

**LIFE SCIENCES INDUSTRY VISION:
LABORATORY AUTOMATION THROUGH A
SMART INVENTORY MANAGEMENT SYSTEM**

TERSO SOLUTIONS



LABORATORY AUTOMATION THROUGH A SMART INVENTORY MANAGEMENT SYSTEM

AN INDUSTRY VISION FOR LIFE SCIENCES

SUMMARY

As the life sciences industry continues to grow, there is an emergent trend toward the need for a real-time, automated, and integrated supply chain based on the concept of a Smart Inventory Management System. The life sciences industry is burdened with many manual and outdated processes that create difficulties for staff and company operations. It is important to determine proactive, value-based solutions that create significant changes in workflows and efficiencies. To better understand what is driving the need for change within the life sciences industry, it is helpful to first define the key issues.

KEY ISSUES AFFECTING THE LIFE SCIENCES INDUSTRY AS A WHOLE

- Manual processes inundate workflows and create errors, hurt customer relationships, drive up costs, and ultimately create burdened environments for employees.
- Temperature monitoring of items in storage and during transportation is needed to ensure product integrity and facilitate regulatory compliance.
- Many organizations are looking for an e-commerce experience that enables them to purchase scientific products online.
- An integrated supply chain, in which all key players (i.e. labs, manufacturers, and distributors) can share real-time information, is necessary to the entire value chain.
- Real-time visibility is becoming more necessary for quick, accurate, and efficient inventory availability and usage data.

Terso defines “life science” as any company in the fields of biotechnology, pharmaceuticals, biomedical technologies, life systems technologies, nutraceuticals, cosmeceuticals, food processing, environmental, biomedical devices, and organizations and institutions that devote a majority of their efforts in research, development, technology, and commercialization.

The life sciences industry as a whole encompasses a surplus of markets, applications, and individual focuses. This report will focus on just one critical component of the overall industry - laboratories that support life sciences. In taking a deeper look into the overall laboratory market, this report will define key issues for labs as well as highlight how to begin envisioning, designing, and building a Smart Inventory Management System to address critical challenges like costs, operations, safety, compliance, and customer support.

LABORATORY MARKET SEGMENT OVERVIEW

Laboratory end-user markets include a wide range of public and private sectors, as well as a number of functions and activities. For example, academic labs include both private and government-run educational institutions. Government testing labs include regulatory bodies like the EPA and FDA. Below is a chart detailing the various segments in the lab market. These include “lab functions” which define the application of a lab’s scope of work, whereas “lab activities” identifies the emphasis of individual labs, regardless of industrial or nonindustrial origin. For example, one aerospace lab could engage exclusively in materials analysis, while another in the same industry might emphasize environmental testing. These distinctions are important, particularly when describing labs in large, diverse industries such as biotechnology and pharmaceuticals, that run the gamut of applications. Differentiating them according to the application provides a much more accurate picture of the real-world lab market.

| LABORATORY INDUSTRIES | | LABORATORY FUNCTIONS & APPLICATIONS | LABORATORY ACTIVITIES & FOCUS |
|-----------------------|---------------------|-------------------------------------|-------------------------------|
| Pharmaceutical | Oil/gas | Basic research | Materials analysis & testing |
| Academic | Biotech | Applied research | Pharmaceuticals |
| CRO's | Government research | Analytical service | Biotech |
| Government testing | Environmental | Quality control/assurance | Medical |
| Metals/mining | Food/agriculture | Methods development | Environmental |
| Hospital/clinical | Paints/coatings | Teaching/other | Forensics/criminology |
| Chemical | Utilities | | Research & development |
| Polymers/plastics | | | Education |

KEY CHALLENGES FOR LABS

Labs continue to struggle with limited funds, cost pressures, economic uncertainty, demand for value-based outcomes, and a changing regulatory environment. Since 2004, the National Institutes of Health funding to labs has decreased by more than 20 percent. To cope with shrinking funds and growing cost pressures, labs have tightened their budgets and are focused on keeping costs down. "Most laboratories are significantly concerned about cost reductions," according to Frost & Sullivan's Mid-Year 2017 LPA End User Trends Survey.

