

“The Future of the Supply Chain and the Importance of Smart Packaging in Containing Costs”

Introduction

Just what is Smart packaging?

It would seem the more I read and learn about what people are calling smart packaging, the more I realize how diverse that answer can be. While I have been exposed to various attempts to classify sub-groupings, for me, it's just better design – using current and emerging technology in logical ways to solve problems we have always had. It results in better product protection, better security, better brand protection, better distribution management, and ultimately, a better experience for our customer. In the end, we run our business more efficiently and I believe that's the reason those of us from the user group are here today; we owe it to ourselves and our organizations to keep abreast of the trends and technology, lest we be caught left behind in “the dust”.

As I address you today, it's from a number of perspectives. First, as a member of IoPP (Institute of Packaging Professionals), which is a co-sponsor of this conference. I was asked to represent the user perspective of smart packaging, from HP's perspective.

If you're not familiar with IoPP, I would encourage you to speak with one of the IoPP members to learn more. The mission of this organization is focused on continued technical education; it provides forums, reference systems, training, individual competence certifications, and hosts a group of technical committees. It certainly follows, then, that an event such as this conference is a good example of the activity that IoPP eagerly supports.

Secondly, in my role as a packaging engineer and manager at HP, and having originally come from the Compaq ranks during the recent merger, I was excited about being part of the larger Packaging Engineering community that was more assertive and innovative in the field of packaging. I have not been disappointed. To keep things in perspective, I manage the packaging function in the Industry Standard Server division. I'm not some guy with “Smart Packaging” in my job title. And, while we have some serious proponents and champions of smart packaging efforts, monitoring developments has not been entrusted to any one individual. That said, the HP Packaging community is very well organized with monthly forums – a management team council, a packaging community virtual coffee talk, and various technical sub-committees addressing specific issues or leveraging opportunities by sharing our best practices; this is structured and managed under a corporate team, which has a charter to keep abreast of technical developments. It shouldn't be a surprise that the technologies we'll be discussing in the next two days are frequently on the list of topics, and the comments I will make should provide reflections from the different HP product divisions, and likely, reflections of the needs of the electronics industry in general.

So, as a user of dumb and smart packaging, I can tell you about some of the needs we have identified, I can tell you a little about what we're doing, and I will switch hats at this point to tell you what HP is doing as a provider of smart packaging, specifically to update you on our RFID program. Finally, I will close with some thoughts as to where we're hoping these technologies will develop. I hope you will find HP to be a great study case as I can assure you we have just about all the supply chain issues that you can possibly imagine.

So, my perspective this morning will be the same as the other morning presentations - that of a smart packaging user. This first of the four sessions of this conference is intended to address brand owner/end-user requirements for smart/intelligent packaging throughout the manufacturing and supply chain. In the second session the focus will be on package protection; third will address pack authentication, and the final session will discuss management of the supply chain.

THE NEED FOR SMART PACKAGING

In the current day, I believe it is easier to see how developments in technologies, the ones we will be addressing in this conference, can play to our benefit. Some of you here today were around to see bar coding get incorporated into our product lines for the first time, and we have had the chance to realize its advantages. For Compaq Computer, it was the early eighties when we started making the bar-coded serial number something other than a preselected name for a specific computer; we were finally building a database. I was a manufacturing engineering manager at the time, and was I ever excited! Finally, my life was going to get easier!

If you ever seen one of the original luggable computers Compaq first produced, you may have noticed a grouping of little colored dots on the label-end of the shipping carton panel. At the time, this was how we kept track of reworks, sub-component revisions, ROM upgrades, and so on. When the need arose to perform factory purges and sorts, for example to pull out a lot of drives that had demonstrated a potential problem during final test; we physically inspected each unit and marked each carton with the results. With the advent of bar coding and the promise of an associative process of connecting components with the end product number, I envisioned that with the simple wave of a hand scanner, I could now identify which units had which subassemblies. Right? In actuality, not so.

