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**RFID: The Smart  
Product (R)evolution**

FORRESTER®



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## RFID: The Smart Product (R)evolution

RFID will provide an unprecedented view into a product's life -- changing the way goods are produced, shipped, marketed, and sold. RFID will roll out in four stages: field tests, shipping assets, cases, and products.

### 2 MARKET OVERVIEW

- Using RFID, UK brewery Scottish & Newcastle saves \$25 million on beer keg purchases annually.
- Early adopters wrestle with technical and people problems.

### 5 ANALYSIS

- RFID answers key questions like: "What's in a product?" and "Where has it been?"
- Health, beauty, and tobacco are prime candidates for RFID.
- Case-level tagging for consumer packaged goods enables "sense-and-respond" supply networks in 2005.

### 14 ACTION

- Support "node-level" data processing and decision-making.

### 16 WHAT IT MEANS

- RFID will turn leading economic indicators inside-out.

### 17 RELATED MATERIAL

- Online spreadsheet detailing RFID adoption in the consumer packaged goods industry.

### 18 GRAPEVINE

### 19 ENDNOTES

## MARKET OVERVIEW

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### RFID Proves Its Worth

While tagging individual Coke cans is not yet practical, many consumer goods manufacturers and retailers are reaping the benefits of radio frequency identification today. Early adopters face a range of technical and people dilemmas -- from tag interference to employee resistance.

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### FIRMS BENEFIT FROM RFID TODAY

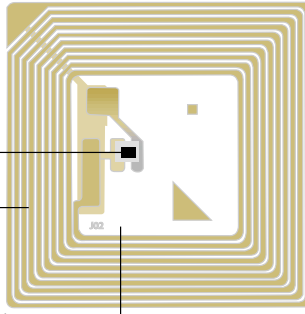
Radio frequency identification (RFID) has ignited the interest of firms that want to increase the accuracy -- and flexibility -- of production, logistics, and selling activities. RFID tags are ideal for transmitting key information about physical objects over short distances (see Figure 1 and see the May 6, 2002 Forrester Brief "RFID Redefines The Retail Supply Chain").<sup>1</sup> And while recent press focuses on RFID's potential, RFID deployments have already yielded benefits like:

- **Better asset management.** By generating a data trail of where an object is and where it has been, RFID allows firms to track their reusable assets throughout the supply chain. By tagging kegs of beer, UK brewery Scottish & Newcastle curtailed the loss of these assets -- many of which were stolen and resold for their high-grade aluminum. The resulting cost savings amount to \$25 million annually.<sup>2</sup>
- **Accurate supply chain execution.** In the CPG industry alone, firms lose a collective \$9 billion a year due to incorrect shipments and unsalables -- which are the result of bad data and manual processes (see the May 2002 Forrester Report "Cutting The Fat Out Of CPG Logistics").<sup>3</sup> In the Tulsa, Okla. Town Test -- sponsored by the MIT Auto-ID Center, Wal-Mart, and Procter & Gamble (P&G), among others -- P&G found that automated data capture using RFID increased accuracy to 99%, up from 95% using physical inventory counts.<sup>4</sup>
- **Speedy -- and profitable -- payment transactions.** New payment devices that use RFID technologies ease the buying experience -- and stimulate incremental sales (see the July 16, 2002 Forrester Brief "Paying With RFID, Smart Cards, And Biometrics").<sup>5</sup> Mobil's Speedpass system cut the average gas purchase from 3.5 minutes to 30 seconds. Just how lucrative is convenience? Speedpass consumers spend 20% more than their counterparts that use traditional payment methods.

**Figure 1** Understanding RFID And Its Uses

**RFID tags are made up of three parts:\***

- 1) **Chip:** holds information about the physical object to which the tag is attached
- 2) **Antenna:** transmits information to a reader (e.g., handheld, warehouse portal, store shelf) using radio waves
- 3) **Packaging:** encases the chip and antenna so that tag can be attached to physical object



**Did you know?**

Tags come in two varieties: active and passive. Passive tags derive their energy from radio frequencies transmitted by readers. They cost less because they don't require batteries. Active tags contain their own battery sources and are always on.

**Four most common flavors of RFID (commercial use):**

	Radio frequency	Benefits	Limitations	Common commercial uses today
1	Low frequency (125 to 134 Kilohertz)	<ul style="list-style-type: none"> <li>• Frequency accepted worldwide</li> <li>• Works well near metal</li> <li>• In wide use today</li> </ul>	<ul style="list-style-type: none"> <li>• Limited read-range potential (impractical for some warehouse operations such as pick and pack); less than 1.5 meters</li> </ul>	<ul style="list-style-type: none"> <li>• Animal identification</li> <li>• Beer keg tracking</li> <li>• Automobile key-and-lock, anti-theft systems</li> </ul>
2	High frequency (13.56 Megahertz)	<ul style="list-style-type: none"> <li>• Frequency accepted worldwide</li> <li>• Works well in moist environments</li> <li>• In wide use today</li> </ul>	<ul style="list-style-type: none"> <li>• Does not work well near metal</li> <li>• Limited read-range potential; less than 1.5 meters</li> </ul>	<ul style="list-style-type: none"> <li>• Library book tracking</li> <li>• Pallet/container tracking</li> <li>• Access control (buildings)</li> <li>• Airline baggage tracking</li> <li>• Apparel item tracking</li> </ul>
3	UHF (868 to 928 Megahertz)	<ul style="list-style-type: none"> <li>• Longer read-range potential; more than 1.5 meters</li> <li>• Commercial use is growing rapidly</li> </ul>	<ul style="list-style-type: none"> <li>• Frequency not licensed for commercial use in Japan</li> <li>• Detuning when tags are in close physical proximity</li> <li>• Does not work well in moist environments</li> </ul>	<ul style="list-style-type: none"> <li>• Pallet and container tracking</li> <li>• Truck and trailer tracking (in shipping yard)</li> </ul>
4	Microwave (2.45 Gigahertz)	<ul style="list-style-type: none"> <li>• Longer read-range potential; more than 1.5 meters</li> </ul>	<ul style="list-style-type: none"> <li>• Frequency not licensed for commercial use in parts of Europe</li> <li>• Complex systems development</li> <li>• Not in wide use today</li> </ul>	<ul style="list-style-type: none"> <li>• Access control (vehicles)</li> </ul>

\*Note: This is a common RFID tag, shown true to size. RFID tags come in hundreds of shapes and sizes.