Labs across the life sciences spectrum maintain a large repository of scientific products such as reagents, biologics, vaccines, blood products, and chemicals, in an effort to guarantee the items are on-site when needed. Managing this large stock of inventory manually is time-consuming, error-prone, and typically results in costly overstocks and waste due to expired products. It can also result in stock-outs, in which case labs must pay for expensive overnight shipping.

Labs continue to face many challenges, which include:

- **Administrative burden:** Many labs are currently relying on expensive assets to handle manually reconciling and tracking inventory versus performing critical tasks. Performing routine work for inventory management can amount to hours, days, and even weeks of time lost on other science-based work such as research and product development. When faculty are burdened with an overwhelming amount of non-value added activities, not only does work productivity suffer, so does morale.
- **Operational costs:** Expenses related to the operation of a laboratory include not only the physical products, but the costs associated with managing that inventory – this means staff, shipping, equipment, logistics, expired or missing product loss, and any resource used by the lab to maintain operations. When manual processes are the main focus of a management system, errors and costs increase.
- **Manual workflows:** Most labs rely on a manual, paper-based system to track who took what item and when, which typically results in faulty record-keeping. It is difficult to read bar codes on products that have been handled multiple times or stored in refrigerators or freezers, due to condensation or frost.
- **Lack of visibility:** The lack of visibility into product inventory leads to several problems, including faulty billing and losses in revenue. Locating products and verifying information for audits is time-consuming and error-prone. Inaccurate documentation of chain of custody results in compliance issues. It is also difficult to quickly identify recalled products and remove them from inventory.
- **Product integrity:** Reagents and other scientific products must be stored and transported at cool temperatures. Temperature fluctuations can occur—both in the products and the refrigerators and freezers in which they are stored—when technicians open the cold storage searching for specific items and when conducting inventory. Manually checking refrigeration units and documenting temperatures for compliance is time-consuming and inefficient.

- **Regulatory compliance:** It is imperative that labs, like all life science organizations, comply with strict guidelines and parameters put in place by regulatory bodies such as the FDA and EPA. Labs must ensure best practices and meet increasing pressures. It is vital that labs have the right staff and procedures in place with the necessary knowledge and resources to comply. Accurate record keeping is central in the chance of an audit, recall, chemical spill, or safety issue; and, in many cases manual records are not kept up to date nor do they include the necessary documentation required by regulatory bodies.
- **Shrinkage:** Inventory shrinkage, due to lost or missing items, is a common problem for logistics. Products are often taken from shelves, coolers, and rooms without being checked out. Many labs stock sensitive materials or controlled substances that must be monitored to comply with safety standards. Labs conducting clinical trials are required to collect and document chain-of-custody information.
- **E-commerce capabilities:** Lab researchers want to focus on their work and not spend time counting and managing supplies. Most also want to purchase products online from manufacturers or distributors. Labs are not easily able to participate in these types of programs currently because they are not able to sell enough volume. There is an inability to pass industry prices and deals on to consumers or partners.

“Labs want the same experience when purchasing lab products online that they have with online retail purchasing,” according to Frost & Sullivan’s 2013 Global Laboratory Products Purchasing Trends poll. The trend toward an e-commerce experience was confirmed in Frost & Sullivan’s 2015 Global Laboratory Products Purchasing Trends poll. “Purchasing online from distributors offering multiple brands is the preferred way to buy laboratory products,” according to Frost & Sullivan’s Mid-Year 2017 LPA End User Trends Survey.

According to the Laboratory Products Association, the lab market had a total global market size of \$14.8 billion in 2016 and is expected to grow by 2.8% by the end of 2017, with an estimated CAGR of 2.9% by 2019. With the growing market, so grow the pressures that labs face. The need for an automated, data-driven model becomes even more evident as labs begin to look for ways to meet new demands and pressures.

LABORATORY PRODUCT ASSOCIATION GLOBAL MARKET FOR LABORATORY PRODUCTS

Laboratory Products Growth Forecast by Region/Country, Global 2016–2019

| | 2016 Final Growth Rate | 2017 Forecast Growth Rate | 2018 Forecast Growth Rate | 2019 Forecast Growth Rate | Overall Trend 2016–2019 |
|----------------------|------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------------|
| Global | 2.4% | 2.8% | 2.8% | 3.0% | ▲ |
| US | 2.5% | 3.2% | 3.0% | 3.0% | ▲ |
| Canada | 1.5% | 2.0% | 2.3% | 2.3% | ▲ |
| Europe | 1.5% | 1.9% | 1.7% | 2.0% | ▲ |
| India | 8.4% | 8.6% | 8.8% | 8.8% | ▲ |
| China | 7.8% | 7.6% | 7.5% | 7.3% | ▼ |
| Japan | 1.5% | 1.5% | 1.0% | 1.2% | ▼ |
| Mexico | 2.5% | 1.8% | 2.0% | 2.2% | ▼ |
| Brazil | (10.0%) | (25.0%) | 0.0% | 0.0% | ▲ |
| Rest of World | 2.0% | 2.2% | 2.5% | 2.6% | ▲ |

