

Bar Code/Sample Tracking – “It All Starts with the Label”

How many times have you heard of a company implementing a new tracking system only to find that it is not providing the expected benefits, or that the company has stopped using the system because of printing, scanning or labeling issues? In the majority of these cases, what you will find is that LIMS implementation was designed and pulled together over many months or longer, but the labeling aspect was reserved for the very end, almost as an afterthought.

This approach is why so many systems fail. Much of the time problems evolve because people find themselves in a scramble trying to pull together a last minute, less than optimal, solution; all because they failed to understand the importance of this small, but critical piece. You see the label is the most important part of the sample tracking process. Without it, the entire system is doomed to failure. How can one capture the results of a test if the bar code or label identifying that sample is not present or legible? For this reason we have devoted this entire article to the various elements of bar code and/or sample printing. Our goal is to provide a checklist for thinking through the labeling process and how it will serve the specific requirements of the customer.

The foundation of any tracking system is the label and to truly understand what you need in a label, you need to define its function. The most important aspect is to get consensus on what you want to appear on the label, including both bar coded and human readable information. For the bar code you will need to identify how many characters you will require, including any prefixes or suffixes and whether the characters are alpha, numeric or both. This information will help you determine how big your label needs to be and what symbologies you will need to consider from a bar coding aspect. This information coupled with the information below, will help you determine what printer and scanner options are available to you based on the bar code mil size and/or symbology needed.

The next step is to design a Sample Flow Chart. This needs to be done for every application you have. Below is a step by step process for laying out your flow chart.

1. Start with the physical location where you plan on printing the labels. Will it be in a central print location or will there be printers throughout your lab/facility or even outside your facility? This will help you decide if a server or web based printing solution is right for you.
2. What is being labeled (also called the substrate) and at what point in the process? For instance, sometimes the labels are printed in advance and put into a kit where the vials are actually labeled sometime later. This also begs the question of whether you want to print multiple copies of a label and if so how many? If this is the case, then you may want to consider multi-part, multi-up or piggyback labels. These label configurations can also allow for labeling a substrate(s), as well as test requests or other documents.
3. Substrate characteristics – glass, plastic, etc.; flat/round; smooth/rough; shape and dimensions.
4. What is the size of area you have available for labeling? For instance, some tests require the ability to see inside the tube or container thus limiting the size or type of label that can be used.
5. What is the application environment? This applies to the temperature of the room and substrate at the time of application. Is the sample pre-frozen? Also, are there any other special requirements such as chemicals, water, etc. that the label might come in contact with at the point of application?
6. What is the service environment? What are the processes that the sample will go through once it is labeled? This would involve temperatures (-80°C) and/or processes – autoclave, clean room, freeze thaw cycles, liquid nitrogen, hot water bath, chemicals, solvents or other special conditions. Will the sample be inserted into instruments or trays that would necessitate a thin label material?

7. As you define the environments you will also need to chart every area where you plan to scan or enter data from the sample. This will help you determine where you want scanners and what the requirements of those scanners will be. For instance, do you want hands-free or omni-directional scanning at any point? What are the anticipated scan distances? Do you want cordless or batch scanners or will you be using scanners connected directly to your PC or Terminal? If so how do you want to connect them (USB, Keyboard Wedge, Serial, etc)?
8. Finally, where does the labels' life cycle end? Does the substrate get thrown away or is it reused. If reused, you need to consider a removable label. Is the label pulled off the container and applied to paperwork or another substrate? If so, you may want to test a piggyback label construction.

After defining your label applications, you should think about any future applications that you may have. For instance, are there certain labeling requirements that you may need to meet in the future, such as the RSS Code (Reduced Space Symbology) or other labels, sizes or layouts you are currently considering? If so, you will want to make sure the equipment you choose is capable of addressing those future needs.

Once you have defined the label applications and given consideration to future needs, it is time to start thinking about which print method is best for your application. Some of this may have been decided for you by the information you captured above, because certain materials are not available for all print methods. However, there are other key questions that need to be answered to help define your needs.

Key Questions:

- Will you be printing labels on demand or in batches?
- Do you want to print from a PC, Network or the web?
- Does the data on the label contain sample specific information? If so, does the sample already exist or is the substrate being labeled prior to the sample being taken?

What print options are available:

1. Preprinted Labels

- Excellent for serialized or predefined data labels utilizing specialty materials where quantities do not justify the expense of investing in a printing system and/or software, or where accounts do not want to be invest time in printing labels. This is often the case with sample kits or where labels are packaged with the study instructions.