Source: Forrester Research, Inc.

- **Faster processes.** Manufacturers and retailers alike increase inventory turns by reducing the time that it takes to process shipments of finished goods. By tagging hundreds of crates of refrigerated goods, the UK retailer J Sainsbury reduced receiving time from 2.5 hours to 15 minutes -- resulting in less spoiled food.

### **But RFID Comes With Technology -- And People -- Challenges**

Despite the benefits, RFID deployments are not trouble-free. Most of the early adopters we spoke with cited obstacles originating in an emerging technology that has a high potential to transform existing business operations. Top challenges include:

- **Lack of worldwide data standards.** While companies like Unilever and Wal-Mart are testing the electronic product code (EPC) in North America, the data model does not have worldwide support. Over the next year, industry groups and user firms must drive EPC adoption worldwide -- with the help of the Uniform Code Council and EAN International.
- **Country-specific idiosyncrasies.** While tags that use UHF and microwaves are gaining popularity, these spectrum bands are not for commercial use in Japan or parts of Europe. This poses a challenge for multinationals like Coca-Cola -- which receives 25% of its revenue from Asia and 23% from Europe and the Middle East -- that expect RFID deployments to work in any country where products are sold.
- **Tag and reader incompatibility.** A reader produced by Texas Instruments cannot understand the radio transmission of a tag produced by rival Philips Semiconductors. The resulting pain: Firms can't apply existing RFID investments to new deployments that require new types of tags. One battle-hardened project manager we spoke with warned, "RFID manufacturers ship you silicon and leave you with the problems."
- **Tag and data overload.** Early adopters wrestle with data collisions and tag detuning when a multitude of RFID tags are in close proximity. In addition, the exponential amount of data that tags produce worries many executives. One executive told us that scanning each product 10 times during its life cycle would create a total of 3,500 transactions per second -- an impossible load for the firm's systems.
- **Wary people.** RFID also stirs up distrust among employees who fear that improved visibility will disrupt the status quo. One company put its warehouse workers in a tizzy when it investigated why its portal RFID sensors were not receiving data past noon on Friday. Turns out that the forklift drivers were literally cutting corners -- and unconsciously bypassing the sensor's read range -- in their efforts to start the weekend early.

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# ANALYSIS

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## RFID Starts In The CPG Supply Chain

To capitalize on the power of RFID, CPG firms should target supply chain applications and categories like health and beauty first. Key accelerators like cheap tags and Wal-Mart's support will drive more companies to tag cases -- redefining CPG trade in 2005 and beyond.

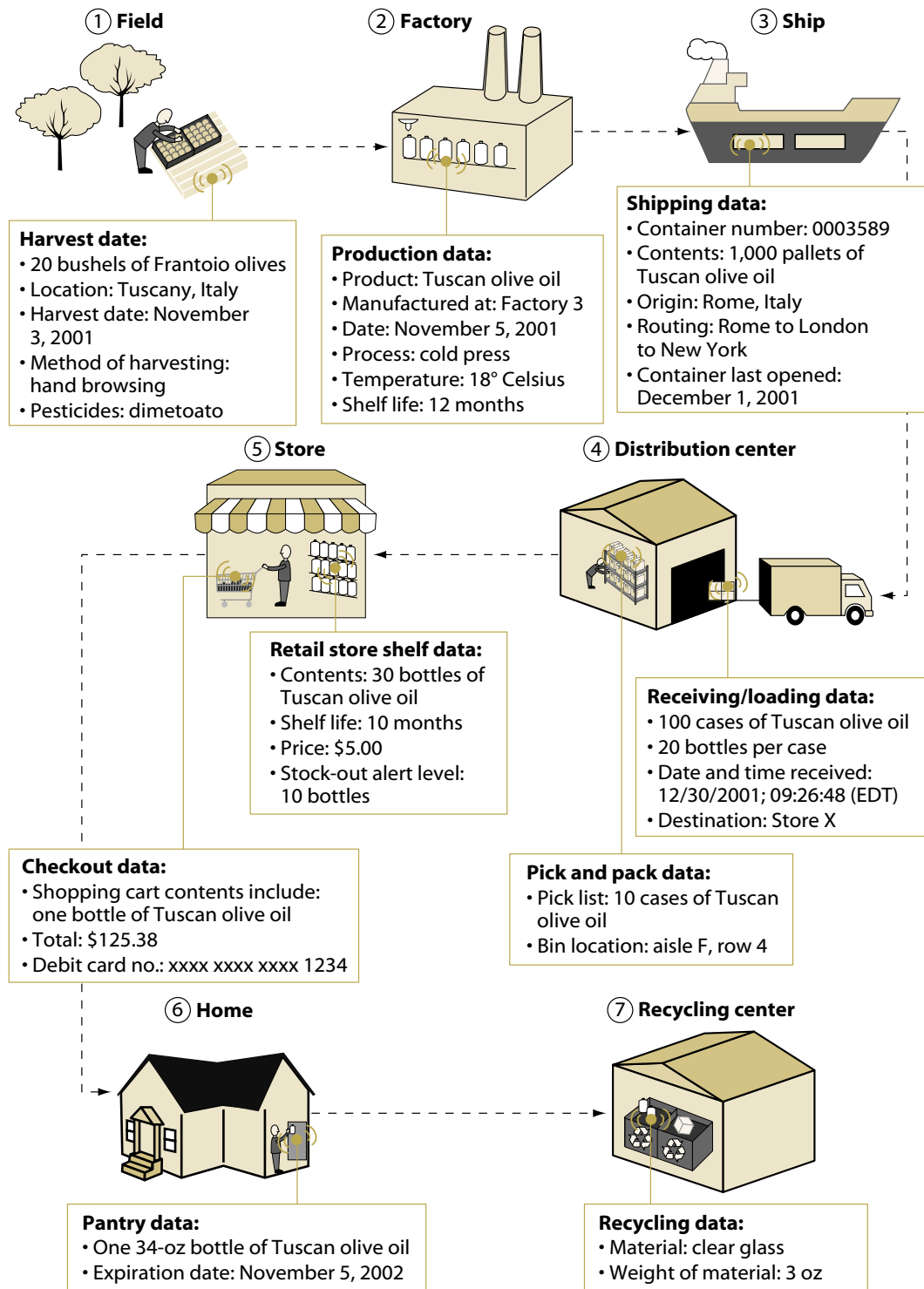
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## RFID REVEALS THE PRODUCT LIFE CYCLE