| | | | |
|-----------|-----------------|-------------|-----------------|
| Trend Key | Decreasing ▼ | Stable ● | Increasing ▲ |
|-----------|-----------------|-------------|-----------------|

Source: Frost & Sullivan

It is important to note that a critical component of laboratory management is the role played by manufacturers and distributors of reagents, biologics, and other scientific materials. These companies also face internal inventory-management problems, including shrinkage, waste from spoilage and expired products, and the inability to quickly respond to recalls. Manual inventory management leads to inaccuracies in billing and reporting.

In the 2017 Laboratory Products Association survey, respondents said manufacturers could help labs with complex purchasing procedures by introducing new, innovative platforms for purchasing equipment. They also believe that automating processes to reduce labor costs could help them cope with budget shortfalls.

KEY CHALLENGES FOR MANUFACTURERS AND DISTRIBUTORS

- **Selling on consignment:** It is labor-intensive and inefficient to service customers that want to purchase products on consignment.
- **Lack of visibility:** Manufacturers and distributors lose sight of inventory as soon as it leaves their facility, and must send representatives to labs to monitor product usage.
- **E-commerce capabilities:** Companies are not prepared to meet their customers' online shopping preferences with the current manual workflows.
- **Compliance and recall management:** With many impending and growing regulations from governing bodies, such as The Joint Commission and the U.S. Food and Drug Administration, manufacturers and distributors must know what items went where and when, to accurately and quickly manage recalled items or demonstrate compliance.

THE SOLUTION: A COLLABORATIVE APPROACH TO SMART INVENTORY MANAGEMENT

Labs have an opportunity to address all of these issues by adopting a Smart Inventory Management System that automatically monitors products in real-time. Collaborating with supply chain partners delivers additional benefits.

A Smart Inventory Management System for Lab Automation

- Provides real-time visibility into the location and status of scientific materials
- Tracks who used what products and when
- Monitors products' temperature and issues alerts if they fall outside of set parameters
- Monitors products' expiration dates
- Simplifies purchasing on consignment
- Automates replenishment and invoicing
- Monitors products in transit for temperature and to ensure chain of custody
- Enables an e-commerce platform for purchasing products

A Smart Inventory Management System uses real-time data and next generation technology to sense the need for change in workflows and processes. It works to eliminate waste and latency inherent in many manual processes we see today in labs, while improving workflows, safety, compliance, item tracking, and business operations.

The adoption of automated systems can already be seen in industries such as healthcare, retail, and manufacturing to improve operational efficiencies and consumer experience.

