers such as Wal-Mart and SAM's Club have issued RFID tagging mandates to selected suppliers. However, most suppliers remain hesitant to respond to those mandates, choosing to limit their project objectives to tactical goals such as baseline compliance - calculating them as a cost of doing business rather than embracing them as a strategic customer alliance or business process initiative.

For most suppliers, this has resulted in a business process cost of $2 to $5 per RFID tag plus the cost of the RFID tag. Their hesitancy to fully embrace RFID, while understandable - prevents them from scaling up, keeps tagging costs high, and ultimately forces the retailer to apply the tags upon arrival at their receiving docks and charge the supplier for that service.

Background

There is a broad effort to measure the true benefits that RFID brings to supply chains, to publish results of pilot projects, and to provide real world information for supplier's ROI models. All of this is necessary to realize the vision and mandate that was announced by Wal-Mart's executive team on November 4th, 2003 in Springdale, Arkansas. Indeed since that original mandate, much has happened to help realize that vision. The cost of RFID tags has dropped from 30 cents to 12 cents. Tag and reader performance has improved many times over what was available five years ago, and studies have shown that RFID actually improves supply chain execution by reducing out-of-stocks and improving other key performance indicators.

Although many hurdles have been overcome since the original Wal-Mart mandate, one final obstacle remains. It is the chasm between the world of low volume pilot projects and the world of mass RFID adoption. This chasm is characterized by the short list of problems that remain. Of those problems, the one has received the least attention is the cost of commissioning RFID tags. This is a hidden cost that exists in addition to the material cost of the RFID tag itself.

The cost of commissioning RFID tags (encoding the right data and applying the RFID tag to the right pallet or case) depends largely on the vendor's internal business process. Following Gartner's Hype curve[1] through the 2004 spike of RFID-mania, tags were envisioned to be embedded in corrugated cartons, making for smart boxes that magically declared their arrival at key choke points in the supply chain. Then in 2005 people began to discover the dream of a smart box was exactly that, a dream for many years to come. There are significant technological and economic barriers to mass adoption of smart boxes.

The 2004 hype depended on a sub 5-cent tag that would already have the correct data in it and be a physically integral part of the box itself. When people discovered that this was a decade or so away from reality, interest in RFID plummeted, following the Gartner Hype cycle exactly as they predicted. Such is the nature of leaders sharing their dreams of what a new technology can achieve. Bill Gates describes that phenomenon in a different way, he said that short term impact of a new technology is often overstated, but the long term impact of a new technology is understated.

In 2005 mandate compliance proceeded slowly with slap-and-ship, a method of just getting the job done with preprogrammed RFID tags manually applied to a select few pallets and cases bound for Wal-Mart and SAM's club. Zebra, Sato, Printronix, Monarch, and others sent their engineers and sales teams to work creating and selling upgraded versions of their legacy printer technology for demand label printing. The market quickly purchased these products. They were a continuation of something that they already understood, from companies that they already knew and trusted. It was easy to convince Wal-Mart suppliers that this was all that they needed to satisfy Wal-Mart and to keep their consumer products flowing into Wal-Mart and the U.S Department of Defense for their RFID mandates. That has been true… up until now.

The business process was awkward though, the sleek new high performance printers were big and power hungry. They were really good at spitting out beautiful RFID labels that contain all of the printed information that you could think of as well as a perfectly encoded RFID tag that contained all of the data that Wal-Mart needed. Then the labels would be carried out to the shipping dock 20, 50, or 100 at a time, sometimes trailing

[1] Gartner's Hype Cycles highlight the relative maturity of technologies across a wide range of IT domains, targeting different IT roles and responsibilities. Each Hype Cycle provides a snapshot of the position of technologies relative to a market, region or industry, identifying which technologies are hyped, which are suffering the inevitable disillusionment and which are stable enough to allow for a reasonable understanding of when and how to use them appropriately. Also please see the References section of this paper.

behind the diligent worker like a tail. Tags were peeled off and slapped onto the cartons, and off they went to the Wal-Mart distribution centers.