RFID provides an unprecedented view into a product's life cycle by associating critical information with physical objects as varied as automobiles, hospital equipment, or bags of chips. In doing so, RFID allows manufacturers, retailers, and consumers alike to determine (see Figure 2):

- **What's in the product?** RFID yields critical information about raw materials and manufacturing conditions when it is used during and even before a product is produced -- from field to factory. This basic information will improve the effectiveness of a variety of activities like recalling a product or determining if two prescription drugs can be taken at the same time.
- **Where's the product been?** Tagged containers, pallets, and cases produce an audit trail of a product as it moves through the supply chain -- from ship to distribution center to store. A view of a product's whereabouts will support better decision-making -- allowing a manufacturer to guarantee an advanced ship notice or enabling a government body to monitor custody changes for food safety.
- **What's demand for the product?** RFID used in retail stores and distribution centers provides a real-time view of demand -- down to movement of products off the shelf. Manufacturers and retailers will rethink inventory management and logistics activities in this information-rich environment.
- **How's the product consumed and disposed of?** RFID-tagged products can continue to capture information after a product leaves the store -- from home to recycling center. This will allow consumers to perform a host of activities like automatically updating shopping lists and easily recycling packaging waste. It will also provide manufacturers and retailers with a deeper view of consumer behavior -- sparking heated debates on privacy and targeted marketing.

Figure 2 RFID Provides Data Throughout The Product Life Cycle



Source: Forrester Research, Inc.

## ONLY A FEW RFID DEPLOYMENTS MAKE SENSE TODAY

While RFID has the potential to introduce staggering changes, too much futuristic ballyhoo -- such as Jetson-like refrigerators and pantries that use RFID to do your grocery shopping -- overshadows today's reality. For most manufacturers and retailers, the key question is: How should we apply such a powerful and multifaceted technology that is so early in its life cycle?

Firms should first look at projects that not only exploit RFID's power but also contain the associated financial and operational risks. Ideal activities for near-term investments:

- **Are labor-intensive and error-prone.** By automating activities like counting inventory, RFID minimizes mistakes that people make when doing highly repetitive tasks. Before automating the tracking of trucks at one distribution center, Utah-based Associated Food Stores found that between 40% and 70% of shipment status data was inaccurate because security guards and truck drivers mistyped information into the yard management system.
- **Are vulnerable to supply chain loss.** Tagging pallets and cases of products that are highly susceptible to theft or spoilage allows CPG firms to pinpoint -- and eventually avoid -- loss in the supply chain. Just how big is this problem? For Gillette, the estimated 5% shrinkage rate for razors and blades translates to \$180 million in lost sales annually. In addition, comparable loss from spoilage can be minimized using sensory RFID tags -- which warn of environmental changes that compromise food quality and currently cost about \$5.<sup>6</sup>
- **Involve high-dollar assets.** To justify investments, firms must spread tag and reader costs -- which run between \$0.20 and \$10, and \$200 to \$6,000, respectively -- across a high-dollar base such as \$900 Prada handbags or cases of over-the-counter drugs. That's why in CPG today, RFID makes sense for reusable assets like pallets, beer kegs, and plastic crates -- not individual goods.
- **Demand limited collaboration.** Early RFID projects have higher success rates when firms focus on internal operations or tracking goods between one or two trading partners. Why? Because RFID deployments that span full supply networks require consensus on intercompany processes, data models, and technology investments -- no small feat when most CPG trade is still done by phone or in person (see the April 2001 Forrester Report "Retailers Reshape CPG Trade").<sup>7</sup>

## CPG Firms Should Focus RFID Efforts On The Supply Chain First

Even if tags were \$0.05, tagging individual consumer packaged goods is impractical because of their low price point. But high levels of inefficiency in B2B trade will drive CPG manufacturers and retailers to invest in technologies that automate distribution

and inventory management activities (see the December 2001 Forrester Report “Collaborating For CPG Success”).<sup>8</sup> Firms can use RFID to help by (see Figure 3):

- **Tagging cases to avoid stock-outs.** In one-third of stock-out conditions, items that are not in the store are available at the retailer’s distribution center.<sup>9</sup> By monitoring tagged cases, RFID readers embedded inside shelves in a retailer’s stockroom notify the distribution center when the store is running low on cases of a product. By creating this real-time view of demand, Procter & Gamble expects RFID to minimize stock-outs while reducing inventory by 40%.
- **Monitoring trucks on distribution center premises.** When CPG firms lose sight of a truck’s location in a distribution center or warehouse yard, they lose money -- in the form of spoiled food, delay penalties exacted by logistics providers and trading partners, and labor costs incurred when a person has to find the truck. Active RFID tags -- with read ranges approaching 100 meters -- can alert nearby sensors to the whereabouts of tractor trailers -- and the inventory they contain.
- **Checking containers to secure cross-border shipments.** Post-September 11, CPG firms face the need to monitor custody changes of cross-border shipments. RFID applications outside of CPG have already demonstrated improved quality control. During the Gulf War, the Department of Defense (DoD) delayed the processing of 25,000 containers shipped to Saudi Arabia when they couldn’t verify contents. Now, the DoD can process more than 250,000 shipments daily using an RFID network that spans 350 ports worldwide.
- **Tagging pallets and cases to speed warehouse operations.** Manufacturers and retailers can shave time off warehouse functions -- like receiving and pick and pack -- by using RFID-enabled handhelds to read tagged cases and pallets. What’s more, benefits extend beyond warehouse automation when firms use “intelligent” cases to speed up cross-docking operations -- thereby increasing inventory turns.