2. Direct/Thermal Transfer Desk Top Printers

- Various industrial and desk top models are available with resolution ranging from 203 to 600dpi (Dots per Inch), print widths from 2” to 8.5” and print speeds from 2-12ips. These printers are designed solely for label printing and thus provide consistent quality whether printing in batch or on-demand.
- These Printers can print linear and 2D codes (Exact 2D symbologies are model dependent)
- The widest variety of specialty label materials are available for this printer type.
- Extreme flexibility in label design and printing - multi-part, multi-up and piggyback options

3. Portable Direct/Thermal Transfer Printers

- Where portable printing is desired.
- Most models are limited to Direct Thermal Printing only, though a few Thermal Transfer models do exist, but these have smaller label roll capacity due to the addition of the ribbon.
- Portable printer limitations include: Label size, 203 dpi print density, and some units require separate hardware or host connectivity for data printing.

4. Laser Printers

- Everyone has a laser printer, thus no specialized printer cost. If printing bar codes though, you will still need to invest in specific bar code fonts or a third party label design package.
- Colored Laser can provide color coding on demand.
- Ability to print the test request and labels together, reducing matching errors. This can either be done by using a collating feature on the laser printer or by using a full label sheet where the test information is printed on one side of the page and the other side contains individual labels
- Piggyback, wrap-around, -80°C and other specialty labels are available in laser, though not as many options exist as with thermal transfer, also the costs are generally higher per label.

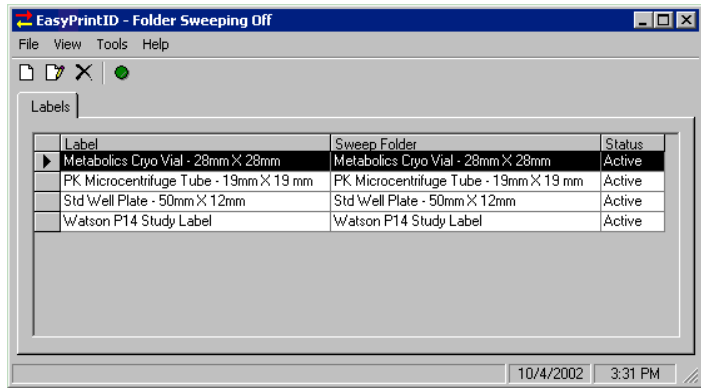
- Other considerations include: Full label sheets need to be printed otherwise label waste can get quite expensive. Also, if printing sample specific data on the label and there are 30 labels on the sheet there can be issues with matching up the correct label to the correct sample

Once you have thought about what printers you are going to use, you need to determine how you intend to design the labels and send the sample data to the printer. Below is a list for consideration.

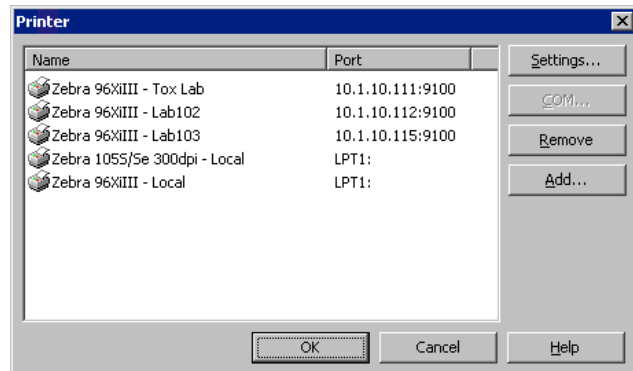
Printing Package Options:

1. Hard Coding: Programmers can hard code the print format for each label design in the native printer language which is more efficient than using a windows print driver. The problem is you need a programmer to create the initial label design, as well as to make any changes to the label as needs change, such as when a new printer with a different print language or dpi is installed, or when data is added or altered on the label.
2. Third party label design packages can be used to design labels for any printer and many different packages with varying features and price points exist today. There is a learning curve with these products, but once mastered they offer good flexibility and ease of printing.