What went wrong? We were inputting all the data, so the information was there, but in a practical sense, the information was still unavailable to me to the extent I wanted. What I realized was the importance of the software managing the data and, unless you had a really good reason to justify the expenditure to have someone develop the routine you needed, it was not going to happen. What I ended up learning to do was to mine what information I could with the existing system and complete the rest by hand. So, from my perspective it was two steps forward, one step back.

But I don't see these problems of implementation with current developments such as RFID for several reasons.

- First, we know now that we will be better off to be more involved. If your requirements are not in the plan, your needs will not be met.
- The Electronic Product Code (EPC) will give us more information, making application software easier to justify.
- 'Middle-Ware' is a must have and this alone will drive its development.
- Finally, someone has done an excellent job obtaining HP management support to champion developments within the corporation.

HP AS A USER OF SMART PACKAGING

How HP sees the benefits of smart packaging impacting its business

I see three factors that drives HP's interest in smart packaging: the type of product we have, the size of our operations, and the complexity of our logistics.

First, since HP has a broad range of products these days, certainly broader than the perspective I had at Compaq, and we have ample applications and opportunities for smart packaging. All of our products are targets for theft because of their value and easy dispensability. Our print cartridges and memory are favorite targets for counterfeiting, and the high value of components just about manifests any possible kind of fraud one could imagine.

Second, just the size of our supply chain provides attractive opportunities. Any percentage of \$50B, one of the estimated sizes of our supply chain I hear mentioned, is a lot of money and an opportunity for cost containment. I guess we have all seen some of the fabulous savings predictions from the promised impact of improved efficiencies in the distribution environment, reduction of theft, warranty tracking, and making the counterfeiter's job harder; as I said, these

forecasts have attracted the attention of the management team. For this reason, HP teams had already been well engaged in RFID well before the need was established with the Wal-mart announcements, but I will get into more detail on HP's RFID initiatives a little later.

Finally, the HP distribution environment has changed dramatically. We are shipping more of our product direct to the customer, we are doing more custom configuration (CTO), and we are heavily leveraging the advantages of outsourced manufacturing. The net of this is that, with many manufacturing facilities world-wide and different distribution systems engaged in our operations, we have a tremendously large and complex operation - in spite of years of considerable efforts to consolidate. In some cases we are seeing a four- to six-fold increase in the number of transfers through shipping hubs. Better accuracy of our material can only help distribution functions such as the 'merge-in-transit' concept and allow build cycle times to be greatly reduced. A simplistic example is a computer system that you may have ordered being delivered to your home - it's no good to you unless all the components are delivered at the same time - but the CPU might be from Europe and, monitor from China, and your extra memory from the West Coast. A more significant impact would occur with our more complex configuration operations such as our rack assembly factory where every rack is uniquely configured to the customer's order.

Control of operating expenditures is a very high priority for HP, and smart packaging is certainly seen as method to reduce those costs. A number of Design-for-Supply-Chain teams have been in existence to review our operations for these opportunities. Perhaps, the best way to show this focus is by means of a few examples.

WHAT HP IS DOING WITH SMART PACKAGING

When Wal-Mart announced their intent and schedule to require RFID tagging, those efforts that were already underway at HP got a huge shot in the arm. What most of us did not realize at the time was that a Core Team had been working quietly in the background setting up a well-coordinated, multi-divisional effort.

As it turned out, there was a reason that this actively was handled so quietly. During this time frame, the HP management team was refocusing our direction towards the growth potential in being able to provide complete, total IT solutions to our customer base. RFID presented such an opportunity, but more on that later.

As an early user of RFID technologies in these pilot programs, HP experienced the usual learning curve. I was asked to comment on some of the obstacles and solutions during his process, but with the team in the midst of the Wal-Mart implementation, they were not in a position to share many specifics. However, the team did express some areas of focus that are worth mentioning:

- You have to test RFID in the live manufacturing environment. Some problems such as RF reflections, absorption, and other factors cannot be duplicated in a lab environment.
- Electrostatic Discharge protection is always a concern.
- Quality programs must be in place to confirm and address field failure incidents as they occur.
- Scalable architecture of the hardware and software will enhance cost-effective implementation.
- Ensure data collection is secure
- And finally, we need to continue efforts to push for integration and standards at the system level.