### Health, Beauty, And Tobacco Products Are Prime RFID Candidates

As CPG firms expand RFID investments, they must also determine the product categories ideally suited for case-level -- and eventually item-level -- tagging. A host of criteria -- like cost of goods and supply chain idiosyncrasies -- make some products more well-suited than others for RFID investments. What categories are ideal for RFID?

- **Yes: health, beauty, and tobacco.** Over-the-counter drugs, cosmetics, and tobacco products like cigarettes are well-positioned for RFID, because firms can spread investments over a high-dollar base. And due to their high cost, these products are also highly susceptible to supply chain theft and gray market distribution -- which RFID curtails. Look for manufacturers like Philip Morris, Revlon, and P&G to drive RFID activity in these categories.<sup>10</sup>

Figure 3 The ROI Of RFID

Goal	ROI time frame			RFID benefit
	Near	Medium	Long	
Speed up warehouse operations	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Pallet and case level:</b> efficient loading and unloading
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Pallet and case level:</b> proactive notification of errors that delay shipments
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<b>Case level:</b> faster picking and packing, easier cross-docking and management of mixed pallets
Tighten quality control	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Pallet and case level:</b> custody change auditing and environmental monitoring of perishable goods
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Container level:</b> custody change auditing for shipping containers used in cross-border trade
Manage assets and capital expenditures	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<b>Item level:</b> increased success rate of product recalls using RFID data combined with purchase history data
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Pallet, case level, and more:</b> better asset management of logistics assets such as reusable pallets, cases, and kegs, as well as heavy machinery like forklifts and tractor trailers
Reduce stock-outs	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<b>Case level:</b> better demand visibility because stores alert distribution centers when back storerooms run low on cases of product
	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<b>Item level:</b> better demand visibility because intelligent shelves in the front of the store indicate when they need restocking
Eliminate theft and counterfeiting	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<b>Case level:</b> theft reduction as cases move through the supply chain
	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<b>Item level:</b> consumer theft reduction and anti-counterfeiting enforcement
Increase trade promotion effectiveness	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<b>Item level:</b> pay-per-performance trade promotion contracts based on shelf inventory and merchandising effectiveness
	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<b>Item level:</b> better promotion planning based on how shoppers browse and interact with products
Improve recycling efforts	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<b>Item level:</b> better recycling of nonhazardous goods (e.g., brown or green glass) and products with hazardous materials such as batteries or fluorescent lights

Source: Forrester Research, Inc.

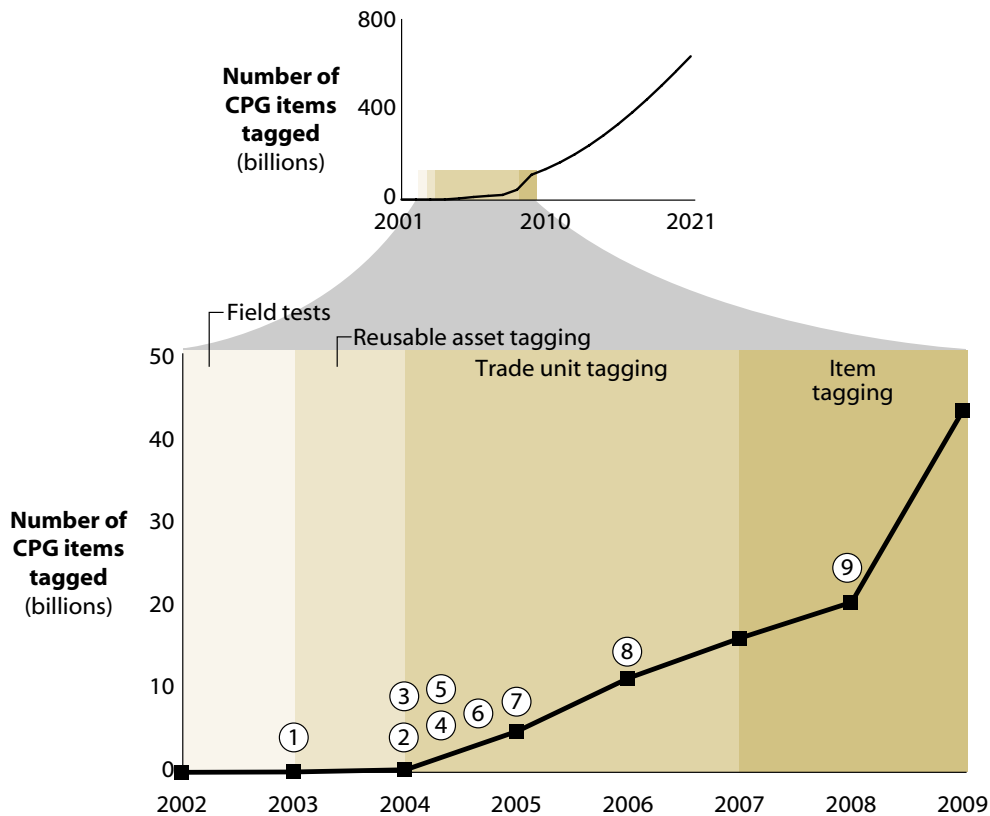
- **Maybe: snack foods and meats.** For frequently promoted snack foods like Coke and Doritos, RFID can smooth inventory management problems by providing real-time data on demand volatility. RFID also makes sense for meats due to spoilage rate, food safety concerns, and supplier idiosyncrasies -- national meat suppliers like Tyson Foods and ConAgra Foods can support RFID investments better than regional players. But since products like Coke are liquid, and meats contain high amounts of liquid, RFID tags -- which don't always transmit signals through water -- are still hit-or-miss.
- **No: other perishables and bulky products.** While fresh categories like fruits, vegetables, and milk are susceptible to spoilage, their unique supply chain characteristics -- local distribution and a high number of fragmented suppliers -- make RFID investments pricey and impractical. It is also unlikely that we'll see large-scale case- and item-tagging for bulky products such as toilet paper since they have a low case price and are often shipped in full pallet loads -- thus diminishing the need for tagging below the pallet-level.