Then a group of engineers and scientists from those printer companies discovered that a high percentage of those labels were failing in the field. The problems were traced back to how the RFID labels were being handled after they were printed, encoded, and carried off to the shipping dock. An advisory paper[2] was written recommending care in handling, tag designs were improved, and printer stations were relocated to positions closer to the tagging activity. Failure rates improved, but the fundamental problem remained, that printing and encoding were two different things that were being combined into one thing called a Smart-Label.

Smart-Labels are different than RFID tags. Tags are not labels. Tags are not printed using a demand label printer such as a Zebra printer/encoder. Tags are printed when the tags are manufactured on a high speed press. Tags only have pre-printed information on them that may include logos, consumer messages, or bar code, but not tag-specific information. If there is any tag or product-specific information printed onto a tag, then it is actually a label. Labels may contain shipping addresses, SSCC bar codes, or any other information that has been required by previous retailer mandates or by MIL-STD-129 for DoD shipments.

It is important to know that neither Wal-Mart nor DoD require Smart-Labels[3]. They specifically state in their requirements that the tag and the label can be separate, and describe how they could both be applied to packaging. In terms of RFID performance, a separate RFID tag can be placed on the carton in a location where it will read better. An RFID tag is actually best used as a supplement to the shipping labels of previous mandates. It has been the printer companies that have promoted the combination of printing and encoding into a single Smart-Label in an attempt to perpetuate the importance of printing and the printers they manufacture.

So why is the Smart-Label a problem for mass adoption of RFID? It seems like a great idea to have the bar code mandates, MIL-STD-129 mandates, and the RFID mandates all

[2] ISO/IEC PDTR 24729-1 Information technology — Radio frequency identification for item management — Implementation guidelines – Part 1: RFID-enabled labels Committee identification: ISO/IEC/JTC 1/SC 31/WG 4/SG 5 June 8, 2006

[3] For RFID tagging of DoD shipments using a tag that is separate from the previously mandated address label, please refer to MIL STD-129P paragraph 4.9.2.1b. From http://assist.daps.dla.mil/quicksearch/basic_profile.cfm?ident_number=35520

satisfied by a single label that can just be applied to a box and shipped out the door. It turns out that would be true, especially if companies would just spend the $150,000 necessary to retrofit existing production lines with print/encode/apply machines to do that automatically. If they would only do that and get their per-tag costs down, and just eat the cost of shipping RFID-tagged cartons to retail stores and distribution centers that do not require tagging yet. If suppliers would just do that, then the chasm would be no more than the cost of retrofitting 1 million production lines at a cost of $150,000 each, totaling $150 billion dollars, give or take a few billion.

Bridging the Gap

The problem is that a capital investment of $150,000 for automatically printing, encoding, and applying RFID labels on 100% of their production output is not likely to pay off before the Smart-Box finally arrives to replace it.

This then is the most significant obstacle, the chasm - the gap - between RFID pilot projects and 100% RFID-enabled production lines. Suppliers need a bridge to cross that chasm. Universal thinking on what the requirements for a bridge might look like include the following thoughts:

1. The bridge needs to provide an efficient means for selectively commissioning RFID tags or labels without having to at least initially pay for RFID tags on all of the pallets and cartons that will never be read by a non-mandated ship-to location. This will help to reduce tagging costs. For some suppliers, the current list of Wal-Mart and SAM's Club ship-to locations and volumes represent less than a fraction of one percent of their annual production output.

2. The bridge needs to fit with existing business processes. Changing business processes is costly and should be made only after thorough analysis and understanding of the total impact is modeled.