HP's RFID OFFERINGS

In May of 2004, HP announced that it would leverage its experience in the RFID applications. I think we all recognize RFID holds the tremendous potential to improve operations. However, the

collection and use of data to make timely business decisions is exactly what the HP Adaptive Enterprise model is all about. This model provides the IT manager with the ability to build a highly flexible, scalable data management system with the objective of providing better real-time information into the business decision making process; it's a system that is capable of being customized and modified to adopt to ever-changing business conditions. Providing better integrated IT driven business solutions was something we have been doing all along, so linking RFID data to business processes was a logical step.

In summary, HP is now a producer of RFID-enabled retail goods, a provider of RFID consulting and integration services, a participant in global RFID standards development, an early adopter of RFID in its own operations, and an innovator in RFID-related technology solutions such as tags, readers and middleware.

The May announcement positions HP as an excellent candidate to provide RFID consulting and integrations services. Some examples are Hasbro, the toy and game maker, and Conros, a leading supplier to Wal-Mart. In both these cases, HP developed working relationships with hardware and software providers to provide a total solution package. In the Conros project, the company selected HP Services to oversee its RFID Implementation, which incorporates solutions from partners Shipcom Wireless for RFID software and Matrics for EPC-compliant reader infrastructure and tags.

Additionally, HP announced some new RFID programs from HP Services that included:

- RFID Discovery Service to help customers build their vision for benefiting from the technology;
- RFID Adaptive Starter Kit for customers that want a proof of concept; and
- RFID Readiness Assessment and Roadmap Planning for customers ready to develop and implement solutions.

To assist with these programs, HP has launched several RFID Centers of Excellence, the first being at HP Labs in Palo Alto, to showcase HP's vision of the future and technology capabilities of RFID. Each center exhibits the latest innovations and research from HP Labs, including secure and manageable sensing infrastructure for locating and tracking objects and their interactions; additionally, they are expected to provide a demonstration and lab environment where customers can build their RFID roadmaps, conduct proofs of concept, and understand their RFID infrastructure requirements.

With a second RFID Center of Excellence in Taiwan announced in April, and another in Puerto Rico just recently, HP plans to open other centers in Geneva, Singapore, Tokyo and the United Kingdom. In short, HP will be a major player in the RFID field.

At the current time, HP has twenty-something manufacturing sites enabled to use RFID in order to cover the products destined to go to Wal-Mart. By the fall of this year all 65 HP consumer product lines destined for Wal-Mart stores will be RFID tagged at the case and pallet level; additionally 40 products destined for the Sam's CLUB stores will be tagged. *(These figures will be update at conference time).*

OTHER SMART PACKAGING

During my interviews of team members of the various organizations within HP, I have discovered we use a great deal of smart packaging. Let me provide some examples.

We are finding the concept of regionalized packaging design is making better business sense as we move to more of a direct ship model. Within the retail consumer space, regionalization allows us to simplify graphics to the language of the country where the product is being sold; the idea to print one language instead of seven, for example, which has an obvious negative impact of

cluttering the graphics. Much effort is being directed to the ability to accomplish a high-quality, on-demand printing capability on the manufacturing line; being able to do this printing with retail graphics on pre-printed cartons, for example, produces a package that interacts with the customer more favorably. Our HP Indigo Printing group has had an obvious play in this application; their product line has made short label runs more economical, their systems allow serialization on the fly, and they can provide specialty printing solutions. HP Indigo does have representation at this conference in the exhibit area; I would encourage you to stop by for more information.