### RFID INVESTMENTS TAKE OFF IN 2005

RFID is today what the bar code was in the early '70s -- a promising technology with narrow exposure. At present, RFID is limited to a handful of pilots and an even smaller number of full-blown deployments -- amounting to around 1 million tagged objects in the CPG industry. But just as it took only three key events to drive the worldwide adoption of the bar code, so will it take a few drivers -- occurring in 2003 and 2004 -- to ignite RFID expansion (see Figure 4).<sup>11</sup> By 2005, Forrester estimates that around 5 billion CPG objects will have RFID tags, due primarily to:

- **Government regulation for cross-border trade.** At the first G8 Summit after September 11, world leaders and policymakers reviewed a plan for strict -- and automated -- checks of freight containers used in cross-border shipping. Just weeks ago, the three largest seaports -- Hutchison Whampoa, PSA, and P&O Ports -- announced plans to tag all containers used in trade with the United States. By 2007, Forrester expects 90% of the 10 million containers -- many of which are used in the importing and exporting of CPG raw materials and finished goods -- to have RFID tags.
- **Lower-cost tags.** Hardware manufacturers like Alien Technology have pioneered new production techniques, which -- when combined with economies of scale -- reduce the cost of tags to \$0.05.<sup>12</sup> Demand in manufacturing sectors outside of CPG -- like apparel, pharmaceuticals, and automotive -- should drive down costs to this price point by no later than 2004. This decrease in price will fuel case-level -- *not* item-level -- adoption within CPG, with the number of tagged cases growing from 160 million in 2004 to nearly 4.5 billion in 2005.

**Figure 4 Forecast: Global CPG Industry, RFID-Tagged Objects, 2002 To 2009**



Accelerator	Date	Description
①	2003	<b>Government regulation for cross-border trade.</b> G8 nations pass regulations calling for computerized customs inspections and quicker exchange of information on the contents of freight containers.
②	2004	<b>Software standards:</b> SAP, Savi Technology, and other software vendors standardize the middleware required for RFID supply chain deployments.
③	2004	<b>Data standards.</b> EPC/RFID pilots like the Town Test drive adoption of data standards for passive identification.
④	2004	<b>Lower-cost tags.</b> Tags reach \$0.05 with 1 billion chips produced for use across all manufacturing sectors.
⑤	2004	<b>Supply chain vendor's investments.</b> CHEP tags its wooden pallets and other reusable assets -- which means that 25% of the reusable logistics assets in the CPG supply chain are "intelligent."
⑥	2004	<b>Wal-Mart's support.</b> Once tags reach \$0.05, Wal-Mart pushes for RFID at pallet level -- and case level for products prone to stock-outs.
⑦	2005	<b>Other retailers' support.</b> Following the lead of early adopters, most retailers require RFID at pallet level -- and case level for products prone to stock-outs.
⑧	2006	<b>US food safety regulations.</b> Forrester expects Hazard Analysis and Critical Control Point (HACCP) regulations to drive RFID adoption for cases of perishable goods because of growing concerns about food safety.
⑨	2008	<b>Tags reach \$0.01</b> on the heels of case-level tagging, making feasible item-level tagging for goods like over-the-counter drugs, cosmetics, and cigarettes.

Source: Forrester Research, Inc.

- **Supply chain vendor's investments.** Firms like CHEP and Georgia-Pacific rent reusable logistics assets -- like pallets and plastic crates -- that are used in CPG trade. These firms are among the first RFID investors: Witness CHEP's Florida pilot involving 250,000 tagged pallets. Forrester expects these firms to expand on early tests and tag the bulk of their reusable assets over the next two years. The effect: 10% of the pallets that pass through the CPG supply chain in 2004 will be "intelligent." Watch for manufacturers and retailers to piggyback on vendor investments by using intelligent assets to monitor their own supply chain activities.
- **Wal-Mart's support.** At a recent Grocery Manufacturers of America (GMA) conference, Kevin Turner, CIO of Wal-Mart, pointed to RFID and UCCnet as the two technologies that will have the biggest impact on CPG trade. Just as Wal-Mart's endorsement of UCCnet has spurred an increase in adoption, so will its support of RFID drive adoption rates.<sup>13</sup> On the heels of lower-cost tags, Forrester expects Wal-Mart to call for case-level tagging of high-velocity goods -- with the intention of decreasing stock-outs.