3. The bridge needs to have a low capital cost.

4. The bridge needs to have a low operating cost.

The costs for capital and operating costs (not including the cost of the tag itself), divided by the number of RFID tags deployed is the tag commissioning cost C_c. The cost of the tag by itself (i.e. the tag's direct product cost) is C_T. The sum is the Total Cost C_{TOT}, where $C_{TOT} = C_T + C_C$. McAllister's Law states that $C_C < C_T$ (i.e. the commissioning cost must be less than the tag cost) for mass adoption of the RFID mandates.

This white paper shows that for supply chain mandates to succeed, both a bridge strategy and a long term tagging strategy must both adhere to McAllister's Law. In other words, given that the promised benefits of RFID will indeed be delivered, then the cost of activating and applying RFID tags must be less than the cost of the tag itself for widespread use in supply chains. This is true in supply chain applications, because the activation costs accrue to the suppliers, the source of the commissioned tags.

Categories of RFID Tagging Methods

Labor is a major consideration when considering various tagging methods. Each possible solution can be categorized as being labor-intensive, labor-efficient, or labor-free.

Demand label printed tagging is labor-intensive, typically costing $2 to $5 per tag. RFID service bureaus provide pre-printed labels, third-party logistics providers charge for turnkey service, and even in-house print-encode-apply operations run at costs in this range. These solutions are the most attractive when volumes are low because there can be a low initial cost, possibly with no capital requirements. However, these solutions do not scale well.

In-process encoding is enabled by ADASA Inc. by providing a labor efficient tagging method where RFID tags are applied within existing business processes where extra handling steps are virtually eliminated. Unique to in-process tagging is the convenience of RFID tags in cartridges. Cartridges are refilled, reused, and brought back to the point of activity where they are applied in rapid succession to selected selling units, cartons, and pallets. Complete tagging solutions from ADASA totals no more than $5000 to get started - definitely not capital intensive. Upward scaling of in-process tagging to higher volumes is easily achieved when the tagging of many selling units or cartons from the same SKU is required. This aligns very well with SAM's Club's shift from pallet tagging directly to units-level tagging. Many suppliers will see a major increase in their tagging demand in coming months. In-process tagging will adapt very well to the imminent escalation of mandate activity.

Automated tagging and Smart-Boxes will be the kings of tagging solutions by the year 2020. The per-tag commissioning cost C_C will be practically nil. Capital costs will be substantial, but amortized over billions of tags, bringing the amortized C_C to almost zero. That day will truly mark the arrival of the "Internet of Things" and will finally realize the vision of RFID's early leaders.

Further examination of the in-process tagging is warranted now that many people recognize that a bridge is needed to span the chasm to the future of RFID. The time is now because the mandates are real, fines are being imposed, and Wal-Mart (now in 2008 officially named Walmart) is committed to RFID. It's not a matter of "if"; it's a matter of when and how.

In-process tagging has a low upfront capital cost of under $5000, so the dominant cost is labor. Assuming a fully burdened labor rate as high as $25 per hour still proves to meet the objectives of McAllister's Law by achieving per tag labor costs well below the cost of the tag itself. Even at tagging rates as slow as 10 cartons per minute, the labor cost is less than half of the cost of the tag. This labor efficient solution compares favorably with the $2 to $5 per tag costs of labor-intensive solutions such as manual print-encode-apply operations.

In-process tagging can fortunately be optimized to achieve up to 60 tags per minute for a C_C benchmark of well under 1 cent per tag. This helps to insure that the bridge will reach all the way to the other side of the chasm.

A breakdown of the tag commissioning costs C_C fall into these three categories:

1. C_{CP} = Cost of presenting or exposing a target surface of a pallet, carton, selling unit, book, or garment, to which an RFID tag must be attached. This cost component is minimized by avoiding special handling. Preferred methods integrate a tagging process with some other existing business activity, such as order picking. Tag-at-Pick is a point where selected items are tagged while they are being pulled from a storage bin onto a pallet for shipment to Walmart. This has a C_{CP} cost of nearly zero, and is preferred wherever possible to avoid special handling of products for tagging.