A second consideration for regionalized packaging is to develop protective packaging specifically for the region intended. For example, packaging can be specifically designed for the brutal environments experienced in India and China, a second design for direct distribution in North America, and a third bulk design for large shipments of CPUs to a configurator. These multiple designs can provide streamlined costs provided the manufacturing and distribution systems can distinguish which type of distribution the product will experience.

The printer cartridge business has obvious exposure in the retail market, and is probably the most likely targeted item when it comes to counterfeit and theft. These threats, plus the volume of product, have facilitated the commitment of resources in the study of smart packaging. Significant effort has been made to provide our partners with cartridge blister packs with the appropriate EAS (Electronic Article Surveillance) device that is compatible with the technology system in place at the retailer. The EAS is embedded within the pack to prevent removal. Additionally, our teams have developed other 'smart designs' such as producing a cartridge pack that doubles for a package to return the empty cartridge for recycling, and another design that eliminates the need for a blister pack by making the entire package with sealable, printable, plastic materials.

The security-related interviews have been most interesting and are indicating mixed results in deterring theft. As one of the easiest of these categories to track dollar-wise, the HP logistics teams have been very active. Of mention was the subcategory of entire trailer theft, which is apparently a significant percentage of the total theft dollars. The opportunity for trying various smart devices is easily justified; potentially a single device could be enough to provide a specific protection/tracking function for what is surely a high-value trailer. Do these systems work? Yes, but only to the point the bad guys figure out what you're doing. I listened to a number of accounts where the thieves demonstrated that they knew exactly which devices to disable; they are even able to effectively use the appropriate electronic hardware to jam device transmission signals. These guys are good! The heart of the problem is that it is hard to control the IP (Intellectual Property) of the system. There are always too many people involved with the control of confidential information, and its value enables the presence of potential informants for the thieves just about anywhere in the system. An educated and informed thief is our worst nightmare!

The key to secure product distribution, I am told, is to keep it moving and keep it tracked. Smart packaging enables both these factors.

I would like to offer one more reflection about a passive system that has been in place for many years. While the logo tape we use on our product was originally a proof-of-authenticity marking, it was recently considered for elimination as a possible cost reduction. The pack teams knew the tape was ineffective because, first, we never really educated our customer to look for this feature, and second, tape manufacturers all over the world were able to demonstrate, either legitimately or else wise, the ability to manufacture reasonable copies of the tape. Nonetheless, it is our partners that have been the ones who have pushed back on any efforts to eliminate it; they appreciate the tamper evident characteristics, as limited as it is. The point for this example, is that collectively, we need every feature we can get.

THOUGHTS ON WHERE SMART PACKAGING COULD GO

As I brainstormed wish lists with other packaging engineers, logistics personnel, and the security organization, we came up with a pretty good wish list of ideas. But, our issues, being typical for those in our industry, produced feature sets that I have found already being discussed in related articles and publications.

First, at the SKU level, I have already mentioned that the HP distribution environment has changed dramatically. In the past decade, our distribution model has changed from a Build to Stock model, where our product was moving from warehouse to warehouse in FTL quantities to a scenario where we are building configurations per an order (CTO) and shipping direct to the customer from the assembly location.

From an engineering standpoint, I would like a better handle on this distribution environment. Measurement of the experience our packages see as they go through this environment has been greatly facilitated with recent equipment miniaturization efforts; however, this is still an expensive and time consuming process for the engineering teams. I am looking forward to the promises of nanotechnology in the miniaturization of sensors. I could see how simplistic, binary, environmental sensors would be helpful in our studies if they were cheap enough to design a large number into logic arrays to provide the desired level of detail in the data.

All of us really want to see RFID take root so we can harvest the benefits. It's clearly a winner of a concept and I applaud those visionaries that have driven it to where it is today. The benefits of faster product flow, better inventory accuracy, and better data will help us all, immediately. At the next level, having the infrastructure in place so that we could have the ability to perform real-time reconciliation of product movements would enhance accountability and, hence, this could contribute significantly in reducing theft in distribution. Essentially this is being able to count every item at every touch point in the system, greatly reducing the opportunity for theft. Did I mention it would be nice to track all this via satellite?