### Smart CPG Products Emerge After 2008

As the adoption rate of RFID increases, Forrester expects that the technology will evolve in the CPG industry through four stages:

- 1) **2002-2003: Field tests generate early successes.** The lessons from today's RFID pilots -- like the Town Test and CHEP's Florida test -- will serve as the foundation for RFID deployments within the CPG industry. As a result, companies should expect data and middleware standards -- in the form of the Electronic Product Code and software agents -- to crystallize, thereby enabling a wave of full-scale RFID deployments in 2004.
- 2) **2004: Tagged logistics assets yield supply chain efficiencies.** Due to the near-term economics of RFID, CPG firms will start with full-scale RFID deployments on reusable assets like trucks, containers, and pallets. RFID tagging at this level will provide data on inbound logistics and warehouse operations -- but will not be as helpful for inventory management and demand planning, activities which are executed primarily at the case level. Thus, RFID will serve primarily as a tool for supply chain efficiencies in 2004.
- 3) **2005-2007: Case-level tagging enables adaptive supply networks.** As CPG firms roll out RFID for case-level visibility, they will tap a wealth of execution data that provides a real-time view of demand signals. This view will allow firms to create flexible "sense-and-respond" supply networks that allow them to shift production and distribution proactively to meet new demand (see the March 2002 Forrester Report "Adapting To Supply Network Change").<sup>14</sup>

**4) 2008+: Smart products revolutionize industry and consumer behavior.**

Not until tag prices fall to a penny or below will item-level tagging reach critical mass in CPG. In 2009, Forrester estimates that 2% -- of approximately 20 billion CPG products -- will have RFID tags. With this level of penetration, grocery retailer investments in RFID-enabled POS systems and store shelves will move out of test environments. Consumers will begin to notice applications -- like smart recycling and automated replenishment -- that change shopping, consumption, and waste disposal.

## ACTION

The focus on \$0.05 tags obfuscates total costs. Startup costs for technology and people match -- or exceed -- tag costs (see Figure 5). To make smart investments, firms should:



### **Purchase multiprotocol readers to reduce total costs.**

While RFID tests often use one type of tag, firms should choose multiprotocol readers -- which work with tags operating at different frequencies -- to ensure that initial investments apply to future supply chain deployments. Increasingly, these deployments will incorporate multiple types of tags as participating firms look to amortize infrastructure costs over a larger base of initiatives. Who can supply multiprotocol readers today? Vendors like SAMSys and ThingMagic.



### **Support distributed data processing and decision-making.**

Enterprise apps like Oracle 8i and SAP R/3 aren't set up to handle real-time RFID data. To manage the exponential increase in real-time events -- and support distributed decision-making -- firms must invest in "node-level" technologies like local databases, analytics, and adaptive agents. Vendors that can help include SAP, which developed agent technology with BiosGroup, and Cap Gemini Ernst & Young, which has an "adaptive supply chain" practice.



### **Recruit quantitative specialists to create business insights.**

Firms won't benefit from RFID investments without analytical frameworks that generate actionable insights. The good news: CPG firms are early adopters of data analytics -- 42% are deploying data mining software (see the March 2002 Forrester Report "Benchmark North America: Business Technographics® Data Overview").<sup>15</sup> To build on this investment, project managers should recruit quantitative specialists to translate raw RFID data -- like "truck carrying 100 cases of Tide left warehouse at 9:00 a.m." -- into business insight -- like "driver should take another route to reach distribution center on time."



### **Avoid flooding enterprise applications with RFID data.**

One exec gave telling stats on his RFID spending: \$500,000 for tags and readers, \$5 million for resources, and \$15 million to upgrade enterprise applications. To avoid the high costs of restructuring enterprise apps' data models, firms should pass critical insights -- not raw RFID data -- to back-office systems. P&G, for example, would update centralized marketing apps with an insight like "Make-Your-Own-Commercial promotion yielded 5% lift" -- not raw data like "8 cases of Vanilla Coke moved in Waco, Texas, H-E-B store #011 on July 11, 2002."

**Figure 5 Tag Costs Are The Tip Of The RFID Iceberg**

Tags	Readers	Local software and infrastructure	Enterprise application integration
		<p>Local server</p>	<p>Integration server</p> <p>ERP</p> <p>SCM</p> <p>CRM</p>
<b>Function</b>			
<ul style="list-style-type: none"> <li>• Hold data</li> <li>• Transmit data using radio waves</li> </ul>	<ul style="list-style-type: none"> <li>• Read tags</li> <li>• Transmit data to local systems</li> </ul>	<ul style="list-style-type: none"> <li>• Store EPC data</li> <li>• Manage local events</li> <li>• Translate raw data into business insights</li> </ul>	<ul style="list-style-type: none"> <li>• Route critical business insights to enterprise applications</li> </ul>
<b>Cost</b>			
<ul style="list-style-type: none"> <li>• Item/case/pallet label tags: \$0.20 to \$1.00 each</li> <li>• Truck/container active tags: \$5.00 to \$10.00 each</li> </ul>	<ul style="list-style-type: none"> <li>• Portal readers: \$2,000 to \$6,000</li> <li>• RFID-enabled handhelds: \$200 to \$1,000 each</li> <li>• RFID-enabled shelves: \$100 per shelf</li> </ul>	<ul style="list-style-type: none"> <li>• Local servers and software: starts at \$5,000, based on number of events</li> <li>• Systems integration: starts at \$10,000, based on number of events</li> </ul>	<ul style="list-style-type: none"> <li>• Variable costs: can run several million dollars if significant changes must be made to enterprise applications</li> </ul>
<b>Key vendors</b>			
<ul style="list-style-type: none"> <li>• Alien Technology</li> <li>• Intermec Technologies</li> <li>• Philips Semiconductors</li> <li>• Texas Instruments</li> </ul>	<ul style="list-style-type: none"> <li>• Intermec Technologies</li> <li>• Matrics</li> <li>• SAMSys Technologies</li> <li>• Symbol Technologies</li> </ul>	<p>Software:</p> <ul style="list-style-type: none"> <li>• SAP/BiosGroup</li> </ul> <p>Systems integration:</p> <ul style="list-style-type: none"> <li>• ConneCTerra</li> <li>• Accenture</li> <li>• PwC Consulting</li> <li>• Cap Gemini Ernst &amp; Young</li> </ul>	<p>Software:</p> <ul style="list-style-type: none"> <li>• Vitria Technology</li> <li>• SeeBeyond Technology</li> <li>• Microsoft</li> </ul> <p>Systems integration:</p> <ul style="list-style-type: none"> <li>• Accenture</li> <li>• PwC Consulting</li> </ul>

Source: Forrester Research, Inc.