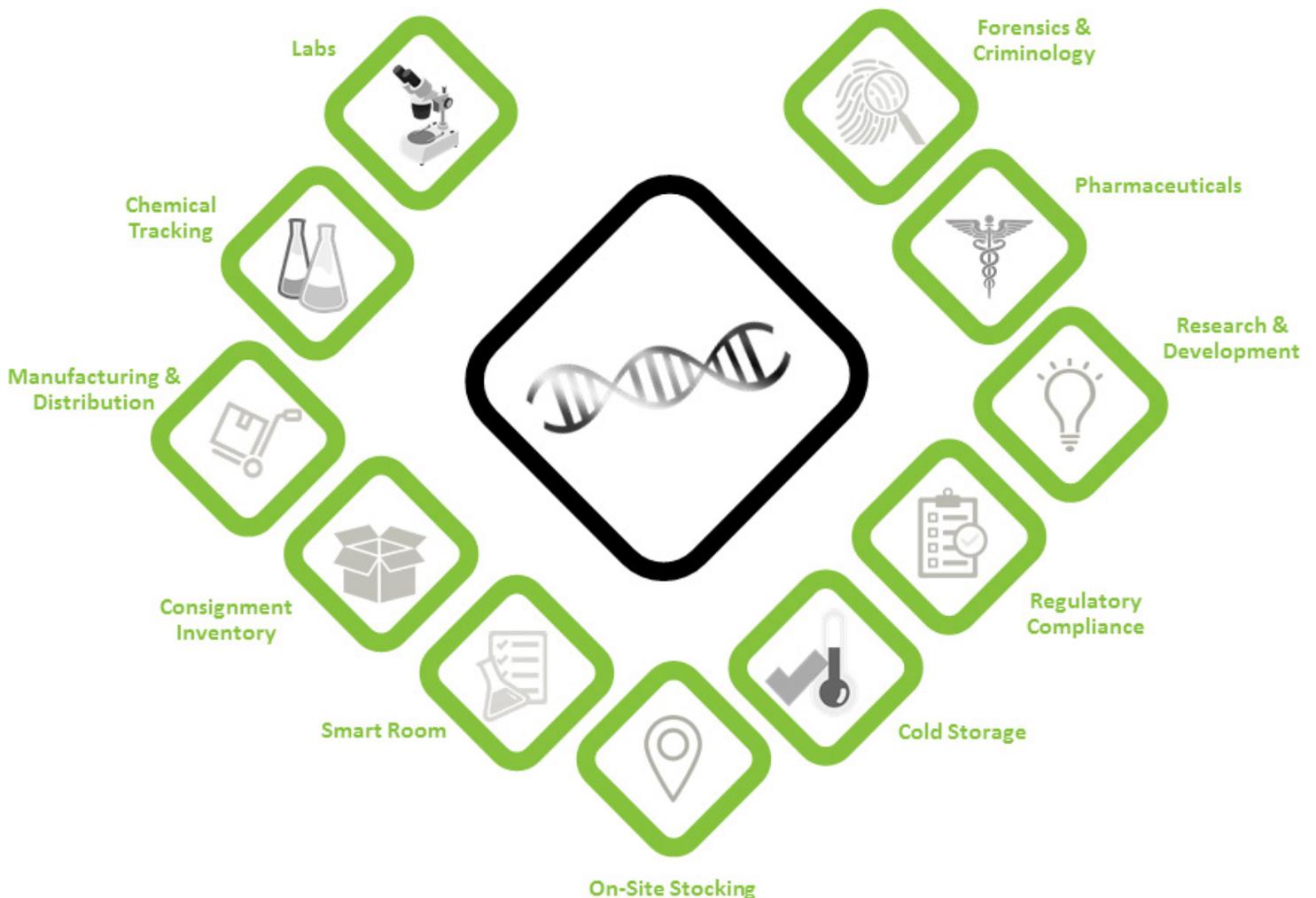
A Smart Inventory Management System features ultra-high frequency (UHF), Generation 2 radio frequency identification (RFID) technology to automatically identify and locate individual items. UHF Gen 2 RFID (also called RAIN) is an inexpensive wireless technology that complies with the universally adopted global ISO 18000-63 standard.

SMART INVENTORY SYSTEM WORKFLOW

- Individual products are identified with RAIN RFID tags
- Users are identified with badges
- Cabinets, refrigerators, and freezers (often referred to as “enclosures” or “sensors”) are fitted with RFID readers to read the tags and badges and monitor temperature
- Stockrooms are outfitted with mounted RAIN RFID readers and a check-in/check-out station for automated and seamless transactions
- RAIN RFID handhelds are used to quickly read tags on shelves or storage areas and to find and verify items
- RAIN RFID mobile cases monitor the additions or removals of tagged items while in the field

A Smart Inventory Management System communicates data from the RFID devices to the cloud, where the information can be stored, managed, and shared via the Internet. The data can be integrated with business application software to enable automatic replenishment, invoicing, and procurement. Inventory managers can visit a secure website to track product use and workflow, and to quickly access reports for compliance, audits, recalls, and other issues. This can also be integrated with existing business systems and EHR’s for simplified workflow.