Within my personal frame of reference I would like this control to extend down to component level. Part of our manufacturing discipline is computerized on-line methods to guide our assembly and test personnel. In our server factory, every part gets scanned in by the operator using current bar code technology. The system ensures we're putting the right part in the assembly, whether it be a drive, processor, or warranty manual. With the EPC code, so much more information can be incorporated into our methods on the line. Having unique codes on each part will provide better engineering change control - not only could I ensure the right part is installed, I could be ensured the right version of that part is installed.

However, while you are considering this, we need to solve the privacy issue. HP currently has a policy that requires we inform our customers of the presence of tagging, and secondly, the ability to remove it. Until recently, I have not paid a lot of attention to privacy concerns. That was until I read a Houston Chronicle newspaper article describing how specific employees in Mexico's top federal prosecutor's office were receiving RFID implants in their arms. Macedo de la Concha, the Attorney General, led the way with his own implant. In an interview, he expressed optimism that one day, they could find his whereabouts if ever taken hostage.

For those in that legal department, suddenly RFID implants became a condition of employment, and now, one wonders when someone will figure out a way to demonstrate it's more cost effective to implant than to issue co-tag badges. There could be other compelling reasons to consider implants. For example, if you were a frequent traveler, would you consider an implant to participate in the Registered Traveler Program administered by the TSA (Transportation Security Administration) to avoid those long screening lines at the airport? It's only a matter of time, and I find it a little scary.

Additionally, we need something that costumers will recognize as a stamp of authenticity. It's got to be something no one else can reproduce and something we can tell the customer to look for. There is some very clever print technology being displayed, but we need to figure out how to

make it all work. Simply put, if HP can secure it, the counterfeiter can too. The solution could be as close or as far away as affordable intelligent devices talking to one another at the point of sale or receipt, possibly tying the product to an automatic warranty registration at the point of sale. Along this line of reasoning, having affordable read-writable tags that we can program on-the-fly might permit some sort of dynamic encryption that could be applied to solving this issue.

I almost hate to mention this, but all of us need help with the payback and ROI modeling. The lean and mean user companies are pursuing cost reductions, but we pursue the easy ones. From my perspective, the packaging industry needs partnerships that will help address the big picture. For example: recovering higher cost devices for reuse, extend print-on-demand into the service arena to provide replacement boxes and running this as a business, providing investigative services to quantify our problem set, and so on. I think there are some great opportunities yet to be tapped.

I need to return to counterfeiting prevention one more time because I think it clarifies what we're up against. While we can count stolen systems, and while we can count non-HP material coming back into our warranty returns stream, determining how much revenue is lost due to counterfeit product being sold in place of bona fide HP product is a guess, at best. The percentages I have heard as estimates of this problem run a wide range but it is always a significant proportion of sales. As I interviewed one of the members of HP's counterfeit investigation teams, the individual's office was full of memory, drives, and processors – and, each had a story. Although some of the counterfeit was obvious to me, very little of it would be detected by a typical customer. Actually, some of the samples were works of art to be admired! I was shown a counterfeit DIMM memory board that looked like the real McCoy, the real thing. It was counterfeit, but this could only be determined by noticing a minor error on a chip label code identifying the part to be manufactured by someone other than the one stamped on the part.

It looks like we just don't need Smart Packaging – we need Smarter Packaging!

CONCLUSION

The requirement to make our packaging smarter, more intelligent, and more functional is clearly understood among the engineering ranks within HP. Given the complexity of our supply chain, operational controls and policies are not enough. We need the means to audit and stay on top of our business on a continuous basis.

I have always appreciated the openness that I find in the packaging community. We're all fighting the same problems, and collectively we can drive solutions. It is my expectation that the interaction over the next two days will leave us all with a newer awareness of what the future has in store for us, but it is my hope that we will leave with a roadmap on how we will work together to realize this promise.