## WHAT IT MEANS

Over the next 20 years, RFID's rise will bring:



### **A new definition of customer in CPG.**

Detailed consumer data will redefine the CPG “customer” -- which means retail accounts to most manufacturers. With this data, manufacturers will increasingly own and manage inventory up to the point of sale. Existing buying and selling practices -- like trade promotions and slotting fees -- will give way to automated replenishment triggered by consumer demand. Grocers will then base profits on compelling shopping experiences -- using in-store technologies to offer targeted consumer promotions, convenient checkout, and optimized merchandising.<sup>16</sup>



### **A reconsideration of traditional economic indicators.**

To cut inventory-carrying costs, US firms are deferring orders -- destabilizing leading indicators like capital-goods orders.<sup>17</sup> But this is more than a temporary phenomenon. RFID offers precise execution data, greasing the skids for “sense-and-respond” supply networks. In this environment, the inventory-to-sales ratio -- which has fallen over the past decade due to just-in-time practices -- will drop further.<sup>18</sup> As a result, the Federal Reserve Board and the Institute for Supply Management will rethink existing indicators -- which gauge large customer orders, inventory levels, and backlogs, rather than production flexibility.



### **Self-regulating smart products.**

Even the most elegant RFID tags are too obtrusive to attach to small objects -- like labels on fruit, ball bearings, or individual pills. New production processes -- developed by Alien Technology and E Ink— will yield chips the size of dust particles, conductive inks that replace clunky antennas, and sensory devices that don't need batteries.<sup>19</sup> New smart products -- like self-regulating machines and medicines that warn doctors and patients of prescription noncompliance -- will further blur the boundaries between information and the physical world.<sup>20</sup>



### **Fewer “wrongful” deaths and better quality of care.**

A 2000 report by the Institute of Medicine estimates that preventable medical errors cost the healthcare industry \$17 billion annually. RFID tags -- which are capable of holding a patient's full medical history or a drug's dosage instructions -- will reduce common errors like mistakes in treatment and diagnosis. As a result, the healthcare industry gains efficiencies. But more important, people will benefit from effective care and a lower probability of life-threatening errors.

## RELATED MATERIAL

### Online Resource

The underlying spreadsheet detailing the forecast in Figure 4 is available by clicking the online “Get Data” button above the figure.

### Methodology

In addition to the companies listed below, we spoke with three additional CPG retailers and manufacturers with revenues of more than \$9 billion.

### Companies Interviewed For This Report

Accenture  
[www.accenture.com](http://www.accenture.com)

Alien Technology  
[www.alientechnology.com](http://www.alientechnology.com)

Auto-ID Center  
[www.autoidcenter.org](http://www.autoidcenter.org)

Checkpoint Systems  
[www.checkpointsystems.com](http://www.checkpointsystems.com)

CHEP  
[www.chep.com](http://www.chep.com)

ConnecTerra  
[www.connecterra.com](http://www.connecterra.com)

Electronic Data Systems  
[www.eds.com](http://www.eds.com)

Genesta  
[www.genesta.net](http://www.genesta.net)

Georgia-Pacific  
[www.gp.com](http://www.gp.com)

GlobeRanger  
[www.globeranger.com](http://www.globeranger.com)

Intel  
[www.intel.com](http://www.intel.com)

Intermec Technologies  
[www.intermec.com](http://www.intermec.com)

Land O'Lakes  
[www.landolakes.com](http://www.landolakes.com)

Microchip Technology  
[www.microchip.com](http://www.microchip.com)

Peapod (Ahold)  
[www.peapod.com](http://www.peapod.com)

Philips Semiconductors  
[www.semiconductors.philips.com](http://www.semiconductors.philips.com)

Procter & Gamble  
[www.pg.com](http://www.pg.com)

PwC Consulting  
[www.pwcconsulting.com](http://www.pwcconsulting.com)

SAMSys Technologies  
[www.samsys.com](http://www.samsys.com)

SAP  
[www.sap.com](http://www.sap.com)

Savi Technology  
[www.savi.com](http://www.savi.com)

Science Applications  
International Corporation  
(SAIC)  
[www.saic.com](http://www.saic.com)

Scottish & Newcastle  
[www.scottish-newcastle.com](http://www.scottish-newcastle.com)

Symbol Technologies  
[www.symbol.com](http://www.symbol.com)

Tesco  
[www.tesco.com](http://www.tesco.com)

Texas Instruments  
[www.ti.com](http://www.ti.com)

ThingMagic  
[www.tbthingmagic.com](http://www.tbthingmagic.com)

Uniform Code Council  
[www.uc-council.org](http://www.uc-council.org)

Unilever  
[www.unilever.com](http://www.unilever.com)

WhereNet  
[www.wherenet.com](http://www.wherenet.com)

X-ident  
[www.x-ident.com](http://www.x-ident.com)

### Related Research

July 16, 2002 Forrester Brief “Paying With RFID, Smart Cards, And Biometrics”

May 6, 2002 Forrester Brief “RFID Redefines The Retail Supply Chain”

May 2002 Forrester Report “Cutting The Fat Out Of CPG Logistics”

May 2002 Forrester Report “Invisible Mobile Reignites Mobile Telecom”

March 2002 Forrester Report “Adapting To Supply Network Change”

December 2001 Forrester Report “Collaborating For CPG Success”

April 2001 Forrester Report “Retailers Reshape CPG Trade”

## G R A P E V I N E

### **Barbie gets a brain.**

Forrester came across some truly bizarre intelligent devices during our report research. One example: an “intelligent” Barbie-esque doll that can shop for her own clothing and accessories. The way it works: The doll has an embedded reader that scans RFID-tagged objects of desire -- like a pink convertible mustang. The doll can purchase products it has “seen” using its electronic wallet and a short-range wireless connection to its owner’s home PC. Our take on this intelligent Barbie: There’s a first time for everything.