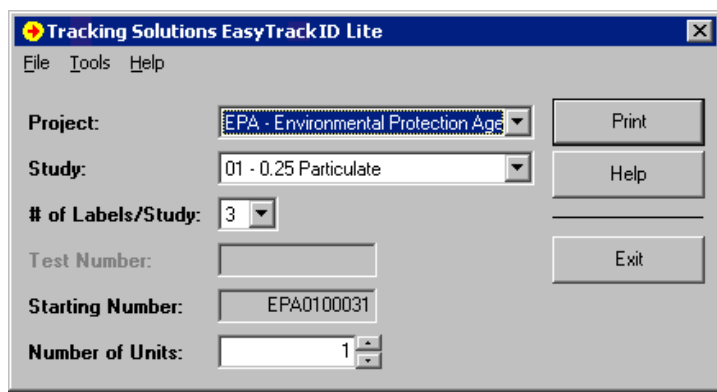
3. What about using a central or web based print server for bar code printing applications? If you have several design formats or wish to print to different printers from one or several databases, then a central printer server solution probably makes sense. It promotes standardization with flexibility and is easy to support. Printing can be controlled from one location or distributed among many for more flexibility. These middleware packages, like "EasyPrintID", offer you a way to print from any windows or LIMS program to any printer in the world without custom programming. Licensing options are based on the number of servers or databases supported.



- This solution allows anyone on the network to drop a report into a print folder designed specifically for their application and print labels. Scripts can also be written to allow users to print directly from their program to the folder. See sample screens.
- The software can be used as a tool to initiate an off-site labeling program whereby a Contract Research Organization (CRO) and a client could share sample information from their LIMS database and have a single label generated that contains information from both facilities, thus eliminating the cost of re-labeling and improving information flow.
- The software can act as a central print server for all databases and LIMS systems.



4. Utilize data input screens as a front end. Custom designed



front end programs can be designed to input sample data which can then be uploaded to any LIMS or other programs. They provide flexibility for inflexible systems and reduce data input errors. They can also print to any thermal or laser printer without special drivers from the data input program. All data entered is stored in its own database which allows for sample logging and sorting even if the LIMS server is down.

Once you have defined your label requirements and method of printing, you are in a position to address your scanning requirements. These systems need to be chosen based on their specific applications. Many errors are made in scanner selection due to the misnomer that all scan engines are the same. This is simply not true. Different scan engines offer different advantages and disadvantages in scan range, decode speed, symbologies scanned, programmability, and connectivity.

Scan Engines include the following:

1. **Laser Scanners** come in long, short, and dual-range offerings and tend to be used in longer-range scanning applications or where a bright visible beam is needed.
2. **CCD and Linear Image Scanners** are designed for short range applications and tend to be faster and more durable than laser scanners due to the fact that they have fewer moving parts.
3. **2D Imagers** are required for decoding true 2D Codes such as Datamatrix and Maxicode, and can also decode all linear symbologies. However, they are more expensive and slower than the other scanner types.

Key areas to think about:

- Will your scanner be directly connected to your PC or Terminal? If so, how? USB, Serial, Keyboard Wedge or wand emulation.
- If you are looking for a portable scanner, do you want cordless or a true batch/wireless model? The latter will require programming. Is this something you will outsource or do internally? If your company is doing the programming what is the preferred operating system -PALM O/S, CE, PocketPC? Also, are you looking for a keypad or a touch-screen model? Define other features or functionality you might want.
- Define what programmability you want in your scanner such as identifying special characters and/or scan sequences. An example would be where there are multiple labels on a container and you only want to scan your specific label. You could design the label with a prefix whereby the scanner would only scan bar codes with that specific prefix and then strip out the prefix prior to entering the data in your application.
- Hands-Free Scanning considerations: Omni-directional for scanning bar codes in any orientation, or using a hands-free stand with a scanner set for automatic turn on when a bar code is present.

Bar Code Scanning Advantages

- Faster, more accurate data input - No re-keying the sample number at work stations, saving time and eliminating transposition errors.
- Ability to scan the samples and instruments (for association) at various points in the process.
- If sample is labeled from a LIMS system, matching the sample to the study can be automated.
- More room for legible information on the label.

Once you have designed your flow chart, get with an expert who knows and understands lab printing, labeling and automation requirements. They will be able to take your flow chart and provide you with the options that exist for your specific application. Once you have a system, you should consider having it validated along with your LIMS.

In Summary:

1. Determine what information you want printed on your label – both bar coded and human readable.
2. Identify your labeling requirements including the maximum label size for your application.
3. Test materials based on your labels' requirements.
4. Select the best printer(s) for your application(s) with an eye to the future.

5. Consider server and web based printing options to determine what best meets your needs.
6. Consider Third Party design and label printing tools such as “EasyPrintID” for enterprise label management and off-site printing.
7. Choose a scanning or data collection system that meets your requirements.
8. Review the flow chart and document the label printing and scanning process.
9. Consider validating your bar code printing system at the time you validate your LIMS system.

Remember the best time to start thinking about your sample printing and tracking requirements is before your LIMS implementation.

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