2. C_{CEV} = The cost of laborers waiting for the machine's encode and verify cycle to complete for each tag. This delay is attributable to tag print/encode equipment that requires a command from a remotely located computer to issue a unique serial number from a pool of numbers that resides in a central location. Access delays through a network are often unpredictable, as are task switching delays inside the computer and its database. If the sum of those delays becomes perceptible by the person who is applying tags, then their productivity is dramatically reduced. Not only do they work more slowly, by their attention wanders and they lose focus on their tagging task. Modern tagging methods cache pools of serial numbers locally within the tagging machinery, thereby

eliminating network delays. A state-of-the-art tagging machine should take no more than a fraction of a second to generate, encode, and verify an RFID tag.

3. C_{CT} = The cost of transporting each custom-encoded tag from where it is encoded and verified to the exact point of each tag's attachment. If the transportation involves shipping or footsteps, then C_{CT} is too high to comply with McAllister's Law. Modern tagging equipment should generate, encode, and apply RFID tags at the point of the tagging activity, resulting in a C_{CT} of zero.

Of all of these costs, C_{CT} is the major source of cost that dominates the industry in its current state. It is also the cost that is the most sensitive to an upward scaling of SKU count, tag count, and ship-to locations. This is because the dominant manual print-encode-apply tagging methods utilize a printing and encoding process that is physically separate from the optimal location for tagging. It is in that location that generic tag stock that could be used to tag any product is given a unique identity that must be matched up with a particular carton and order. That matching process requires attentiveness to what is printed on a Smart-Label and matching that to what is printed on a carton. It is time consuming, error-prone, and costly.

$$C_C = C_{CP} + C_{CEV} + C_{CT}.$$

Conclusion

In Gartner's Hype Cycle, successful technologies exit the trough of disillusionment along the slope of enlightenment. Is McAllister's Law the key to this enlightenment? Or are companies willing to continue wasting money on inefficient tag deployment methods, pony up serious capital for automation, or just give up on the entire vision? Place your bets, the game has begun!

References

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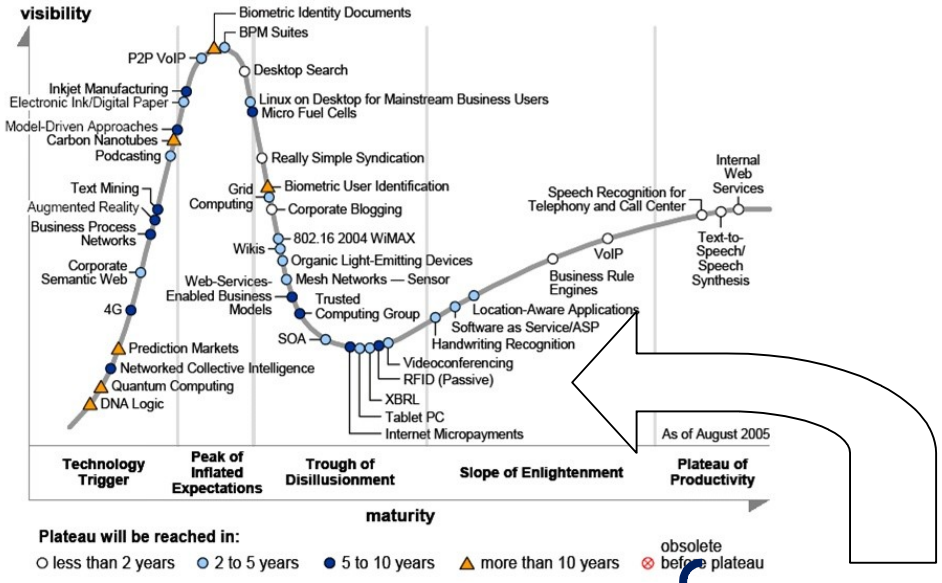

RFID is projected to reach the plateau in 2010 to 2015. The author of this paper predicts that this coincides with the mass adoption of SmartBoxes with chips pre-embedded in them.