SMART INVENTORY MANAGEMENT SYSTEM: LABS



To see how this works, consider Promega, a provider of life sciences products, which, in 2012, reported \$1.7 million in savings from using a Smart Inventory Management System featuring RAIN RFID refrigerators and freezers. Before adopting the system, Promega (of which Terso is a subsidiary) said it was losing roughly 15 percent of its on-site inventory to shrinkage each year, and that it had to write off approximately \$400,000 of expired products annually. In addition, the company had no visibility into how products were stored at customer sites, and wrote off \$100,000 annually due to product spoilage. Beyond the cost savings, the information Promega captured from automatically tracking products enabled the company to improve customer service. Hundreds of Promega customer sites worldwide use RFID refrigerators and freezers to store and monitor products. Promega reports their labs have eliminated all paperwork associated with purchasing, accessing, tracking, monitoring, and reordering reagents—and that, in turn, has reduced lab costs and increased researchers' productivity.



As well, a large research-based institution has implemented an automated, RFID-based solution to reduce shrinkage, write-offs, and lab check-out times for scientists. By adding this smart inventory system, this research institute saw a 70% reduction in shrinkage and expired products which minimized operational costs associated with write-offs and missing inventory. Scientists were able to eliminate hundreds of hours of work that were previously spent locating products, sometimes with no success. In turn, program-specific budgets were better allocated and waste and safety issues were no longer a concern. Organizations in the life science fields can greatly benefit from implementing a Smart Inventory Management System.

INTERNAL BENEFITS

With a Smart Inventory Management System, many administrative duties are eliminated and thus reduce operational costs and improve safety. The process is simple.

- **Inventory management process:** RFID-tagged scientific materials are stored in cabinets, refrigerators, freezers, or stockrooms equipped with RFID readers. Lab staff use RFID badges as identification for tracking purposes. To access a product, users swipe their ID badge in front of an enclosure, remove the item and get to work. The system automatically records the date and time the item is removed and by whom. When items are removed or returned, the system automatically updates inventory software. No time is spent physically recording or checking-in or –out products.
- **Safety and compliance:** The system automatically collects and records data required to meet safety and compliance regulations, and provides accurate information for audits. The enclosures track products' expiration dates, eliminating waste. The refrigerators and freezers monitor products' temperatures and issue alerts if they fall outside of set parameters. In the event of a recall, products can be located quickly and removed from inventory.

LABORATORY SUPPLY-CHAIN BENEFITS

When labs adopt Smart Inventory Management, the system provides real-time visibility into the location and status of products throughout the value chain. This includes automating the chain of custody from point of manufacture to use in the lab.

- **Improving operations:** Real-time inventory data from labs is shared securely with manufacturers and distributors, automating invoicing and eliminating billing errors.
- **Reducing costs:** The system automates consignment purchasing, eliminating overstocks, stock-outs, and expensive shipping fees. Manufacturers and distributors reduce labor costs, because company representatives do not have to visit labs to manage on-site product consignments.
- **Establishing e-commerce platform:** Smart Inventory Management used in conjunction with an e-commerce platform provides significant benefits for those who want to shop for life sciences products online. Instead of visiting multiple vendor sites, they can view a variety of products and easily manage accounts. RFID enclosures at labs can communicate with RFID enclosures at a central distribution site, for inventory management and fast delivery at reduced shipping costs.

THE FUTURE IS HERE

The healthcare sector is beginning to adopt the Smart Inventory Management concept in hospitals, at manufacturing and distribution centers, in surgery centers, and dental offices to alleviate the burden of traditional, manual inventory management techniques and improve workflows, enhance employee satisfaction, save money, and increase patient experience. The life sciences industry must develop strategies to address internal and external challenges in a similar fashion. A Smart Inventory Management System provides business intelligence and automation which frees up employees to focus on doing the job they were meant to do.

ABOUT TERSO SOLUTIONS, INC.



TERSO™
SOLUTIONS, INC.

Terso Solutions, Inc. is the leading provider of automated inventory management solutions for tracking high-value medical and scientific products in healthcare and life science. Terso Solutions, Inc. is backed by 18 years of RFID product development and implementation experience. Our product line includes RAIN RFID cabinets, refrigerators, freezers (-20C to -80C), smart rooms, and mobile solutions. Terso has deployed over 1,800 RAIN RFID-enabled sensors worldwide.

Headquartered in Madison, WI, Terso Solutions is a wholly-owned subsidiary of the Promega Corporation. We have grown significantly since our start in 2005, including the launch of Terso Solutions GmbH based in Mannheim, Germany. Despite our growth, the principles and values that guided Terso in the beginning still serve us today.