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### **Finding the missing sponge.**

Speaking of interesting new RFID applications, we came across a small company, Surgical Resources, that has patented an RFID-tagged surgical sponge. The goal is to reduce the number of patients that suffer adverse reactions -- even death -- when a surgical team fails to remove all the sponges used in a procedure. Forrester applauds the makers of the “intelligent” sponge for their obvious contribution to patient care. But we see an added bonus: more bad news for personal injury lawyers.

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### **How to stop online grocery customers in their tracks.**

Safeway -- which is ramping up online grocery services on the West Coast -- has one thing right: providing the same prices on its Web site that it does in stores. The catch? Shoppers don’t know if the online price they see is the price that they’re going to get. While perusing the Web site, we found the following terms and conditions: “[Prices quoted on the site] are guide prices only. The actual price you pay will be the price charged in store at the time your order is picked for delivery.” So, how much could the bill vary? There’s no safe way to determine -- until you see your bill.

# ENDNOTES

- 1 Since an RFID tag can hold hundreds of characters of information -- compared to the bar code, which holds between 12 and 15 -- it can identify the individual product, versus just the SKU.
- 2 In addition, Scottish & Newcastle uses RFID-tagged beer kegs to identify -- and stop -- pub owners who buy beer from unsanctioned wholesalers. But the most surprising benefit of all involves export duties on beer. The UK government exacts these duties based on the alcoholic content of beer. In the past, the breweries lacked a method to identify the alcoholic content of the dregs that remained in the keg -- thereby preventing them from reclaiming duties for this unconsumed beer. Since it uses RFID to identify the alcoholic content of the dregs, Scottish & Newcastle can make a legal claim to collect these duties.
- 3 More than half of CPG firms rely on the phone or face-to-face meetings to conduct most logistics activities. Less than 5% of logistics budgets go to new technology investments.
- 4 The goals of the Town Test are: 1) to learn more about how RFID technologies and data standards work, and 2) to discover the real benefits of RFID. Participating firms like Procter & Gamble, Unilever, Kraft Foods, Coca-Cola, and Wal-Mart are testing RFID at a SAM'S CLUB in Tulsa, Okla. Phase one of the test involved pallet-level tagging, phase two involves case-level tagging, and phase three will involve item-level tagging.
- 5 Companies like McDonald's and Stop & Shop Supermarket are eager to reap the benefits of RFID payment devices. McDonald's is using Speedpass wands in Chicago-area restaurants, and Stop & Shop has announced plans to use Speedpass for payment and loyalty programs.
- 6 Up to 20% of all foods are discarded from spoilage due to inadequate control in the distribution system. Source: Food and Drug Administration (FDA).
- 7 Interviews with CPG manufacturers and retailers revealed that promotion planning, category management, forecasting, sales tracking, and logistics are done primarily over the phone or in person.
- 8 High levels of inefficiency are due, in part, to low levels of technology investment. But CPG companies are ramping up technology investments to drive supply chain efficiencies. In 2001, CPG manufacturers and retailers projected their 2002 technology spending across three supply chain categories: procurement apps, ERP, and supply chain apps. They planned to spend 14%, 12%, and 8% more than the cross-industry benchmark in each respective category.
- 9 Comment made by Steve David, CIO of Procter & Gamble, at BiosGroup's conference in Chicago on June 26, 2002.
- 10 In an effort to collect shelf-level movement data, Revlon has teamed with International Paper and SAMSys Technologies to pilot "smart packaging" and RFID-enabled shelves.
- 11 As early as 1969, the Grocery Manufacturers of America (GMA) called for a standardized code for products. But it took three key events for the bar code to take off worldwide: 1) the federal government instituted new requirements for nutritional labeling on food containers (1973);

- 2) the Universal Product Code (UPC) chose the linear bar code as the standard symbology (1973); and 3) the European Article Numbering (EAN) association developed a code compatible with UPC -- thus creating a worldwide standard (1977).
- 12 Alien Technology has developed a technique called “fluidic self-assembly” that maximizes the number of chips on a silicon wafer. This is an effective cost savings technique, since a wafer typically costs between \$1,000 and \$3,000 (\$US). This technique also makes it easier to attach these small chips -- which are roughly 4 microns in size -- to an antenna and other tag materials.
- 13 The number of companies subscribing to UCCnet’s global registry grew to more than 100 CPG manufacturers and retailers -- fueled by the April 4, 2002 letter in which Wal-Mart, among other manufacturers and retailers -- called for industry adoption.
- 14 Forrester calls this model “adaptive supply networks.” Adaptive supply networks support continuous adaptation by allowing manufacturers to: 1) sense and interpret data and leading indicators; 2) decide and act on the data based on risk and opportunity; and 3) learn and transform processes based on new business insights.
- 15 By comparison, only 30% of the cross-industry benchmark are piloting or rolling out data mining software.
- 16 Forrester’s upcoming report “Building Smarter Stores” will provide more detail on new in-store technologies that change the shopping experience (please note that the report title is subject to change).
- 17 Witness the wild swings in capital-goods orders: up 4.6% in February, down 3.1% in March, and up 1.9% in April of this year.
- 18 Over the past decade, the US inventory-to-sales ratio has fallen from 1.53 in 1993 to 1.36 in May of 2002.
- 19 Forrester’s upcoming report “Building The Nanotech Industry” will look at the role of nanotechnologies in solving business problems over the next 15 to 25 years (please note that the report title is subject to change).
- 20 Source: *The New York Times*, “Improved Drug Regimens Help Patients Take Their Medicine,” July 16, 2002. This article illustrates the literal life-or-death benefits of drug compliance -- citing studies that indicate that people who take HIV medications 94% of the time are half as likely to suppress the virus as those who always take their medications.